CMD 25-H9.REF4 CNSC Staff Submission

Reference Package 4 for CMD 25-H9 CNSC Staff Submission on Denison Mines Licence Application to Prepare Site and Construct the Wheeler River Project

Classification	Unclassified
Type of CMD	References
CMD Number	CMD 25-H9.REF4
Original CMD	CMD 25-H9
Public hearing date	08 December 2025
PDF e-DOC #	7605555
Summary	This document contains documents referenced in the Environmental Assessment Report appended to 25-H9, to be placed on the Record for the proceeding.
Actions required	There are no actions requested of the Commission. This CMD is in support of the actions and recommendations set out in CNSC staff CMD 25-H9.

CMD 25-H9.REF4 Soumission par le personnel de la CCSN

Références liées 4 au CMD 25-H9 Soumission par le personnel de la CCSN la demande de Denison Mines visant à prépare le site du projet de Wheeler River et à entamer les activités de construction

Classification	Choisir un niveau de classification
Type de CMD	Références
Numéro de CMD	CMD 25-H9.REF4
CMD Original	CMD 25-H9
Date de l'audience	08 décembre 2025
Numéro e-Doc du PDF	7605555
Résumé	Ce document contient les documents cités dans le rapport d'évaluation environnementale annexé à 25-H9, qui seront versés au dossier de l'instance.
Mesures requises	Aucune mesure n'est requise de la Commission. Le présent CMD appuie les mesures et les recommandations énoncées dans le CMD CMD 25-H9 du personnel de la CCSN.

Canadian Nuclear Safety Commission Commission canadienne de sûreté nucléaire

Canada

Choose a level

CMD 25-H9.REF4

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Signed by:

X Beaton, Dana

Digitally signed by Beaton, Dana
DN: C=CA, O=GC, OU=CNSC-CCSN, CN="Beaton, Dana"
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Date: 2025.11.24 08:17:18-05'00'
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Dana Beaton
Director General, DERPA

Annex 6

Federal Indigenous Review Team (FIRT) Review of Denison Responses to Information Requests (IRs) and Supporting Documents Received February 10, 2024

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale (March 2023)	Information Requirement (IR) (March 2023)	Rationale for Status (October 2024)	Status	Denison Response to CNSC Comments, October 18, 2024
IR-01	-	English River First Nation (ERFN)	Current use of lands and resources for traditional purposes	General	**Context:** Denison has not gone far enough in terms of learning from and incorporating information from ERFN provided in the *Traditional Knowledge Study and Health and Socio-Economic Study Report*. It appears Denison put a disproportionate amount of reliance on the views and interests of one ERFN land user. While we applaud the efforts of Denison to seek feedback from ERFN land users directly and to work closely with such land users, ERFN's rights and interests in the region of the Project (and the potential of the Project to adversely impact such rights and interests) extend well beyond that of just one land user. **Rationale**: It is important for the Proponent and regulators to understand that while the rights and interests of individual ERFN members are important to consider, the Elders and elected leaders of ERFN represent the collective rights and interests of ERFN as a Nation. The results of the scoping study indicated that ERFN holds firmly established rights to the area where the planned project is located. Numerous studies conducted over several decades have examined ERFN's relationship and connection to land use and occupancy of the region where the proposed mine is located from traditional land use, subsistence harvesting, ecological, and sociocultural and economic perspective.	The draft EIS should be revised to reflect the totality of ERFN TK and land use information. Denison and CNSC must continue to work with ERFN to ensure that impacts on ERFN rights are appropriately and fully considered, mitigated, and accommodated.		Accepted	n/a
IR-02	-	Canadian Nuclear Safety Commission (CNSC)	Mitigation Measures	General Appendix 16-C	**Context:** Denison's 2019 Wheeler River Terms of Reference states: "The EIA will also discuss the monitoring programs required to demonstrate regulatory compliance and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders." The CNSC's Generic Guidelines for the Preparation of an Environmental Impact Statement (EIS), also state: "The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the Proponent intends to implement them and the environmental outcome the mitigation is designed to address. **Rationale:** The EIS and the Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information. It is not clear which monitoring programs will be employed to demonstrate regulatory compliance, and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders.	CNSC staff expect Denison to provide a comprehensive list of commitments along with the next version of the EIS, including any commitments made to Indigenous Nations and communities and other stakeholders (As committed in the Wheeler River Terms of reference, and as noted in the November 28th, 2022 email from CNSC staff to Denison: *Future Submission of a Commitments Table for Wheeler River EIS*).		Accepted	n/a
IR-03	-	CNSC	Site preparation	Section 1.3.2 Temporal Boundaries Appendix 10-A (ERA)	**Context:** The EIS and TSD-ERA provide assessment on the Project timeframe, including construction, operation, and decommissioning phases. **Rational**: The site preparation phase is not included in the timeframe (EIS and TSD-ERA). As per REGDOC 2.9.1, the sub-section 4.1.1 Complexity of the environmental risk assessment requirements states that "The applicant or Licensee shall identify facility characteristics and activities that may interact with the environment during	Please provide an assessment of those facility characteristics and activities that may interact with the environment during the site preparation phase, along with an assessment of their potential effects, in order to reflect the entire lifecycle or provide a rationale for its exclusion.		Accepted	n/a

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					the relevant phase of the facility or activity's lifecycle (for example, site preparation, construction, operation, and decommissioning."				
IR-04	-	Environment and Climate Change Canada (ECCC)	Fish and fish habitat	Section 2, Project Description Section: Glossary	**Context:** The Proponent defines 'clean waste rock' as "Waste rock generated as sandstone cuttings and core from drilling activities associated with well and freeze hole development that does not have uranium containing materials". ECCC notes that the use of the term "Clean Waste Rock" could be misunderstood to mean that the waste rock is devoid of any contaminant. Even when the waste rock referred to as "clean waste rock" does not contain uranium materials, it could contain other metals or contaminants that could have adverse environmental effects. It is also not clear whether the "clean waste rock" is characterized for Acid Rock Drainage/Metal Leaching (ARD/ML) given that some portion of the basement rock is to be drilled out to anchor the freeze walls and may have ARD/ML potential. **Rationale:** The current definition of 'clean waste rock' in the draft EIS could lead to inappropriate handling and disposal if it is assumed to be devoid of any metals or other contaminants that might negatively affect the environment.	Provide a clear and more detailed definition of the term 'clean waste rock'.		Accepted	n/a
IR-05	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 2.2.1.2	**Context:** Water volumes for mud/diamond drilling is listed as minimal as the mud will be re-used. The mud is identified as a mixture of water, clay, and environmentally friendly polymers that clean out the cuttings and help to keep the drilling bit cool. **Rationale:** Although the mud for drilling will be re-used, there could be environmental impacts should there be an accident while drilling.	Please identify the components of the environmentally friendly polymers for the drilling mud and potential environmental impacts should the mud not be recovered.		Accepted	n/a
IR-06	-	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for Proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow",	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A).		Accepted	n/a

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					And that "The applicant or Licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems". Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.	• site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.			
IR-06	IR-06-R1	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for Proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow", And that "The applicant or Licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems". Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.		Accepted	n/a

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					contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.				
IR-07	-	ECCC	Fish and fish habitat	Section 2.2.1.4.2, Wellfield Operation Section 2.2.1.4.2.2, Secondary Containment of Mining Solution – Pumping	**Context:** The description in Sections 2.2.1.4.2 and 2.2.1.4.2.2 refer to the differential rates of injection and withdrawal, which implies that more solution will be withdrawn through the recovery well than volume of mining solution injected. According to the description of the site, a freeze wall will create a barrier between the uranium deposit to be mined and outside the isolated area to prevent inflow of groundwater from the sandstone outside the freeze wall. Secondly, it was indicated that the basement rock below the uranium deposit will prevent infusion of groundwater from below. The Proponent stated that inward hydraulic gradient will be created by recovering more solution than is being injected. In general, the wellfield will operate to draw a minimum of 1% more solution out of the wellfield compared to solutions injected in. This will help avoid increased subsurface pressures from injection pressure build up within the deposit. **Rationale:** It is not clear where the extra groundwater will come from that will sustain this differential rate of injection and withdrawals as the freeze wall and bedrock basement will isolate the injection well from groundwater. If it is assumed that there is limited amount of groundwater present in the sandstone layer above the uranium deposit, that amount of groundwater in the sandstone layer is finite and will be exhausted at some point. Therefore, it is not clear where the extra groundwater will come from. If the extra volume of water is not accounted for in the modelling, that would ultimately affect the volume of water that ends up in the receiving environment and likewise the amount of contaminants contained.	Clarify where the extra groundwater will come from to sustain this differential rate of injection and withdrawals during operation and if this extra water has been accounted for in the model and the amount of water that ends up in the receiving environment.		Accepted	n/a
IR-08	-	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.1.4.2.2 Project Description	**Context:** This section describes how an inward hydraulic gradient will be created within the mining area as a secondary containment method for control of mining solution. While the process is described, there is no information on contingency measures in place for pump failure or system maintenance solutions. There is also no information on how quickly the hydraulic gradient, and therefore secondary containment, would be compromised if any pumps stopped working. It is also unclear how primary containment (i.e., well design) failure, such as	Provide further information regarding how the inward hydraulic gradient system functions, with particular focus on how the hydraulic gradient and secondary containment will be maintained if any wells or pumps were compromised.		Accepted	n/a

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					physical/mechanical issues compromising casings, would affect the creation of the hydraulic gradient and secondary containment as well. **Rationale:** It is important to have contingency planning in place in the event that there are any issues with the hydraulic gradient and secondary containment system for control of the acidic mining solution. There is no information in this section on how the hydraulic gradient (i.e., secondary containment) would be maintained if a well or pump (i.e., Primary containment) experienced problems.				
IR-09	-	CNSC	Geology and Groundwater	Section 2.2.1.4.2.2	**Context:** This section indicates that mining solution within the mining area can primarily be controlled by maintaining an inward hydraulic gradient. The inward hydraulic gradient will be created by recovering more solution than is being injected. **Rationale**: If, for some reason, the recovered solution is much more than that being injected, an excessive drawdown could be created. If, by accident, mining solution is leaking into the upper sandstone aquifer through crack in injection/recovery well casing at the same time, it would be challenging to remediate the upper sandstone aquifer in dry conditions (due to excessive drawdown).	Please clarify if any measure will be implemented to avoid excessive drawdown and develop contingency measures to address such accident.		Accepted	n/a
IR-10	-	ECCC	Fish and fish habitat	Section 2.2.1.4.2.3, Tertiary Containment of Mining Solution - Freeze Wall	**Context:** The Proponent stated that as a tertiary means of containment for the mining area, the uranium deposit is proposed to be surrounded by a freeze wall that extends from the surface to the basement rock, isolating the mining area from regional groundwater. Current plans are for the freeze wall to be a minimum of 10 m thick, be installed 25 m away from the uranium deposit, and extend 30 m into the basement rock (Figure 2.2-6). As explained in Section 2.2.1.4.2.2, mining solution will be injected into the ore zone under pressure and will likely react, not just with the uranium in the ore zone, but also the binding or cementing material in the sandstone. This means that some portion of the sandstone above the uranium layer and perhaps some portions of the freeze wall will dissolve, thereby creating more void than just the thickness of the uranium layer or horizon. The void may affect the integrity of the freeze wall as containment. **Rationale:** It is not clear how the Proponent will monitor the freeze wall to verify whether portions of the freeze wall are being dissolved in the mining process and how it plans to verify the integrity of the freeze wall as a containment for the mining solution. In addition, if the dissolution reaction of the uranium ore is exothermic, then the heat generated may also affect the integrity of the freeze wall.	1. Explain how the integrity of the freeze wall will be maintained as a means of containment that prevents migration of the mining solution out of the ore zone into the receiving environment. 2. Demonstrate that the mining solution injected under pressure will not compromise the integrity of the freeze wall as a containment. 3. Demonstrate how both exothermic and chemical reactions of the mining solution used to dissolve the uranium ore will not compromise the integrity of the freeze wall as a containment. **Technical Discussion Required**: Yes. ECCC would like to better understand the chemical constituents that compose the mining solution and the chemical reactions that it will cause.	The Proponent's response is accepted. Please also see AD-50 in the Advice to Proponent table.	Accepted	n/a
IR-11	-	ECCC	Change to an environmental component due	Section 2.2.3 Project Description	**Context:** It is unclear how much contact water may be produced during the drilling of the mine well field during the construction phase of the proposed Project. Figure 2.2-14 indicates that no water will be produced during the drilling process in the construction phase. In Section 2.2.1.2 both mud rotary drilling and diamond drilling	Provide further information on potential wastewater produced during the construction phase from drilling processes, and if proposed infrastructure can contain any water produced.		Accepted	n/a

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			to hazardous contaminants		are proposed for the creation of wells. Both processes require water, however only mud rotary drilling produces liquid mud that is then reused in the drilling process. **Rationale:** It is unclear if the liquid mud produced during drilling can be reused indefinitely with further water additions, or if this eventually becomes the clean sand grain cutting and how it will be disposed of (i.e., liquid or solid waste). If the mud produced from drilling is classified as liquid waste and disposed of as contact water, it is not clear if this is accounted for in the site water management plan and water balance during the construction phase. Contact water from well drilling during the construction phase has not been quantified or accounted for in Figure 2.2-1, and therefore it is unclear if proposed infrastructure during the construction phase has the capacity to contain this waste stream in addition to the waste streams currently outlined in Figure 2.2-1.				
IR-12	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description	**Context:** There is not enough information provided within the draft EIS and site water infrastructure designs to determine if the infrastructure will sufficiently contain mine site contact and non-contact water runoff. It is unclear how water management will occur during all proposed Project stages at the Project airstrip, which is located away from the main Project site. No information has been provided regarding water that may come into contact with fuels and oils from machinery on the air strip, how and where that contaminated water will be treated, and how surface runoff around the airstrip will be managed. Additionally, it is unclear if contaminants from heavy machinery on roads have been considered during runoff collection plans throughout the mine Project site. Water management at the airstrip and roads can have impacts on surface water quality and sediment quality and contaminants (e.g., Hydrocarbons) from these sources should be considered in overall site water management plans. In Section 2.2.3.1 a site drainage plan for contact and non-contact water has been provided in Figure 2.2-17, and water balances have been provided for the different Project phases in Figures 2.2-14 to 2.2-16. In Section 2.2.3.4 a volume of 30,000m3 for the process water pond is provided, and it is stated that the process water pond has the capacity to contain Probable Maximum Precipitation (PMP) event estimated to be 483.3mm while allowing for 1.0m of freeboard. However, there are no estimates on the total volume of water that may be drained from the overall site infrastructure (i.e., the well field, processing areas, etc.) during a 24-hr PMP event. Additionally, in Figure 2.2.17 culvert locations are provided, however there is no further information on culvert designs, flow ratings and capacity for PMP events. **Rationale:** In order to be able to understand site water management and flood risk potential, more information needs to be provided regarding the site water infrastructure designs and capture volumes during PMP events. This information will aid ECCC in understanding how contact and non-contact water will be conveyed throughout the site. Runoff from roads and the site airstrip will contain contaminants from vehicles, heavy machinery, aircrafts and de-icing practices. Additional information on the runoff collection systems and expected contaminant	1. Provide information on how contact and non-contact water from the site airstrip will be managed. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 2. Provide further information on how potential contaminants in runoff from roads have been considered in the site water management. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 3. Provide estimated volumes of water to be drained from overall site infrastructure (such as the mine terrace, airstrip, camp area etc.), during a 24-hr PMP event. 4. Provide additional information on culvert designs and conveyance capacity for PMP events.	In a supplementary submission provided by Denison on July 9th, 2024, much of the information requested has been provided. Table 1 of round 3 attachment IR-12 is a screening of constituents of potential concern (COPCs) in water catchments. For the "Camp" catchment, risks to the aquatic environment from nutrients is described as "*None expected.*" However, sewage spills occur occasionally at camps and would release nutrients which could reach the aquatic environment. Also in Table 1, a management/mitigation often referred to is, "*A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.*" No further details were found on how wash bay water will be handled such that it does not pose a risk to the aquatic environment. The Proponent is relying on its spill response plan to handle any spills from the freeze plant and substation as well as the camp. Section 14 of the EIS, Accidents and Malfunctions, does not discuss these hazards. Given the stated reliance on the spill response plan for brine and sewage spills on site, it will be important that the plan explicitly address brine and sewage spills. <u>In order to resolve this IR, Denison are expected to:</u> • Include nutrients from sewage as a contaminant of potential concern for the Camp Watershed in Table 1 of round 3 attachment IR-12 or provide justification why there are no risks to the aquatic environment from nutrients from the camp. • Clarify how wash bay water will be handled, given that it may potentially contain contaminants. *The following outstanding issue will be further assessed as part of licensing technical reviews, prior to the granting of a Licence*: • Denison will be expected to incorporate information provided in this supplementary submission in the Spill Response Plan.	Not Accepted	**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments associated with the IR response in this table are available in Appendix A.** In response to this IR, the Site Water Management Plan has been updated using track changes; see Attachment IR-12, IR-12-R1A, and IR-112-R1B (Round 3) below in Appendix A. Briefly for context, nutrients as a COPC related to sewage in the Camp Watershed have been incorporated into Table 1, and clarification with respect to the wash bay water management has been provided. In addition, responses to the CNSC's round 4 comment related to nutrients, the wash bay, and commitments for the Spill Response Plan are also provided here. **<u>Nutrients:</u>**

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					concentrations for the site airstrip and roads is needed to determine if the receiving environment and aquatic and terrestrial receptors are protected.		See also AD-75 in the Advice to Proponent table.		The domestic wastewater treatment plant pond stores treated domestic wastewater prior to conveyance to the process water pond that reports to the industrial wastewater treatment plant (IWWTP). To clarify, the accidents and malfunctions assessment (EIS Section 14) considered four scenarios that could introduce COPCs to the environment from site "ponds and retention berms" (see Table 3-13, Appendix A or EIS Appendix 14-A), including overtopping, flooding and containment failure – the domestic wastewater treatment plant pond would fall into this generic "ponds and retention berms" category. The "ponds and retention berms" scenarios were deemed low risk or risks were deemed to be as low as reasonably practical (ALARP), given design and other mitigations. **Wash Bay:** Described in Section 2 of the EIS, a wash bay is proposed as part of the Wheeler River Project infrastructure. The wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. The wash bay area will have an impermeable floor and a lined water collection sump. Rinse water from the wash bay sump will be routed to the wellfield runoff pond or directly to the

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									process water pond. It will be subsequently conveyed as a component of the influent stream to the IWWTP where it will be treated. Treated effluent would be discharged to Whitefish Lake once deemed suitable for release. For the purpose of the site water management strategy, water derived from the wash bay is by definition "contact water". **New Commitment:** Denison concurs that it will incorporate information provided in this supplementary submission in the Spill Response Plan during licensing. This commitment is reflected in the updated commitment register (see commitment 2-35) that is provided as part of the EIS submission.
IR-12	IR-12-R1A	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description Proponent response to IR-12	**Context**: Runoff water from site infrastructure such as the airstrip and roads may be categorized as non-contact water because it does not come into contact with contaminants of potential concern (COPCs) directly from mining operations infrastructure. However, it still has the potential to contain deleterious substances from mine-related activities such as operation of vehicles, including heavy machinery and aircraft, spills, fire management practices, and snow removal practices. The *Metal and Diamond Mining Effluent Regulations* (MDMER) pursuant to the *Fisheries Act* requires all mine effluent and seepage from the mine site that contains deleterious substances be discharged through a final discharge point. This includes deleterious substances in non-contact water from all site infrastructure including the airstrip, roads, and camp area. **Rationale**: All mine effluent and seepage that contains deleterious substances must be discharged through a final discharge point. This includes site non-contact water which has the potential to contain deleterious substances such as those released from vehicles, machinery, aircrafts, spills, and de-icing practices. The Proponent has not included how non-contact water runoff from site infrastructure will be captured within site water management planning. To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the capture of non-contact water.	1. Update site water management plans to include management of potentially deleterious substances contained in non-contact water from all site infrastructure. 2. Provide updated estimates of water volumes to be drained and managed from overall site infrastructure (including runoff from roads, airstrip, camp area, etc.) during the different Project phases. Include updated information on water treatment flows, capacity and effluent discharge during normal operations, and a 24-hr Probable Maximum Precipitation (PMP) Event.	To be resolved as part of IR-12.	Accepted	n/a

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IR-12	IR-12-R1B	ECCC	Water Quality - Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description Proponent response to IR-12	**Context:** The Proponent has clarified that there is no infrastructure in place for management of non-contact water from site infrastructure that may contain COPCs, including but not limited to roads, the airstrip, and the campground. **Rationale:** To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the type of infrastructure and its location for the capture of non-contact water.	Provide a map marking the locations of proposed surface drainage structures for runoff collection including collection ditches, culverts, diversion ditches, perimeter berms, collection ponds and other similar structures.	See also AD-73 in the Advice to Proponent table.	Accepted	n/a
IR-13	-	ECCC CNSC	Fish and fish habitat	Section 2.2.4, Waste Management Section 2.2.7.7, Borrow Area Section 2.3.1.3 Site Preparation and Earthworks	**Context:** The Proponent indicates that a borrow area is planned for an area northeast of the processing plant. The borrow material or overburden will be used during construction for roads, airstrip, pads, and in the batch plant for concrete production needs, during Operation for ongoing maintenance of various Project components and during decommissioning for fill and cover material. Suitable construction fill material will be sourced from the proposed borrow area and any suitable clean sandstone generated during freeze wall and well drilling (Section 2.2.7.7). It was also noted in Sections 2.2.1.3 and 2.2.14 that the freeze wall will be established by drilling over 300 vertical holes from surface to the basement rock. The freeze holes will extend 30 m into the basement rock and will produce waste rock from basement rock (Figure 2.2-6). However, there is no information whether the waste rock from basement rock would potentially be acid generating and/or metal leaching. This means that all the extra 30 m of basement rock should also be characterized for potential ARD/ML to determine use or appropriate disposal. **Rationale:** ECCC notes that the Proponent did not indicate whether the borrow material and the drill out part of the sandstone layers and basement rock will be tested for Acid rock drainage/metal leaching (ARD/ML) potential before they will be used during construction, operation and decommissioning. ARD/ML is an environmental hazard that will have an adverse effect on waterbodies frequented by fish. Potential acid generating and metal leaching waste rock could pose negative impacts on the environment if they are not managed adequately.	Please provide: 1. Information on whether the waste rock from the basement rock is potentially acid generating and metal leaching; a. Confirm that any borrow material to be used for construction will be characterized for potential ARD/ML. b. Confirm that the part of waste rock recovered from the basement rock, will also be tested for potential ARD/ML. 2. Criteria for segregating the potential acid generating and metal leaching waste rock, if it exists, from clean waste rock; and, 3. A plan to manage the potential acid generating and metal leaching waste rock, if it exists.	Denison has captured their commitment to develop the waste rock segregation criteria and to develop appropriate mitigations and management for potentially acid generation (PAG) material in version 2 of the Commitments Register (ID 2-33), so this IR has been accepted.	Accepted	n/a
IR-14	-	CNSC	Wastes and Decommissioning	Section 2.3.3.1.3 Decontamination, Demolition, and Disposal (p. 2-82) Table 4.3-2: Key Issues and Concerns from English River First Nation (p. 4-33)	**Context:** The EIS states "Concrete foundations will be left in place. Any portions of concrete foundations remaining above grade will be levelled and rebar will be cut-off at grade. Large slabs will be perforated on a 2-m grid to permit drainage. Concrete slabs will be covered with 0.5 m of development rock or locally stockpiled till." (p. 2-82) Further, Denison notes that "Concern about responsible authority for restoring the environment, including contaminants when mining concludes. How long will it take to have the environment fully restored and, if Denison is no longer the operator, how will this be completed?" (p. 4-33). This comment status is noted as *Complete*.	How has the proposal to leave these foundations in place been received by the Indigenous Nations and communities during engagement sessions? Have engagement activities influenced Denison's planned decommissioning approach? Describe in additional detail how the comment from p. 4-33 has been addressed and how this has been received by those who expressed this concern?	Denison has captured their commitment related to addressing concerns from Indigenous Nations and communities on their decommissioning approach within the Preliminary Decommissioning Plans in version 2 of the Commitments Register (ID 4-5), so this IR has been accepted.	Accepted	n/a

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					Rationale: Permanent structures will remain following decommissioning, according to the excerpt above. It's unclear how engagement activities influenced Denison's planned decommissioning approach, or how the comment above has been addressed or received.				
IR-15	-	ECCC	Fish and fish habitat	Section 2.2.3.4 Project Description Section 8.1.3.4.2, Aquatic Environnent	**Context:** In Section 2.2.3.4 it is stated that the estimated PMP event for Project infrastructure planning is 483.3mm. In Section 8.1.3.4.2 it is stated that the PMP is 489.3 mm. **Rationale:** It is unclear which value is the correct PMP value and if Project infrastructure has been planned correctly.	Provide the correct PMP value and verify that Project infrastructure has been designed utilizing the correct value.		Accepted	n/a
IR-16	-	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** The EIS and technical supporting documents do not provide sufficient justification for the selection of the proposed wastewater treatment systems for the industrial wastewater treatment plant or the domestic wastewater treatment plant. In addition, it is not clear how the upper bound of the industrial wastewater treatment plant effluent quality was obtained. **Rationale:** Draft REGDOC-2.9.2 formally documents the CNSC's expectations to Licensees for controlling releases to the environment. For proposed new facilities, these expectations include conducting a best available technology and techniques, economically achievable (BATEA) Assessment, and determining key parameters necessary to support the EIS. These include identifying: • environmental release targets to inform the design of wastewater treatment systems to constrain the quantity and concentration of contaminants and physical stressors released into the environment, • the best available technology and techniques through an options analysis; and • the anticipated influent characteristics, overall treatment efficiencies, and maximum predicted design release as the output of the assessment. Consideration of the principle of pollution prevention and BATEA is also a requirement of REGDOC-2.9.1. CNSC staff have met with Denison to discuss the expectations in draft REGDOC-2.9.2.	Please provide a summary of the BATEA assessment to justify the selection of the wastewater treatment plant system. As part of the summary, please identify the anticipated environmental release targets used to inform the design, as well as the maximum predicted design release concentrations and loadings to the receiving environment. The maximum predicted design releases should be used in the ERA to demonstrate protection of people and the environment.		Accepted	n/a
IR-17	-	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** It is also acknowledged that Denison stated in meetings with CNSC staff that Denison intends to propose final release targets to the CNSC as part of the licence application submission. **Rationale:** It is not clear in the submission whether Denison has considered whether any applicable technology-based performance standards exist in Canada or internationally, and would be relevant as effluent discharge targets, in order to ensure principles of pollution prevention are applied. Consideration of this would	Denison should harmonize their proposed Effluent Release Targets with the technology-based performance standards that exist in the Metal and Diamond Mining Effluent Regulations where applicable, or other suitable international regulations.		Accepted	n/a

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					help ensure that the proposed effluent discharge targets harmonize with existing federal, provincial/territorial, and/or municipal requirements. For example, there are release limits for radium-226, TSS, and pH outlined in the federal Metal and Diamond Mining Effluent Regulations, which have been demonstrated to be achievable in the uranium mine and mill industry. In addition, countries like the United States, where in-situ recovery has been conducted in the past, have specific technology-based limits. These are known as New Source Performance Standards and are identified in US Code of Federal Regulations (US CFR) 40, Chapter 1, Subchapter N, Part 440 – Ore Mining and Dressing Point Source Category. It is not clear whether these have been considered in Denison's assessment. These should be considered when identifying suitable achievable technologies.				
IR-18	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3.9, Project Description Appendix 8-E	**Context:** In Table 2.2-1 the upper bound Industrial Wastewater Treatment Plant (IWWTP) effluent quality final discharge targets for Constituents of Potential Concern (COPCs) are provided. General parameters (e.g., temperature, pH, etc.), and several Schedule 4 Substances with maximum authorized concentrations (lead, nickel, suspended solids, and un-ionized ammonia) under the Metal and Diamond Mining Effluent Regulations (MDMER) have not been provided in this table. There are several COPCs (aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese) for effluent characterization under Schedule 5 Section 4 of the MDMER that have not been provided in this table. Additionally, no information on water quality guidelines has been provided in this table. Furthermore, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. **Rationale:** ECCC requests the Proponent include the general water quality parameters that influence water quality thresholds, parameters in Schedule 4 and Schedule 5 Section 4 of the MDMER, and their respective water quality guidelines for consideration and transparency. Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non- acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.	1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 4 Substances under the MDMER with maximum authorized concentrations: lead, nickel, suspended solids, and un-ionized ammonia. 3. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 5 Section 4 parameters required for effluent characterization under the MDMER: aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese. 4. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. 5. Describe additional mitigation measures that can be considered to minimize impacts to aquatic biota from uranium concentrations in effluent.	In a supplementary submission provided on July 5th, 2024, Denison provided responses to the following outstanding requests: 1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include the following missing Schedule 5 Section 4 parameters required for effluent characterization: aluminum, iron, nitrate, thallium, and manganese. Provide further explanation if this information is not available. 3. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. Include information on the concentrations of modifying environmental factors (i.e. pH, hardness, etc.) used to calculate these guidelines as footnotes. 4. Provide a clear commitment to ECCC for continued consultation on developing effluent discharge targets including a review of final_predicted effluent discharge targets once available. *This IR is resolved for the purposes of the EA process. The outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a licence.* For item one, the effluent conductivity and TDS presented are not plausible, as explained in the FIRT's May 31st draft comments. As the conclusions of significance for the EA are not influenced by this error, the correct effluent conductivity and TDS will be assessed during the BATEA assessment required for licencing, and predictions will be updated by Denison as needed. It is recommended that conductivity not be used as a surrogate for TDS while monitoring, until the conductivity-TDS relationship is corrected. Follow up for item three is addressed in IR-108 and IR-115.	Accepted	n/a

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							To address item four, the Proponent will have to follow the guidance and requirements in REGDOC-2.9.2 to develop effluent discharge targets. The CNSC will engage with ECCC during this process as necessary.		
IR-19	-	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.4 Project Description	**Context:** In this section, it is proposed that the IWWTP precipitate pond will have a single geosynthetic composite liner system, which is used for ponds/pads that only store non-radioactive materials. However, from Section 2.2.3.9 on industrial wastewater treatment, it is unclear if the precipitates from the stage three neutralization process that are pumped to the IWWTP precipitates pond will have any residual radioactivity. **Rationale:** For the protection of the surrounding environment, it is important that any ponds/pads that are expected to store radiological contaminants be designed to have proper controls (i.e., liners with monitoring systems) in place.	1. Confirm the characterization of the precipitates that are to be stored in the IWWTP precipitate pond. 2. If radiological constituents are expected within those precipitates, update the draft EIS to ensure the proposed geosynthetic liner system for the IWWTP precipitate pond will be adequate to ensure the protection of the surrounding environment.		Accepted	n/a
IR-20	-	NRCan	Fish and fish habitat	Section 2.3.3.1.1 Appendix 7-C	**Context**: The Proponent's objective for mining area remediation is to restore the groundwater within the confines of the freeze wall to an acceptable remediation target (EIS, sec. 2.3.3.1.1). The Proponent's acceptable decommissioning objectives for groundwater quality are provided in EIS Table 2.3-3 and in Table 3-5 of Appendix 7-C. These objectives were based on laboratory core flood tests performed by flushing samples of ore with groundwater and groundwater amended with sodium hydroxide or sodium bicarbonate. The composition of the remediated groundwater observed in the core flood tests serves as the source term for the post-decommissioning reactive transport modeling presented in section 4 of Appendix 7-C. **Rationale**: In NRCan's opinion, it is important for reviewers to be able to assess the level of remediation achieved in order to reach the Proponent's decommissioning groundwater quality objectives. Therefore, the Proponent should provide complete water quality data for the pregnant lixiviant that remains in the ore zone after the end of mining and prior to any remediation.	NRCan requests that the Proponent revise Table 3-5 of Appendix 7-C to show the water quality in lixiviant remaining in the ore zone at the end of mining, prior to remediation activities.		Accepted	n/a
IR-21	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.3.3.1.3, Project Description	**Context:** The decommissioning process for the wellfield and associated infrastructure is discussed, however there is no information provided on the potential risk for subsidence of the ground above the depleted uranium deposit. After the uranium has been dissolved and pumped to the surface, a cavity will be formed in the area where the uranium used to exist. This could destabilize the overlying substrates, causing the ground at the surface to sink in the future. There is currently no information regarding this risk, and how it may alter the overlying environment, surface water features, runoff, or existing nearby waterbodies. **Rationale:** From a surface water and sediment quality perspective, it is important to understand how potential subsidence in the future post-decommissioning may affect the existing environment. It is currently unclear if there is any risk to the aquatic environment if subsidence were to occur and alter existing waterbodies, create new surface water features, or if there will be any risk to the	Provide further information on the potential risks from subsidence including the probability of occurrence, how it may affect surface water features, and if there exists any risk to the planned decommissioning of waste management infrastructure.		Accepted	n/a

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					decommissioned onsite industrial landfill and industrial wastewater treatment plant precipitate pond.				
IR-22	-	NRCan	Fish and fish habitat	Section 2.10 Appendix 2-C, section 1.1.1.4	**Context**: With respect to the choice of In-Situ Recovery (ISR) mining solution, two alternatives were assessed: alkaline and acidic lixiviants (Appendix 2-C, sec. 1.1.1.4). In the consideration of technical and economic feasibility of the alternatives (Table 2, Appendix 2-C), the Proponent concludes that: Option 1 (alkaline) is not technically feasible based on the uranium deposit geochemistry. Option 2 (acidic) is technically and economically feasible based on the uranium deposit geochemistry and ability to dissolve uranium. Accordingly, the alkaline alternative was not carried forward into the Environmental Assessment (EIS, Table 2.10-1; Appendix 2-C, Table 3). While acidic ISR solutions are widely used internationally (e.g., Kazakhstan), in the United States, where the environmental regulatory regime is more strict, alkaline solutions have been used exclusively since 1970. **Rationale**: In NRCan's opinion, the Proponent should provide a more thorough technical justification for adopting an acidic ISR lixiviant.	In the Alternative Means Assessment (Appendix 2-C), NRCan requests that the Proponent provides a more thorough technical justification for selecting an acidic ISR lixiviant rather than a less environmentally problematic alkaline leach used exclusively in the USA.		Accepted	n/a
IR-23	-	CNSC	Alternative Means	Section 2.10.2 Alternative Means Appendix 2-A PD Engagement Tables Appendix 2-C Alternative Means Assessment (p. 3)	**Context:** There are multiple rows in the Indigenous Tables for Appendix 2-A where comments and concerns raised by Indigenous Nations and communities and other members of the public were taken into consideration in the Alternative Means Assessment. However, it is unclear how these were considered. A few examples: • 16-EN-DesNd-101.1: Interested in any future business opportunities that may be available as Denison advances their Wheeler River Project. • 16-EN-ERFN-100.15: In that territory near the Wheeler River there are a lot of spawning and calving areas for moose, caribou; those creeks are for whitefish spawning. There's lots of heavy muskeg there. A lot of us have been there, and we'd like to know there'll still be access to the area. • 6-EN-ERFN-100.17: Today because of climate change, things are starting to happen that normally didn't happen. Even the permafrost is now further down. In the Wheeler River area, where there's some permafrost, have your environment guys seen a change? Will there be a change? These are some of the questions that need to be answered in order to come out with a positive spin. **Rationale**: Appendix 2-C, Alternative Means assessment, states (p.3): "Engagement with Interested Parties naturally included alternatives means and the engagement input was included in the evaluation of alternative means. Refer to the references list below and *Appendix 2-A Engagement Database Summary – Project Description* for details of engagement information referenced in this alternative means assessment."	Please explain how comments and concerns collected during Denison's engagement sessions were considered or influenced the alternative means assessment. Please include this information in the EIS and/or it's appendices.		Accepted	n/a

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					It is unclear in section 2.10.2 of the EIS, Appendix 2-A or Appendix 2C how the comments documented by Denison have been considered or influenced the alternative means assessment.				
IR-24	-	CNSC	Alternative Means	Section 2.10.2 Alternative Means	**Context:** While Appendix 2-C (Alternative Means Assessment) is detailed and includes all aspects of the Alternative means assessment that are required, the summary of the analysis and conclusions in Section 2.10.2 of the EIS lacks the level of detail required to understand the methodology used, and how Denison arrived at these conclusions. **Rationale**: As noted in the Agency's Operational Policy Statement on Addressing "Purpose of" and "Alternative Means" under the CEAA 2012: "If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the Proponent, and be documented in the EIS in sufficient detail to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the choice."	Please summarize the analysis of the alternative means assessment within the body of the EIS, in sufficient detail that a reader of the EIS has adequate information to understand the methodology used, and how Denison arrived at these conclusions. *Note: In addition to the adding text to summarize, Table 6 in Appendix 2-C could be useful to understanding table 2.10.1 in the EIS.		Accepted	n/a
IR-25	-	CNSC	Current use of lands and resources for traditional purposes	Section 3, Sections 4, Section 5, Section 11 (and all other applicable once Métis Knowledge Use Study is completed)	**Context:** The EIS states that Denison is currently negotiating an agreement with MN-S and no traditional land use information is included throughout the EIS given no agreement was signed or Traditional land use information was shared at the time the EIS was being drafted. As noted in the EIS Denison has committed that: "As information becomes available from the agreed-upon process between the Métis Nation – Saskatchewan and Denison, it will be incorporated into the final EIS." (p. 11-36) **Rationale:** More information is required to better understand the issues and concerns, valued components, and current use of lands and resources for traditional purposes by MN-S near the Project area. Requirements are detailed in CNSC's Generic EIS Guidelines, section 8.9: Indigenous land and resource use.	Please update the revised Draft EIS to reflect the integration of the Métis Use and Knowledge Study in the Draft EIS where applicable, when this study is completed and provided to Denison. In addition, please include an updated Issues and Concerns table that includes relevant information from the MN-S as a result of engagement activities and relevant MN-S studies in the next version of the EIS, as appropriate. Should this information not be made available to Denison at the time of revising the draft EIS, the next version of the EIS and the response to this IR should provide a status update on discussions and engagement with MN-S and next steps.		Accepted	n/a
IR-26	-	CNSC	Precautionary principle and approach	Section 3.4.8 Lands Taken Up from an Indigenous Perspective (p. 3-14)	**Context**: Denison states: "Discrepancies among IK and western scientific information provide an opportunity for Denison to take a precautionary approach. Examples of concrete actions to address uncertainty in cases where IK and LK have differing conclusions on predicted Project effects include addressing uncertainty through monitoring and follow-up programs and communicating results of those monitoring and follow-up programs to demonstrate they have been responsive to the IK shared." (p. 3-14) **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "In documenting the analyses included in the EIS, the Proponent will demonstrate that all aspects of the Project have been examined and planned in a careful and precautionary manner in order to avoid significant adverse environmental effects.	Please clarify how the precautionary principle, and the Privy Council Office's, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making* has been considered and incorporated into the EA described in the EIS.		Accepted	n/a

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					A document by Canada's Privy Council Office, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making*." (Section 2.5)				
IR-27	-	CNSC	Cumulative Effects Analysis	Section 3.4.8	**Context:** During an outreach and engagement trip by CNSC in October 2022, an abandoned exploration camp adjacent to the proposed Wheeler River site was observed. This site has not been identified within the EIS as part of the cumulative effects assessment. As noted in section 3.4.8, KML has also raised concerns with Denison related to abandoned camps and industrial waste left with no programs for clean-up. **Rationale:** Section 9.4.3 of CNSC's Generic Guidelines for the Preparation of an EIS states that "The applicant shall assess any residual adverse environmental effects of the Project in combination with other past, present or reasonably foreseeable projects and/or activities within the study area."	Please specify why abandoned exploration camps and industrial waste aren't taken into consideration when completing cumulative effects assessment.		Accepted	n/a
IR-28	-	CNSC	Current use of lands and resources for traditional purposes	Section 4, IER and engagement appendices, including: Appendix 2-A Appendix 6-B Appendix 7-B Appendix 8-A Appendix 9-A Appendix 10-B Appendix 11-A Appendix 12-A Appendix 13-A Appendix 14-B	**Context:** The summary of issues tables do not appear to include all of the key issues identified by the Indigenous Nations and communities. For example, some Indigenous Nations and communities have shared concerns with respect to accident prevention and overall safety on the Key Lake road (Highway 914) due to increased traffic, impacts on treaty rights and section 35 rights due to cumulative impacts, and decommissioning, that were not captured in the issues and concerns and summary tables in Section 4.3.2 and in the IER. The tables in the engagement appendices include a column titled "Response (From Denison)". The "Response" column does not include responses, but instead points the reader to where this comment or concern was considered. When navigating to the sections referenced, it is often unclear how this information was considered or influenced the assessment. **Rationale:** Additional detail is required in order to ensure the key issues are all identified and to understand the status of validation for each issue raised and the response provided.	1. Update the summary of issues and concerns tables to include all relevant issues and concerns raised by each of the Indigenous Nations and communities to date, including concerns raised in the Indigenous Knowledge studies provided, additional engagement, and Draft EIS comments. 2. Please include a column in the issues and concerns tables to clearly articulate the specific mitigation/monitoring measures that Denison have committed to, or any other measures, in order to address the concerns raised by each Indigenous Nation and community during the engagement process to date. 3. Denison must demonstrate that each Indigenous Nation and community has validated that the summary of issues and concerns table reflects their understanding or agreement, and/or a path forward to complete the validation throughout the EIS and the updated IER. Validation must be complete by the time the technical review is complete, prior to submission of a final EIS. Should Denison not be able to fully address issues, concerns or feedback raised by any Indigenous Nation or community, through mitigation and monitoring measures, this should be documented, and a rationale provided. 4. Update the response column of the Engagement tables to describe how these were considered in the sections referenced. Consider renaming this column to reflect the nature of the content (i.e., how the information was considered).	This response has been accepted. Denison has provided fully updated information as of January 2024. It will be expected that a fully updated IER and issues and concerns tables for each Nation as per the original IR, be provided in future submissions, for CNSC staff awareness of progress on this work. This includes updates on the validation from all Nations and communities, or updated paths forward to validation, if applicable. Note: In the IER Denison provides this information in charts categorized by Nation and in the Appendix 4-B of the EIS, Denison instead includes one large chart with the concerns categorized by key topic. CNSC would recommend using only one method for both the IER and EIS, preferring the format used in the IER by Indigenous Nation and/or community.	Accepted	n/a

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IR-29	-	CNSC	Current use of lands and resources for traditional purposes	Section 4.3.2 and IER	**Context:** In this section, Denison includes the engagement with BNDN and includes a summary of issues and concerns table for the Nation. Within the history of interactions (Section 4.3.3.2.1). **Rationale**: Denison states that they have been providing information on the Project to BNDN in 2019, 2021 and again in 2022 and that Denison and BNDN have not responded to date in order to advance further engagement and dialogue.	Please ensure updated information of any additional engagement activities that Denison has completed with BNDN related to understanding their current and traditional land use and potential interests near the proposed project is provided.		Accepted	n/a
IR-30	-	CNSC	Indigenous physical and cultural heritage	Section 4.3.2.1.3, Table 4.3.2	**Context:** Concerns were raised during engagement sessions that "Elders are not being consulted as most of the engagement has been through online means and without a translator". **Rationale:** There's no indication that a translator has been employed to engage with Elders since 2021 in the engagement Table 4.3.2.	How has Denison adapted engagement with Elders from the ERFN since receiving this comment on March 31, 2021?		Accepted	n/a
IR-31	-	CNSC	Indigenous Engagement	Section 4.4.2.1.3, Key Engagement Activities (p. 4-88)	**Context and Rationale:** Regarding the following: "An open house for the general public was planned to be hosted in 2022 on preliminary effects and mitigation, but due to concerns identified by MN-S about hosting a public open house in a community with a significant Métis population, this meeting was postponed by Denison. Denison looks forward to rescheduling the meeting in collaboration with the MN-S." (p. 4-88)	Please provide an update on the evolution or progress of this engagement with local communities, following collaboration with MN-S (or otherwise).		Accepted	n/a
IR-32	-	CNSC	Current use of lands and resources for traditional purposes	Section 5.3 Section 9.0 Terrestrial Environment	**Context:** Some sections of the EIS (such as Fish and Fish Habitat, Indigenous Lands and resource use) indicate that Indigenous and/or local knowledge was considered when defining the spatial boundaries. However, this is not included in other sections, such as Terrestrial Environment. **Rationale:** Section 5.2.2 of CNSC's Generic EIS Guidelines require that spatial boundaries be defined by considering, but not limited to, the following criteria: Community and Indigenous traditional knowledge, ecological and technical considerations.	Please provide any additional details about how any comments or concerns raised were considered in defining the spatial boundaries with Indigenous Nations and communities with respect to spatial boundaries, for the Terrestrial Section and which specific Indigenous Nations and communities were engaged on these topics and how their input and knowledge was incorporated into the EIS. If already presented in the EIS text body, please indicate where this information can be found or link to Section 4 of the EIS or in the IER.		Accepted	n/a
IR-33	-	CNSC	Residual Effect Characterization	Section 5.8.1, Definitions for Residual Effects Characterization and Significance Section 5.8.1.1, Residual Effects Characteristics Section 8, Table 8.3-9: Fish and Fish Habitat -	**Context:** Denison uses specific criteria (Residual Effect Characteristics: Direction, magnitude, geographic extent, duration, frequency, reversibility, context and likelihood) and associated ratings (e.g., adverse/positive, low/moderate/high) for the predicted effects assessment. However, it is unclear whether an aggregation method was used in order to determine whether impacts will be significant or not significant, depending on the combination of rating categories (i.e., weightings that were calculated, use of decision rules). For example, medium term and long term are both used to represent the same time category: "Effects are expected to last between 3 to 38 years (i.e., effects expected during Construction through to the end of post-Decommissioning)." (See table 8.4-13 on p. 8-200 compared to table 8.4-12 on p. 8-199 and table 8.5-9 on p. 8-246).	If an aggregation method was used and ratings (e.g., High, medium, low) were weighted, what weightings were used, how were these calculated? Please also describe any decision rules that informed the determination of significance. If no aggregation was used, how did Denison ensure that results were consistent, given the varying rankings for each of the key criteria, and varying combination? Regarding inconsistencies in ratings, please use consistent terminology for same rating.		Accepted	n/a

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				Surface Water Quality	**Rationale:** The Generic Guidelines state: "The method used to describe the level of the adverse effect should be transparent and reproducible." In Table 8.3-11, duration was moderate, but again uses same rationale. There is no 'moderate' in Table 8.3-8, and by the same rationale, this should be medium-term to be consistent with definitions provided and summary Table 8.3-12. It was noted that all three tables should be deemed medium-term based on definitions of ratings outlined in Table 8.3-8. Frequency was also showing up as "continuous" and "continuously" in these tables.				
IR-34	-	CNSC	Cumulative Effects Analysis	Section 5.9.2.2 (p. 5-41)	**Context:** Denison identifies the Gryphon deposit as a project that is not reasonably foreseeable. The direct quote from the EIS indicates that the "Development of the Gryphon deposit as an underground mine was evaluated at the prefeasibility level in 2018 but has not advanced to feasibility study or EA. Denison has not announced an intent to proceed with the development of the Gryphon deposit." (p. 5-41) **Rationale:** The guidance Assessing Cumulative Environmental Effects under the CEAA, 2012 defines *Reasonably Foreseeable* as a "physical activity [that] is expected to proceed, e.g. the Proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed." In a press release by Denison Mines (2018: Denison announces decision to advance Wheeler River Project following positive PFS results), Denison publicly disclosed intention to seek the necessary EA for Gryphon to proceed: "After careful consideration of the risks and opportunities associated with permitting and concurrent advancement of project engineering activities, the Company has decided to submit a PD and initiate the EA process in early 2019 for the Phoenix ISR operation, and to bring the Gryphon operation forward, at a later date, as required to achieve the PFS plan of Gryphon first production by 2030." Further, Denison's Wheeler River Webpage references a "start of pre-production activities for the Gryphon operation in 2026"	Please update the cumulative effects assessment in the EIS to include the Gryphon deposit as a Present or Reasonably Foreseeable Project.		Accepted	n/a
IR-35	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 6, Chemicals of Potential Concern	**Context:** The use of petroleum products (e.g., propane, gasoline, and diesel) at the Denison Mines Wheeler River site is associated with vehicles and periodic operational testing of emergency generators as well as stationary pumps for emergency power or fire water systems. Thus, the air emissions will contain acrolein. **Rationale:** This chemical of potential concern (COPC) poses potential risks to human health via inhalation, but acrolein appears to have been missed or deemed insignificant. However, its consideration in the assessment will provide information on the significance of the associated risk.	Please consider acrolein in the assessment or provide a rationale for its exclusion.		Accepted	n/a

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IR-35	IR-35-R1	Health Canada (HC)	Change to an environmental component due to hazardous contaminants IR-35 Response from Denison	Section 6, Chemicals of Potential Concern	**Context**: Potential health risks from long-term exposure to acrolein were not considered in the Proponent's response to IR-35. **Rationale**: No annual predicted concentrations for acrolein were provided in the draft EIS or in the response to IR-35. Concentrations were modelled for short-term exposure (1h and 24h) only in the draft EIS and compared to the 1-hour and 24-hour Ontario Ambient Air Quality Criteria for acrolein. It is Health Canada (HC) guidance to assess both potential short and long-term health effects. The predicted annual concentrations for acrolein should be compared against chronic reference concentrations (e.g., the USEPA Reference Concentration (RfC)[1] (0.02 µg/m^3) and the Tolerable Concentration (TC) from Environment and Climate Change Canada and Health Canada's Priority Substances List Assessment Report[2] (0.4 µg/m^3)).	Use predicted annual concentrations and available chronic reference concentrations to account for potential health risks from long-term exposure to acrolein to support the decision to screen out acrolein as a COPC from further assessment.	This IR has been accepted. In a June 27th, 2024 supplementary submission, updates were made to Table 3-10 in the Revised DRAFT EIS (January 2024; Appendix 10-A - Environmental Risk Assessment) to include the predicted maximum annual concentration for acrolein at the fence line, as noted in Denison's Response to IR-35.	Accepted	n/a
IR-36	-	CNSC	Other	Section 6, Table 6.1-11 Baseline External Gamma Monitoring	**Context:** For one of the exposures in the summary table for baseline external gamma monitoring (Table 6.1-11), the cell states "Destroyed in Field". **Rationale:** No rationale or indication as to why or how it was destroyed is provided.	Please provide any additional info available as to how equipment was destroyed.		Accepted	n/a
IR-37	-	CNSC	Air Quality	Section 6.1.1.1, CALPUFF model	**Context:** "The Saskatchewan Ministry of Environment (SK MOE) has developed the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) to assist Proponents in conducting air dispersion modelling assessments in a consistent manner. The guideline defines the recommended approach for dispersion modelling assessments in Saskatchewan, including model selection, emission source characterization, and the determination of compliance criteria to apply." **Rationale:** Saskatchewan air quality guideline requires consultation on use of CALPUFF model, where it states" The ministry acknowledges that there will be situations where specialized air dispersion models such as CALPUFF, CALQ3HCR and others may be applicable. The use of specialized models requires consultation with the ministry" OR "Pre-consultation with the ministry must be undertaken prior to the facility conducting specialized modelling (p. 3)." It is not clear if Denison Mines consulted with Saskatchewan MOE on use of CALPUFF model. Noted that Section 6.1.4.2 is again referring to Saskatchewan MOE guidance for justification, but no indication that they consulted with them (a requirement).	Please confirm and provide a summary of the consultation with the Saskatchewan MOE on the use of CALPUFF model for the Wheeler River EIS as per provincial air quality guidelines.		Accepted	n/a
IR-38	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.1, Potential Interactions Between the Project and Valued	**Context:** In this section, the Proponent identifies primary interactions between Project activities and air quality valued components and their associated key indicators. These primary interactions may result in an adverse effect on the valued component. Among the primary interactions are the use of emergency generators in a backup role should there be an interruption of the provincial electrical grid.	Provide an evaluation of a worst-case scenario of grid power interruptions (i.e., average aggregate length of power outages) during the winter months for this section of the electrical power grid.		Accepted	n/a

[1] https://iris.epa.gov/static/pdfs/0364_summary.pdf
[2] https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/psl2-lsp2/acrolein/acrolein-eng.pdf

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				Component / Key Indicators	However, it is not evident what is the anticipated frequency and duration of interruption to grid power. **Rationale:** The Proponent states in the conservative operation scenario that while the site will be powered from the provincial grid at the operations stage, the back-up power generators were assumed to be operating under emergency conditions as a worst-case scenario. ECCC acknowledges the positive impact of extending the electrical grid to the Project site with resultant reduction in generator emissions. The impact of an interruption in grid power would be greatest during the winter months when energy use would be greatest and surface-based temperature inversions, which vertically trap emissions, would be strongest.				
IR-39	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.2, Potential Project-Related Effects	**Context:** In this section, the Proponent discusses the approach taken for air dispersion numerical modelling. Using their CALMET data set, the Proponent's CALPUFF model runs indicated exceedances for 24- hour total suspended particulates, 24-hour particulate matter (PM10), 1-hour nitrogen dioxide, and 24-hour uranium concentrations. However, there is no mention of possible diurnal and seasonal occurrences of the exceedances. **Rationale:** Adequate assessment of the modelling results requires knowledge of the temporal characteristics for the exceedances. For example, wintertime exceedances may be due to strong temperature inversions, especially during the overnight to morning hours. These strong inversions are challenging for numerical models to capture. Exceedances during warmer months may be due to specific wind directions, which transport emissions directly to downwind receptors.	Provide additional information on any diurnal and seasonal influences of the modelled exceedances.		Accepted	n/a
IR-40	-	CNSC	Air Quality	Section 6.1.6.2.1, Air quality significance determination	**Context:** Significance determination was not conducted for air quality due to interconnectedness with other assessment endpoints. **Rationale**: It is not clear where and how these air quality assessment endpoints were factored into the assessment.	Please provide additional information to demonstrate where and how these air quality assessment endpoints were factored in.		Accepted	n/a
IR-41	-	CNSC	Air Quality	Section 6.1.6.2.2, Background concentrations	**Context:** The EIS states that "Conservative regional background concentrations from the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) and based on the La Loche monitoring station were used for particulate matter, NO2, SO2, and CO. The La Loche monitoring station is located near anthropogenic sources, while the Project is in a remote area removed from anthropogenic sources." **Rationale:** If La Loche monitoring station is located near anthropogenic sources and the Project is not, use of this data is not a conservative or realistic representation of background. For a realistic approach, background data considered should be upper 95th percentile (or max if n<10) from an area representative of project location For a conservative approach, background data from an area located even further	Please provide additional rationale to justify the appropriateness of La Loche monitoring station concentrations as background for project location.		Accepted	n/a

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					from anthropogenic sources (if this exists) should be used, or an upper limit of background less than upper 95th should be applied as the background. Upper limit of background is used to screen out COPCs or often subtracted from total to ascertain relative contribution / impact from source, so using a higher upper limit may result in COPCs screening out or appear to have a lower relative contribution. If background was added to source, then approach used would be conservative. If this is the case, confirmation and reference to where this is discussed in methodology should be provided.				
IR-42	-	HC	Physical stressors (noise and vibration)	Section 6.2.4.2.2, (p. 6-66) Section 6, Section 6.2.9, (p. 6-72)	Nighttime noise impacts are not adequately considered for human receptors. **Context:** The EIS states in Section 6.2.9 that, "While the predicted sound levels were less than the guideline values, the increase from baseline was predicted to be noticeable" (p. 6-72). No information is provided on individual noise events occurring during the nighttime period**.** **Rationale:** While the increase from baseline is predicted to be noticeable, it is important to also consider that changes to the characteristics of the sound from baseline (e.g., a change in frequency, changes in sound modulation, increased impulsiveness or tonality, or a shift in noise from the daytime to being more at night) may cause noise to be even more noticeable. Consult ANSI S12.9-2005/Part 4, clause A.1.3 for further information. In particular, consideration should be given to potential impacts on sleep, where adverse impacts are reported to begin when sound levels inside bedrooms exceed 30 dBA for continuous noise sources and 45 dBA LAmax for discrete noise events (WHO, 1999).	1. Provide a description of the project- related nighttime noise sources that may impact human receptors as well as a qualitative discussion of the resulting potential impacts on perception considering not only changes in sound levels but also sound characteristics (e.g., tonality, impulsivity). 2. Confirm whether individual nighttime noise events exceeding 45 dBA LAMax outdoors (or 30 dBA indoors) are expected to occur more than 15 times over the nighttime period at any nearby potentially noise-sensitive human receptor location(s). This may be of particular concern if some construction and/or operations activities occur during sleeping hours.		Accepted	n/a
IR-43	-	HC	Physical stressors (noise and vibration)	Section 6.2.5, (p. 6-66) Section 6.2.5, (p. 6-71)	Mitigation measures for project-related noise were not identified for the Construction phase. **Context:** The mitigation measures provided in Section 6.2.5, including a complaint management system is also to be implemented as part of the EMS, are only proposed for the operations phase. However, construction activities are predicted to last more than one year. Construction noise will involve the use of equipment operating at the site, construction of surface facilities, drilling, and partial operation of the freeze plant. It will also include regular truck trips and air traffic for personnel changes. **Rationale:** It is unclear if listed mitigation measures also apply to the construction phase (or only to the operations phase).	1. Clarify whether mitigation measures and the proposed EMS apply to the Construction phase. If not, identify mitigation measures for noise impacts related to Construction phase activities, and consider applying the EMS to the Construction phase and implementing the community complaints and response procedure from the beginning of construction activities. 2. Health Canada suggests that construction noise lasting longer than 1 year be assessed as operational noise, and that noise mitigation measures be applied also to the construction phase. Special consideration should be given to mitigation measures for construction noise that occurs at night, in order to minimize impacts on sleep (i.e., avoiding tonal or impulsive noise sources at night). **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of Appendix H of Health Canada (2017), which identifies additional construction noise		Accepted	n/a

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						mitigation measures that could also be considered to reduce project- related noise.			
IR-44	-	HC	Physical stressors (noise and vibration)	Section 6.2.8, (p. 6-71)	The noise complaints resolution and response procedure is not sufficiently described in the EIS. **Context:** Section 6.2.8 discusses Monitoring and Follow- up. The Proponent indicates: "The EMS will also include a community complaints and response procedure" (p. 6-71). **Rationale:** Details have not been provided regarding how the complaints would be received, addressed or what the timelines will be for providing a response or resolution. It is important to provide information to potentially affected communities in advance of particularly noisy activities. Community consultation and advanced notification of noisy activities has been shown to reduce complaints (see Health Canada, 2017).	1. Provide the details of the noise complaints resolution and response procedure as per Health Canada (2017). 2. Consider conducting community consultations and/or implementing an advanced community notification system to pro-actively reduce the probability noise-related impacts and complaints.		Accepted	n/a
IR-45	-	HC	Change to an environmental component due to hazardous contaminants	Section 6 Air Quality Technical Supporting Document Section 6.3.1	The carcinogenic risks of diesel exhaust from the Project should be assessed. **Context:** Section 6.3.1 discusses modelled predictions of exceedances for Particulate Matter (PM). TSD p. 22 states: "concentrations of 24-hour PM2.5 are also elevated around the standby generators at the freeze plant, which emit fine particulate matter from combustion of diesel fuel". However, diesel particulate matter is not evaluated for the whole project in the air quality model or the air quality assessment. **Rationale:** Health Canada has determined that diesel exhaust is carcinogenic in humans which is consistent with the conclusion of the International Agency for Research on Cancer (IARC), and that diesel exhaust is associated with significant population health impacts in Canada. To characterize the carcinogenic risk of diesel exhaust from a project, HC has published a report (2022)1 which provides a quantitative assessment of the relationship between ambient PM2.5 exposure and lung cancer risk. Specifically, this report quantifies the increase in risk of lung cancer mortality (over the baseline rate in the Canadian population) due to PM2.5 exposure. This quantitative assessment is considered appropriate to characterize risks from diesel PM given the contribution of diesel exhaust to ambient PM2.5 in Canada, and that the carcinogenicity of diesel exhaust has generally been evaluated based on the respirable PM fraction1,2,3. **References:** [1] HC. 2022. Lung Cancer and Ambient PM2.5 in Canada: A Systematic Review and Meta-analysis. Available at: https://publications.gc.ca/site/eng/9.907038/publication.html	1. Evaluate the carcinogenic risk of all potential diesel exhaust from the Project based on the approach proposed by Health Canada (2022). Additional guidance (Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation") is provided as an appendix to this comment table.[i]		Accepted	n/a

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					[2] HC. 2016. Human Health Risk Assessment for Diesel Exhaust. Available at: http://publications.gc.ca/collections/collection_2016/sc-hc/H129-60-2016-eng.pdf [3] IARC. 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. https://publications.iarc.fr/Book-And-Report Series/Iarc-Monographs-On-The-IdentificationOf-Carcinogenic-Hazards-To-Humans/Outdoor Air-Pollution-2015				
IR-46	-	HC	Physical stressors (noise and vibration)	Appendix 6-A Table A-1	Low-frequency noise and associated potential human health effects were not assessed. **Context:** Some equipment that may emit low-frequency noise (LFN) have been listed in Table A-1: Assessment Scenarios and Sound Level Data (Section 6 Appendix A); however, no information describing potential impacts of this type of sound on nearby human receptors are presented. **Rationale**: Low frequency noise can be associated with the introduction of noticeable vibrations and rattles in nearby structures. Research indicates that annoyance related to noise is greater when low-frequency noise is present (ISO 1996-1:2003). As sound environments are usually characterized using A-weighted decibel levels (dBA) that reflect the frequencies most audible to the human ear, the impacts of low- frequency noise may need to be assessed separately.	1. Clarify whether any project-related activities (construction, operation and/or decommissioning) may produce LFN that could impact off-site human receptors. Evaluate LFN in the noise assessment, if and where applicable. See Appendix C of Health Canada (2017) for a discussion of LFN.		Accepted	n/a
IR-47	-	ECCC	Air Quality	Appendix 6-A, A.1	**Context and Rationale:** Verification of the following calculation is required for assessing predicted emissions of dust from general construction. It appears the result of 0.70 ton/acre/month is incorrect and should instead be 0.314 ton/acre/month. Appendix 6-A, Appendix A, A.1 (p. A4) TSP Emission Factor for General Construction: $EF\ (TSP) = 0.11 \frac{\frac{ton}{acre}}{month} \times 1.2 \frac{\frac{ton}{acre}}{month} \div 0.42 \frac{\frac{ton}{acre}}{month} = 0.70 \frac{\frac{ton}{acre}}{month}$	Explain how the emission factor total suspended particulates (EF (TSP)) result was obtained or rectify if it is incorrect and update the draft EIS to reflect the correction.		Accepted	n/a
IR-48	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, Figure 6.2.3, p. 6-57	Noise-sensitive receptors are not included on noise contour maps. **Context:** Noise-sensitive receptors are identified in the acoustic model report in Section 6 Appendix 6-E but not presented on any maps in the atmospheric and acoustic sections of the main report (Figure 6.2-3). **Rationale:** The noise assessment typically includes a map illustrating modelled noise levels from the Project at receptor locations in the study area. Certainty regarding the presence of human receptors in the regional study area is also recommended in order to assess cumulative impacts.	1. For more clarity, identify noise-sensitive receptors on Figure 6.2-3: Noise Assessment Study Area as well as on contour maps showing the baseline and predicted noise levels.		Accepted	n/a

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IR-49	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The Noise Source Characterization is incomplete. **Context:** Section 3.0 of the Draft EIS Section 6 Appendix 6- E discusses Source Characterization. There is no detail regarding potential tonal or impulsive noise sources in Section 3.0. **Rationale:** The draft EIS should include a description of sound source characteristics (e.g., tonal, impulsive, highly impulsive) in order to properly inform the quantitative noise assessment and which assumptions/adjustments need to be applied and to properly evaluate impacts of project noise on health of affected receptors.	1. Identify any tonal, regularly impulsive, highly impulsive, or high-energy impulsive noises likely to be produced during project activities that could be audible at noise sensitive receptors. Furthermore, describe the timing (e.g., hours of night-time activities), frequency and duration of noise events, and their sound characteristics, including frequency spectrum. See Health Canada (2017) for details.		Accepted	n/a
IR-50	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The description of noise modelling does not document or justify the use of sound level adjustments**.** **Context:** ISO Standard 9613-2 has been used for the sound level modelling; however, it is unclear if all applicable adjustments have been considered as per ISO 1996-1:2016 (Table A.1). **Rationale:** When modelling techniques are used to estimate present (baseline) or future (construction and operational) sound levels, these techniques and any accompanying assumptions, including the use of sound level adjustments, it is important to provide appropriate documentation and justification. Note that in situations where more than one source characteristic adjustment is applicable (e.g., impulsive or tonal), only the higher of the adjustments is used. However, all time-of-day adjustments and the quiet rural area adjustment are to be added to the highest of the applicable source adjustments.	1. Clarify whether ISO-1996-1:2016 has been considered in the modelling to account for any applicable sound level adjustments. Adjustments should be considered when calculating Ln (night- time sound level) and Ldn (day-night sound level). In addition, if applicable, adjustments can be applied depending on the noise characteristic (impulsive, highly impulsive, etc.), and because the Project location is considered to be in a quiet rural area. See: ISO 1996-1:2016 and Health Canada (2017) for details.		Accepted	n/a
IR-51	-	CNSC	Geology and Groundwater	Section 7, Figure 7.8-1 Appendix 7-C	**Context:** Figure 7.8-1 (p. 7-107, main EIS report) shows monitoring well cluster outside of the freeze wall. **Rationale**: It is not clear what the targeted hydro-stratigraphic units of each monitoring well cluster are. In addition, it is not clear how the establishment of the freeze wall and any leakage from the brine solution will be monitored. If there is any "window" within the freeze wall (i.e., the freeze wall is not continuous), is there any way to identify that?	Please clarify the targeted hydro-stratigraphic units of each monitoring well cluster in Figure 7.8-1 (p. 7-107, main EIS report). Please clarify how the establishment of a continuous freeze wall will be monitored.		Accepted	n/a
IR-52	-	ECCC	Fish and fish habitat	Section 7, Geology and Groundwater Appendix 7	**Context:** According to the Proponent, ''an acidic or low pH mining solution will be used to leach uranium ores from the ground. Mining solution may be a mixture of sulphuric acid, hydrogen peroxide, ferric sulphate, and freshwater (from shallow groundwater well or surface waterbody) or recycled water. Wellfield will consist of a combination of injection and recovery wells, in the general the arrangement of one recovery well in the center surrounded by four injection wells (5-spot pattern) with about 5 to 10 m between wells. The final wellfield is expected to include approximately 300 wells over an area measuring 90 m wide x 750 m long''.	1. Explain why 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells was not presented. 2. Alternatively, provide simulation results and a sensitivity analysis for the injection and extraction of the acidic solution in the mining area.		Accepted	n/a

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					As the components/contaminants mentioned in the description of the hydrogeologic contaminant transport processes above may be transported to Whitesfish Lake through groundwater, the injection and recovery wells should be included in the model. **Rationale:** The hydrogeologic contaminant transport processes described above are an important part of the proposed Project and it is not clear why numerical modelling results and a sensitivity analysis for the above processes was not presented.				
IR-53	-	CNSC	Geology and Groundwater	Section 7.3, Table 7.3.-2 Appendix 7-C	**Context:** The field-based hydraulic conductivity values (referred to as K values hereafter) in Table 7.3-2 (p. 7-32, main EIS report) indicate that the K value ranges of upper and lower sandstone aquifers have a significant overlap with those of the intermediate sandstone aquitard. However, the calibrated K value in Table 2-2 (p. 2.7, Appendix 7-C)) for the intermediate sandstone aquitard is close to the lower end of the field-based K value range, while the calibrated K values for the upper and lower sandstone aquifers are close to the upper end of the field-based K value range. **Rationale:** It is not clear how representative the calibrated K values are of the field-based K values for each hydro-stratigraphic unit, and if the significant difference between the K values for the upper and lower sandstone aquifers and those for the intermediate sandstone aquitard is supported by the geological properties of the corresponding stratigraphy units. It is stated in the report (p. 7-36, main EIS report) that "Vertical fracture or fault zones that hydraulically connect the Local (upper) and Semi-Regional (lower) groundwater flow regimes are present throughout the Athabasca Basin". But fractures and fault zones are not explicitly considered in the model. There is possibility that these features could increase the hydraulic connection between the upper and lower sandstone aquifer.	Please provide additional information to support the representativeness of the calibrated K values (for example, use graph to present the measured K values and the calibrated K values).	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Please include figure(s) (y axis representing depth below ground, x axis representing K, different length of vertical line segment representing different packer testing intervals, etc.) showing the field measured K values, as well as the calibrated K value for the upper sandstone aquifer, intermediate aquitard, and lower sandstone aquifer. This would help demonstrate the distribution of field measured K values and representativeness of calibrated K values.	Accepted	n/a
IR-54	-	CNSC	Geology and Groundwater	Section 7.3.1	**Context:** EIS states: "The most important associated topographic features in the region are the northwest to southeast trending drumlins and eskers…." This is not the trend shown on the provided maps, nor described elsewhere in the report, e.g., Section 7.3.2.1 **Rationale:** Inaccurate information in the EIS	Please update the EIS where required to accurately describe the topographical features.		Accepted	n/a
IR-55	-	NRCan	Fish and fish habitat	Section 7.3.3.1; Appendix 7-A, sections 3.4, 3.5, 3.8, 4.2;	**Context**: According to the Proponent's conceptual hydrogeological model (EIS, sec 7.3.3, Figure 7.3-7, Table 7.3-2; Appendix 7-A, sec. 3.4, Table 3-4), the horizontal hydraulic conductivity of the Intermediate Sandstone (Iss) aquitard is 8.4 E-09 m/s based on field measurements. The Proponent further assumes a 10:1 anisotropy ratio for the unit (Appendix 7-A, sec. 3.5.1) such that its estimated vertical conductivity is 8.4 E- 10 m/s. Based on this information, structural geology and groundwater quality data, the Proponent concludes that the connectivity between	In the "Parameter Uncertainty Assessment" for the numerical groundwater flow model (Appendix 7-C, sec. 2.8), NRCan requests that the Proponent develop a calibrated numerical model with an alternate conceptualization of the Intermediate sandstone as a "leaky" aquitard with a horizontal hydraulic conductivity on the order of 1 E-07 m/s and a much lower anisotropy ratio. This should involve modifying the model		Accepted	n/a

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				Appendix 7-C, section 2.8	the Upper sandstone aquifer and the Intermediate Sandstone aquifer (sic) is limited (EIS sec. 7.3.3.3; Appendix 7-A, sec. 4.4). While acknowledging the paucity of conductivity data and the Proponent's attempt to mitigate this by leveraging collateral information on fracture frequency and clay content (Appendix 7-A, sec. 3.3.1), NRCan considers that the hydraulic conductivity assigned to the Iss aquitard is unrealistically low and inconsistent with the following lines of evidence: a) The conductivity value for the Iss is based on the geometric mean of 18 field measurements, 12 of which are from the same borehole (WR-695) located in the Gryphon zone, beyond the domain of the numerical model (Appendix 7-A, Appendix C, Table C-1). If the conductivity data were weighted equally, with one value per borehole, the geometric mean would be approximately 1.5 E-07 m/s, or two orders of magnitude higher; b) The Proponent notes that vertical fracture or fault zones that hydraulically connect Upper and Lower aquifer systems are present throughout the Athabasca Basin including in the Phoenix area (EIS, sec. 7.3.3.2.2; Appendix 7-A, sec.3.8.1); c) The Proponent notes that groundwater chemistry data (major ions) corroborate the presence of structurally controlled vertical hydraulic connections between the Upper and Lower aquifer systems (EIS, sec. 7.3.3.2.2, sec. 7.3.3.3; Appendix 7-A, 4.3.3); d) Groundwater chemistry data (Appendix 7-A, sec. 4.2, Table 4-1) also indicate the presence of detectable levels of "bomb" tritium (indicating recharge waters < 50 years old) in the Lower Sandstone Aquifer (GWR-025, GWR-008, GWR-033) and in the Iss (GWR-009, GWR-034), outside the area of U mineralization. This is also evidence of vertical hydraulic connection through the Iss. In summary, whereas the Proponent conceptualizes the Iss as a very low-permeability unit with localized vertical hydraulic connection (WS Shear), NRCan interprets the Iss as a "leaky" aquitard with pervasive fracture-controlled and much higher vertical hydraulic conductivity. **Rationale**: The significance of NRCan's alternative interpretation of the Iss hydrostratigraphic unit is that deep groundwaters, including mining-impacted waters, may represent a greater proportion of baseflow discharge to Whitefish Lake than the 1% currently estimated in the Proponent's groundwater flow model (EIS, sec. 7.4.2.1, p.7-51; Appendix 7-C, sec. 2.6.3).	lateral boundary conditions to allow for groundwater inflow/outflow across the entire thickness of the Athabasca Sandstone Group rather than just the Lower Sandstone aquifer.			
IR-56	-	CNSC	Geology and Groundwater	Section 7.3.3.2	**Context:** It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." **Rationale:** It is not clear why the exploration boreholes have not been decommissioned.	Please clarify why the exploration boreholes have not been decommissioned and the timeline to decommission the boreholes according to appropriate guidelines/procedures. If it is not decommissioned before the ISR operation, what is the potential impact of the unplugged boreholes on the mining solution migration?		Accepted	n/a
IR-57	-	NRCan	Fish and fish habitat	Section 7.3.3.2 Appendix 7-A,	**Context**: The Proponent's conceptual model of groundwater flow in the Local Study Area (EIS, sec 7.3.3, Figure 7.3-7) involves an unconfined Upper system hosted by overburden and the Upper sandstone aquifer, and a Lower confined system hosted	In section 2.5.2 of Appendix 7-C (Calibration Results), the Proponent should demonstrate that the numerical groundwater flow model reproduces quantitatively or at least		Accepted	n/a

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				sections 3.1.2 and 3.7 Appendix 7-C, section 2.5.2	by the Lower Sandstone Aquifer. The Intermediate Sandstone aquitard acts as a confining unit. Vertical heads gradients are directed downwards west of the Phoenix deposit and upwards beneath surface water receptors including Whitefish Lake (EIS, sec. 7.3.3.2). Using head data from nested monitoring wells (Appendix 7-A, sec. 3.1.2, Table 3-1) the Proponent calculates upward gradients in cluster WR-607, between the Lower Sandstone aquifer and the Upper Sandstone aquifer. In cluster LA-5, an upward gradient is calculated between the Upper Sandstone and the overburden unit (Appendix 7-A, Table 3-5). In areas west and south-west of the Phoenix deposit, groundwater is estimated to flow downward under a vertical gradient of approximately 0.015 m/m (Appendix 7-A, p.3-15). **Rationale**: In NRCan's opinion, the Proponent's interpretation of vertical head gradients in the LSA is not fully accurate. For the "Up-Gradient" monitoring well cluster, the tabulated head data (Appendix 7-A, Table 3-1) and data logger hydrographs (Appendix 7-A, Appendix B) indicate a downward gradient (0.014 m/m) from the overburden unit to the Intermediate Sandstone and an upward gradient (0.056 m/m) from the Lower Sandstone to the Intermediate Sandstone. Head data from the "NW" monitoring well cluster indicate a similar pattern of downward (0.016 m/m) and upward (0.014 m/m) gradients converging in the Intermediate Sandstone. In the "Downgradient" and "SE" monitoring well clusters, head observations and data logger hydrographs indicate downward gradients from the shallow aquifer system but essentially equal heads in the Intermediate and Lower Sandstones. This more complex picture of groundwater flow systems in the LSA does not appear to have been captured in the Proponent's conceptual model. Given the importance of the baseline hydrogeological regime for predicting the transport and fate of COPCs in the post-decommissioning period, the Proponent needs to demonstrate that the numerical groundwater flow model accounts for observed vertical head gradients.	qualitatively the vertical head gradients calculated from observations in the nested monitoring well clusters (Appendix 7-A, Table 3-1).			
IR-58	-	ECCC	Fish and fish habitat	Section 7.3.2.4, Ore Deposit	**Context:** The Proponent states that the Phoenix ore bodies are long and narrow (approximately 25 to 50 m wide) and are located within or near a graphitic pelite unit. Hydrothermal alteration associated with the ore zone is a discontinuous envelope of clay alteration and a sulphide-cemented rock zone that extends into the overlying sandstone and the underlying basement (Figure 7.3-3). This black, clay-rich zone is approximately 3 m thick on average and locally hydraulically isolates the ore zone from the overlying sandstones and underlying weathered basement rock. **Rationale:** As indicated by the Proponent, a 3 m black clay rich zone isolates the ore zone from the overlying sandstones and underlying weathered basement rock. It is, however, unclear whether this discontinuous clay layer will prevent downward migration of uranium-bearing solution into the Paleo-weathered basement rock or horizontal flow along the unconformity surface to escape into the environment. Escape of uranium-bearing solution into the environment will have a negative effect on the receiving environment.	1. Verify that there will be no downward migration of mining solution into the paleo- weathered basement rock or that there is no flow along the unconformity surface. 2. If downward migration of the mining solution occurs, explain how it will be mitigated.		Accepted	n/a

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IR-59	-	CNSC	Fish and fish habitat	Section 7.4 Assessment of Project-related Effects, Figure 7.4-2 (p. 7-56)	**Context:** Figure 7.4-2: Simulated Change in Groundwater Discharge and Flow through Whitefish Lake Over the Life of the Project appears to be missing information. **Rationale:** Legend is included below the image, but the Legend box is blank. The green dotted line is not represented by anything in the legend.	Please update this Figure to ensure it is complete, and that features are properly indicated in the legend.		Accepted	n/a
IR-60	-	NRCan	Fish and fish habitat	Section 7.4.2.1 Appendix 7-C, section 5.2.1, Appendix B	**Context:** In the discussion of the limitations of the numerical groundwater flow model (Appendix 7-C, sec. 5.2.1), the Proponent invokes the well known modeling principles of "Occam's razor" and "Parsimony" which guided the parametrization of hydraulic conductivity in model layers. The Proponent states that hydrogeologic property values were applied uniformly for, among other units, the Lower Sandstone aquifer beyond the immediate area of desilicified materials. However, in the layer parametrization for the Lower Sandstone aquifer (Appendix 7-C, Appendix B, Figure B-5), NRCan notes a large zone of enhanced conductivity (1 E-05 m/s) extending south from Kratchkowsky Lake, which contrasts with the value (2 E-07 m/s) assigned elsewhere outside the desilicified zone. NRCan also notes the extremely detailed parametrization of hydraulic conductivity in the clay cap overlying the ore zone where borehole control is dense (Appendix 7-C, Appendix B, Figure B-6). **Rationale**: In NRCan's opinion, these model features appear to violate the principle of "Parsimony" and require greater justification supported by field observations.	NRCan requests that the Proponent provide justification based on field evidence for the multiple hydraulic conductivity zones assigned to the Lower Sandstone aquifer and the clay cap above the ore zone.		Accepted	n/a
IR-61	-	CNSC	Geology and Groundwater	Section 7.4.2	**Context:** There is no discussion of potential induced seismicity from mining processes. **Rationale:** Induced seismicity may lead to a loss of process as identified for natural seismicity.	Please provide information on the potential mining-induced seismicity.		Accepted	n/a
IR-62	-	ECCC	Fish and fish habitat	Section 7.4.2, Potential Project-related Effects	**Context:** The Proponent indicates that the mining area includes: • the ‘active mining area’, which is the target ore zone; • a zone extending between 11 and 13 m above the active mining area that represents the maximum vertical height over which the injected mining fluids will migrate upwards from the ore zone during active mining; and • a zone extending 50 m vertically upwards from the active mining area (that incorporates the active mining area and the 11 to 13 m zone defined in the previous bullet) that was selected to account for potential upset conditions. **Rationale:** It is not clear to ECCC how the Proponent would be able to limit the mining solution migration within 11 & 13 m above active mining as the maximum vertical height over which the injected mining fluid will migrate. As the mining fluid will be injected under pressure into zones with possible presence of fractures, the pressure may also cause additional fractures and given that the solution is warm/hot will possibly dissolve the other cementing material in the sandstone above, making it difficult to accurately predict where the solution will migrate to.	1. Explain plans to limit the upward migration of mining solution into the overlying layer to 11 and 13m above the ore zone. 2. Explain what impacts will occur if the mining solution migrates beyond the predicted height.		Accepted	n/a

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IR-63	-	CNSC	Geology and groundwater	Section 7.4.2.1, Potential Effect #1: Groundwater Quantity – Construction to Decommissioning Appendix 7-C, Section 2.7, Groundwater Conditions During Mine Operations	**Context:** The numerical groundwater model described was calibrated to observed water level and stream baseflow data. Table 7.4-3 in the EIS indicates that Denison recognizes the potential for freeze wall operation to impact groundwater quantity. To simulate this impact, the model was adapted to reduce recharge (to 50%) within the freeze wall area, reduce hydraulic conductivity associated with the vertical freeze walls, and simulate pumping within the freeze wall area. Recovery from pumping and effects on discharge to groundwater discharge to Whitefish Lake are discussed in the potential effects section. **Rationale:** Although this assessment considered drawdown of the water table and discharge to Whitefish Lake, the discussion did not address the potential effects of operating the freeze wall on the local and semi-regional groundwater regimes. What would the pathway be for groundwater to pass around the freeze wall? What is the basis for the parameters selected, e.g., 50% recharge and lower hydraulic conductivity for freeze well? These factors need to be considered when evaluating the potential impacts of freeze well operations on groundwater flow conditions and corresponding receptors.	Please provide a more fulsome discussion on the impact of freeze wall operations on local and semi-regional groundwater regimes and potential receptors. Please provide the rationale for assumptions made for key model parameters (e.g., selection of 50% recharge, hydraulic conductivity value used to represent freeze wall). In addition, please discuss the potential pathways for groundwater flow around the freeze wall, complete with figures demonstrating these pathways.		Accepted	n/a
IR-64	-	ECCC CNSC	Fish and fish habitat	Section: 7.4.2.2, Potential Effect #2: Terrain Morphology and Stability – Operation Appendix 7-A, Appendix K (p. 12)	**Context:** The Proponent stated that the geological assessment predicted maximum vertical displacement in altered sandstone immediately above the mining area (17.5 cm). A very minor change in elevation at ground surface (of less than 7.5 cm) was predicted within a discrete and localized area overlying the ore body. The modelling work is considered to provide a worst-case bounding scenario. If subsidence were to occur over the lifetime of the Project, or in the years following mining, the extent of vertical displacement is not expected to exceed that predicted in the modelling, which is based on an assumed volume extraction. **Rationale:** ECCC notes that the thickness of the ore zone has an average thickness of 5 m with a range of 2 to 17 m, and is 25-50 m wide and that the overburden rock above the ore zone measures about 400 m. Therefore, it is not clear how the Proponent determined that the surface expression of a subsidence on the surface if it occurs will be limited to 7.5 cm and localized. A subsidence greater than 7.5 cm, implies that the void in the ore zone will be narrower, and will affect the amount of water migrating through the zone. It was the recommendation of the consultant who conducted the work in Appendix K that more accurate material properties should be used for future modelling.	Explain: • Will this be revisited with updated data based on extraction feasibility results? • How will the surface expression of a subsidence will be limited to 7.5 cm and localized? **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent consider implementing remediation measures immediately after mining to prevent subsidence from occurring in the first place.		Accepted	n/a
IR-65	-	CNSC	Geology and Groundwater	Section 7.4.2.2	**Context:** It is stated the maximum subsidence is 7.5cm based on modeling with an assumed volume extraction. Has subsidence from dewatering/pumping and from lack of inflow of groundwater due to freeze wall been considered? **Rationale:** Surface facilities and wells may be impacted if there is unaccounted for subsidence.	Please provide additional details for any dewatering/pumping induced subsidence.		Accepted	n/a

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IR-66	-	CNSC	Geology and Groundwater	Section 7, Table 7.5-1, Row 1, Column 6	**Context:** Column 6 in Table 7.5-1 indicates the mitigation measures for a valued component. For Row 1, Geology, there is no description of mitigation measures but only that contingency plans will be developed if based on monitoring. **Rationale:** Subsidence may impact wells and surface infrastructure.	Please provide additional details on monitoring and contingency plans related to the geological environment (e.g., subsidence), including triggers for implementing such plans.		Accepted	n/a
IR-67	-	CNSC	Geology and groundwater	Section 7.6.2.1 (Remediation Objectives)	**Context:** Metallurgical testing, including batch reaction, coreflood testing and column tests are mentioned frequently throughout Sections 2 and 7 of the EIS. Outside of the composition of restored solutions from coreflood tests #2B and 3C, results from these various tests are not reported in the EIS or any associated Appendices. **Rationale:** The results from metallurgical testing are important to a number of items discussed in the EIS, including (but not limited to): evolution of hydrochemistry during remediation, source of salts in Lower Sandstone Aquifer porewaters, process plans, industrial wastewater treatment, estimating composition and volume of process precipitates, and composition of mining fluids and leachate. In particular, the EIS posits that mining area decommissioning objectives are achievable based on metallurgical testing and provides these objectives in Table 2.3-3. CNSC staff need to understand the specifics of this metallurgical testing, given its importance for the development and justification for mining and remediation activities. Denison must also provide information demonstrating that the proposed restoration actions and remediation targets are As Low As Reasonably Achievable (ALARA).	1. Please provide a summary of the results and the analysis of results of the metallurgical tests within the EIS, or provide the technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. This should include sample information for cores (e.g., mineralogy, location, U content, depth), test conditions (e.g., duration, # of iterations, column length, flow rate, temperature, pressure, sample frequency, influent/effluent composition), as well as results and how they are pertinent to the development of ISR activities. 2. Please provide further clarification/justification on how results from two singular coreflood tests (i.e., Coreflood #2B and Coreflood #3C) can justify large-scale remediation activities and targets following solution mining. 3. Please provide material demonstrating that the proposed restoration actions and remediation targets are ALARA.		Accepted	n/a
IR-68	-	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.3, 4.1, 4.4.4 and 4.7	**Context:** Sources terms for the COPCs considered in 3D reactive transport modeling are given by the composition of "Restoration Solution #1", which the Proponent believes is representative of groundwater quality in the ore zone after remediation at decommissioning (Appendix 7-C, sec. 3.3, Table 3-5; sec 4.0). The Proponent considers COPC source terms as "initial conditions" for groundwater quality in the ore zone at the start of the model simulation period. During the simulation, no additional mass of COPCs is transferred to groundwater in the ore zone. **Rationale**: In NRCan's opinion, this representation of COPC sources is not conservative as it fails to account for various long-term slow mass release processes. These processes could include redissolution of secondary phases formed during ISR mining (e.g., radium-bearing gypsum or barite, jarosite, alunite) and migration of unrecovered lixiviant or restored solution from low-permeability regions or stagnant zones that were not fully swept during mining or remediation. NRCan notes that scenario #2 in the Proponent's transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) does consider an extended source release period for protons (desorption from chlorite). However, in NRCan's opinion, additional modeling scenarios should consider extended-release periods for other COPCs as well.	NRCan requests that the Proponent's reactive transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) consider extended source release periods for additional COPCs.		Accepted	n/a
IR-69	-	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C,	**Context**: For hydrogeological and geochemical assessments in support of ISR projects, the Proponent identifies two aspects of primary importance (Appendix 7-C, sec. 3.1). These are a) groundwater remediation (Appendix 7-C, sec. 3.1.1); and b) the assimilative capacity of host rocks downgradient from the ore zone (Appendix 7-	NRCan requests that the Proponent provide a detailed description of the expected mineralogical and hydrogeochemical changes occurring within the ore and barrier zones as a result of the injection of acidic lixiviant.		Accepted	n/a

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				sections 3.1 and 3.2	C, sec. 3.1.2). According to the Proponent, the objective of groundwater remediation at decommissioning is to achieve water quality in the mined zone that does not pose a risk to receptors at the point of exposure. Assimilative capacity refers to the ability of groundwater-rock reactions to naturally sequester or attenuate COPCs migrating from the ore zone during the post-decommissioning period. **Rationale:** However, in NRCan's opinion, the Proponent has neglected to mention the most fundamental aspect for hydrogeological and geochemical assessments in support of ISR projects. That aspect is the choice of ISR lixiviant and its effects on the mineralogy and hydrogeochemistry of the ore zone during mining operations. The Proponent provides information on the pre-mining mineralogy (Appendix 7-C, sec. 3.2.1) and hydrogeochemistry (Appendix 7-C, sec. 3.2.2) but no information on their expected changes as a result of ISR mining. This Information is important when considering source terms in reactive transport modeling.				
IR-70	-	CNSC ECCC	Fish and fish habitat Geology and groundwater	Section 7.6.2.2.3, Evaluation of Geochemical Reactive Transport Appendix 7-C, Section 4.4.2, Sub-Domain Model Hydrogeologic Parameters	**Context:** The EIS indicates that "changes to hydrogeological conditions within the mining area were considered during development of the 3D sub-domain model. Dissolution of ore within the active mining area is expected to enhance … hydraulic conductivity". In Section 4.7 (Prediction Uncertainty Analysis), predictive uncertainty scenarios are provided. For scenario 7, the hydraulic conductivity (K) of the ore zone was increased even further than initial model assumptions. The value used is not indicated in the text. **Rationale:** A hydraulic conductivity (K) value of 5x10-6 m/s, which is a factor of five (5) greater than the value assumed for the ore zone, was applied in the base case numerical model to account for this impact. It is unclear from the information provided in Section 7 of the EIS or associated Appendices what the basis of this five-fold increase in K value for the ore zone, and how this was judged to be conservative, or to adequately represent anticipated conditions. This parameter is important as it impacts the rate at which contaminants flow from the ore zone following mining activities. Due to of the dissolution of uranium, larger voids will likely be created, and the hydraulic conductivity may increase by more than a factor of 5 compared to pre-project material. Therefore, a variation of at least one or two orders of magnitude for hydraulic conductivity should be used in the sensitivity analysis. Having a representative, conservative value for hydraulic conductivity is essential for understanding groundwater as a pathway of contaminant transport to Whitefish Lake and potential impacts to aquatic life. The K value used in the predictive uncertainty analysis should be reported.	Please provide a more fulsome discussion on the anticipated impacts of mining on permeability of the ore zone due to mining activities in the EIS or in an Appendix. The value used for scenario 7 of the prediction uncertainty analysis should be provided. The scientific rationale for the use of a K value only a factor of five greater than the value assumed for the ore zone in the 3D regional model should be provided, alternatively, provide simulation results for a more conservative scenario. Specifically, this discussion should address the potential effects of mechanical permeability enhancement with tools, dissolution of ore, gas plugging, chemical plugging, plugging due to ion exchange, and mechanical plugging.		Accepted	n/a
IR-71	-	CNSC	Geology and groundwater	Section 7.7.1, Climate Change Considerations	**Context:** The report states that in a scenario of increased precipitation and decreased/constant evaporation, climate change may result in greater flows in the Wheeler River drainage system and increased recharge to groundwater, which would correspond to increased groundwater discharge to Whitefish Lake. Additionally, it is also stated that climate change was evaluated qualitatively.	Please provide a discussion on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area. Provide justification for performing qualitative assessment of impacts of climate change rather than a quantitative one.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.*	Accepted	n/a

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					Rationale: It is not clear why the impacts of increased evapotranspiration associated with higher average temperatures were not considered, even though these are likely outcomes of temperature increases due to climate change in areas such as the Prairies (Climate trends and projections - Canada.ca). It is also not clear why climate change considerations were not assessed quantitatively.		The effect of climate change on groundwater recharge in Prairies or Canada is generally uncertain due to the large degree of uncertainty in the modelling of future recharge although future changes in temperature and precipitation are expected to alter groundwater recharge (through changes to runoff, evapotranspiration, and snow accumulation). While CNSC staff accepts the response on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area, no justification has been provided on why quantitative analysis was not completed to address the effect of climate change on groundwater recharge.		
IR-72	-	CNSC	Geology and groundwater	Section 7.8.2, Groundwater Monitoring	**Context:** Monitoring seems to consider COPCs from surface facilities, and excursion of pumped mine fluid in the Lower Sandstone Aquifer. There does not appear any discussion on how the proposed monitoring program considers potential excursions of brine from freeze wells. **Rationale:** It is unclear how potential excursions of brine from freeze wells will be monitored. Would this be through the fiber optic cables installed within the freeze well network? Or would it be achieved in the monitoring well clusters? If this is the case, how would an excursion of brine from a freeze well be differentiated from an excursion of mining solution?	Please provide further information regarding how potential excursions of brine from freeze wells will be monitored as part of the proposed groundwater monitoring program.		Accepted	n/a
IR-73	-	CNSC	Geology and groundwater	Section 7.8.2.2, In Situ Recovery Mining Area Appendix 7-A, Appendix C	**Context:** The EIS recommends that a follow-up study be carried out to supplement available data on hydraulic conductivity in the Desilicified Zone (DSZ). **Rationale:** Appendix C (Summary of Hydraulic Testing Data and Conductivity Values) of Appendix 7A indicates that only n = 6 hydraulic conductivity values are available for the DSZ, one of which appears unreliable due to a problem with packer sealing. This is relatively few values compared to the Intermediate and Lower Sandstones. Additionally, limited hydraulic head data from boreholes screened in the DSZ is available (GWR-037, GWR-012 and GWR-014; See Figures 16/17 in Appendix 7-A) – most information appears to originate from open core holes. The information presented in its current form is insufficient considering the importance of this zone as a preferential pathway for contaminants following remediation activities, and the heterogeneity of the unit due to intense hydrothermal alteration and fracturing. Further information regarding hydrogeological properties and groundwater flow would aid greatly in validating and refining the numerical groundwater model.	As per the EIS recommendations, please provide additional information to supplement available data on hydraulic conductivity in the DSZ. Please provide the following information as part of the follow-up study: 1. identification of the vertical conductivity (KV) as there is an upward flow component (isotropy was assumed in DSZ for numerical model, this assumption must be verified) 2. quantification of the horizontal and vertical flow gradients in the DSZ; and 3. identification and mapping of any structures with the potential to influence groundwater flow in the DSZ, such as fracture/fault zones.		Accepted	n/a
IR-74	-	CNSC	Geology and Groundwater	Section 7.8.2.3	**Context:** It is stated in Section 7.8.2.3 (p. 7-113, main EIS report) that, at the Post-Decommissioning Stage, "Excursion are signaled by a change in water quality that is outside of that bounded by modelling predictions", and "The model predictions spatiotemporally bound COPC concentrations in the subsurface that do not pose a risk to the receiving environment. Water quality that is outside of this bounding is defined as representing a material increase over a meaningful period compared to the predicted values either in rate of change or magnitude of change of COPC concentrations." **Rationale**: It is not clear in which locations (e.g., is it in the mining area, or	Please clarify in which locations the water quality data is used to compare with the model predictions to determine if excursion occurs.		Accepted	n/a

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					downstream of the mining area, or anywhere else?) the water quality is used to compare with the model predictions to determine if excursion occurs.				
IR-75	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K	**Context:** The geomechanical study showed that the stability of the remnant ore zone and surrounding rock mass is highly sensitive to the magnitude of the material properties. To quantify this risk, the Proponent conducted a sensitivity analysis to assess the influence that material properties have on the stability of key stratigraphic layers. The results of the sensitivity analyses suggest that small variations in the cohesion magnitude and angle of internal friction may significantly influence the stability of the altered sandstone, ore zone, and upper and lower clays. **Rationale:** By considering the potential uncertainties and risks in association with the geomechanical study and the empirically derived rock mass strength parameters and the non-site specific physical parameters of different rock formations used for the modeling, the Proponent's consultant suggests to define a laboratory testing program to address data gaps in the current geotechnical data and increase confidence in the material properties, and use more accurate material properties to model the phased extraction of uranium-enriched rock and assess the associated risks for cavity collapse and failure in the steel casing. CNSC staff concurs with these suggestions.	Please provide a plan to implement recommendations for further detailed geomechanical studies to reduce the uncertainties and risks in association with the stability and deformation analyses of ore zone rock matrix and its overlying rock mass formations and assess their impacts on the mine operation.		Accepted	n/a
IR-76	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K (p. 12)	**Context:** Based on the consultant's report, the modeled vertical strain is approaching or exceeding the tensile and compressive yield limits for steel casing. **Rationale:** Failure of steel casing may result in process loss or alter groundwater flow and quality.	Please provide additional details on how casing integrity will be monitored and potential effects mitigated.		Accepted	n/a
IR-77	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K Results of a Geomechanical Study Investigating the Influence of Uranium Extraction on Mining-Cavity Stability for the Wheeler River Uranium Project (Revision 1)	**Context:** It is reported in the appendix K report, within Appendix 7-A, that both phase I scoping analysis and phase II detailed strip model were investigated by numerical modelling. The analysis discussed influence on host rock stability as a result of incremental increase in volumetric extraction and graded conservative treatment of material properties. **Rationale:** As critical components of a numerical geomechanical simulation, initial and boundary conditions are crucially important to the confidence and reliability of the modelling results. However, this information is absent from the current report. In-situ principal stresses largely affects the stability of the excavated host rock, and the vertical strain and surface subsidence. This information is also absent in current form.	Please provide details on the boundary and initial conditions applied on stress loading and strain for the numerical analysis. In particular, the in-situ principal stresses, which are critical to correct understanding of the excavation disturbance to the host rock, should be provided and justified as appropriate.		Accepted	n/a
IR-78	-	CNSC ECCC	Fish and fish habitat Geology and groundwater	Appendix 7-A, Section 3.5.2, Porosity	**Context:** This section of the report outlines the estimated/assumed effective porosity values. The only reference provided is for permeameter testing on rock core samples (Scibek, 2019). Additionally, the report states that "As tracer test results to estimate effective porosity were unavailable at the time of modelling, effective porosity values for the	1. Please provide the reference for the data substantiating the assumed effective porosity values reported in Appendix 7-A and used in the numerical model in Appendix 7-C. 2. Please provide information on how the site-specific effective porosity values from tracer tests or pumping tests,	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Effective porosity is an important parameter to understanding groundwater flow and contaminant transport. The Proponent states that "As tracer test results to	Accepted	n/a

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				Appendix 7-C, Section 2.3.2.1, Porosity Values	sandstone bedrock and basement units were sourced from literature values", where literature values are effective porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to justify this value. Additionally,, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". **Rationale:** The source of reported effective porosity values is unclear from Section 3.5.2 in Appendix A (e.g. literature review, field work, laboratory work). In Section 2.3.2.1 of Appendix 7-C, there is a lack of clarity regarding the effective porosity data used in the numerical model. It appears that no site-specific data derived from tracer tests or pumping tests is used in the numerical model. Given that effective porosity directly correlates to seepage velocity and by extension transport time and distribution of COPCs in groundwater, it is an important parameter. Given its relative importance for contaminant fate and transport, effective porosity should be based on field measurements, or at the very least accounted for in the sensitivity analysis.	were considered in the numerical models. Section 2.2.1.4 of the EIS asserts that tracer tests were carried out in 2021 – this information should thus be available for improving/updating models. Alternatively, provide a sensitivity analysis for the effective porosity in the Desilicified Zone, or contaminant transport simulation results with more conservative effective porosity values.	estimate effective porosity were unavailable at the time of modelling, effective porosity values for the sandstone bedrock and basement units were sourced from literature values", including porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to explain this value. Additionally, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". In response to the IR, the Proponent explained and supported their methodology for selecting a value for effective porosity. This method included consideration of literature values and a regional analogue at Cigar Lake. ECCC notes that a tracer test was conducted, the results of which were not considered in the selection of the effective porosity parameter. If field test data is available that is potentially relevant to determining effective porosity, it should be included in the EIS when discussing effective porosity. The field test data should also be made available for review by the FIRT, to confirm the conclusions reached by the Proponent. Other sources of information can be useful when explaining the most appropriate value for effective porosity such as literature values and regional analogues, as per the Proponent's IR response. However, field test results should be presented in the EIS and considered as a part of such an explanation. If the Proponent feels that not utilizing field test data is the most accurate approach when selecting an effective porosity value, then this conclusion should be reached with consideration of the field test data as a part of the evaluation. Provide a discussion of how the effective porosity values are selected, including a discussion of how field test results were considered. This information is necessary to confirm that the selected effective porosity values are valid. This also relates to IR-52.		
IR-79	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4, Groundwater Chemistry	**Context:** Table 4-1 in Section 4 of Appendix 7-A provides groundwater monitoring results from sampling activities carried out at 26 monitoring wells in 2019, 2020, and 2021. The majority of these wells were only sampled once (n = 8) or twice (n = 17). In some cases (Lower Sandstone Aquifer/Intermediate Sandstone Aquitard), the variability of results between sampling events is quite high. Data for the Paleoweathered Zone is sparse. **Rationale:** Insufficient information is presented in the EIS and associated Appendices to concretely define baseline groundwater chemistry for the different hydrostratigraphic units. As defined in the CNSC's Generic Guidelines for the Preparation of an EIS: "Based on the scope of the project, the EIS will present sufficiently detailed baseline information to determine the effects the project could have on the VCs and analyze those effects". This is particularly important given	Please provide the statistical basis (number of samples and variability) by which "baseline" is defined and the justification that the current information is sufficient to adequately characterize groundwater quality. In order to ensure sufficient baseline information is collected, further iterations of sample collection for groundwater monitoring wells in all defined hydrostratigraphic units may be required. In addition, groundwater quality downgradient from the proposed mining area should be further characterized to assess spatial influence of alteration and hydraulically active features,		Accepted	n/a

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					certain features of the study area (i.e., presence of zones of thermal alteration/desilicification, as well as hydraulically active fractures/faults), and the need to adequately characterize baseline conditions in the Desilicified Zone downgradient from the proposed mining area. As an example, the US Nuclear Regulatory Commission (NRC) typically requires a minimum of four (4) quarterly samples from (i) surficial aquifers, (ii) production aquifers, (iii) overlying aquifers, and (iv) underlying aquifers to characterize preoperational groundwater quality (E. Striz, pers. comm.).				
IR-80	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** This section provides data for groundwater samples collected during the Cigar Lake analogue study and Millennium Project for further regional context. The previous studies are heavily referenced to support interpretations made for the conceptual site model. **Rationale:** The Piper Plots in Figure 26 are difficult to interpret (many overlapping circles with variegated colors), and Cigar Lake samples plot predominantly as Na/K-Cl/SO4 groundwater facies. Conversely, samples collected as part of the Phoenix Project (current), plot either as Ca-HCO3 or Ca-SO4/Cl groundwater facies. No explanation is provided for the observed hydrogeochemical differences between groundwater from the Phoenix project and the Cigar Lake analogue study/Millenium Project.	Please provide additional clarity to and interpretation of Figure 26 in Appendix 7-A, including a revision to the Figure to allow for easier interpretation. This could include clear identification of end members, as well as arrows indicating proposed evolution of groundwater chemistry. Further discussion should be provided describing observed differences between groundwater chemistry at the Phoenix project compared to Millenium/Cigar Lake.		Accepted	n/a
IR-81	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** The report states in the description of hydrochemistry of the Lower Sandstone Aquifer that, "On the basis of groundwater chemistry and tritium values in that groundwater, the authors (of the Cigar Lake analogue study in 1994) concluded that the groundwater reflected a younger water component that had penetrated to depth along hydraulically active fractures/faults. The same conclusion is made here (in the Wheeler River EIS) for the Phoenix study area – meaning that fracture/fault conditions are such that some areas of the MFa are characterized by younger/recharge groundwaters". **Rationale:** Tritium results for most wells in the Lower Sandstone Aquifer (MFa) reported in Table 4-1 of Appendix 7-A exhibit tritium concentrations <15 Bq/L for the 2020 sample, and 0.1 or <0.1 Bq/L for the 2021 sample. Tritium in modern precipitation typically varies from 1 – 3 Bq/L. Conclusions made in the text are not supported by data, especially given that tritium values are not reported in the EIS for local precipitation or surface water. This is important in reinforcing the assumption from the conceptual model that modern meteoric water circulates at depth in the Lower Sandstone Aquifer.	Provide a further discussion on the interpretation of tritium in groundwater, rather than echoing conclusions from the Cigar Lake analogue study. Consideration should be given to the assertion that modern meteoric water circulates at depth in the Lower Sandstone Aquifer. Collection and analysis of stable isotope (e.g., $\delta 2H$, $\delta 18O$) samples is a cost-effective solution which would greatly improve understanding of groundwater hydrology and support the development of a conceptual model.		Accepted	n/a
IR-82	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** A. In-field measurements of Oxidation-Reduction Potential (ORP) for three (3) out of twenty-six (26) groundwater samples are presented in Table 4-1 of Appendix 7-A. Although sparse, these values are also used to characterize redox conditions for representative groundwaters in Table 3-5 of Appendix 7-C. B. In Section 3.5.5 of Appendix 7-C it is stated that groundwaters in the PHREEQC model were allowed to equilibrate with atmospheric concentrations of oxygen,	1. Provide further discussions and information (i.e., ORP measurements or analytical data for redox couples) on redox conditions at the Phoenix site. Particular focus should be given to the spatial heterogeneity of redox processes. Tools such as the reference provided [2] below provide an example of simplified framework for characterizing redox conditions in aquifers.	Please see AD-65 in the Advice to Proponent table.	Accepted	n/a

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				Appendix 7-C, Section 3.5	resulting in oxidizing subsurface conditions. In Section 3.7 of Appendix 7-C it states that input files for 3D reactive transport were generated based on outcomes for PHREEQC modelling. However, in reading Section 4 of Appendix 7-C, it is unclear whether this assumption (equilibration with atmospheric oxygen) was carried forward for the 3D model. C. As per p. 3.49 of Appendix 7-C, "A small amount of reactive pyrite was assumed for the first 500 m of transport away from the ore zone in the model, primarily in the desilicified sediments of the Lower Sandstone Aquifer, and deeper portion of the Intermediate Sandstone Aquitard". **Rationale:** A. Given the importance of redox conditions for U mobilization and precipitation/dissolution of minerals (e.g., pyrite/metal oxyhydroxides) and the corresponding influence on contaminant transport from both a modelling and monitoring perspective, these should be further characterized. It should also be noted that the measurement of Oxidative-Reductive Potential (ORP) in natural waters can be complex and difficult due to the variability and disequilibrium of natural systems and issues inherent to electrode calibration (e.g., Schuring et al., 2000). Measurements of redox couples (e.g., As(III)/As(V); Fe(II)/Fe(III); S(-II)/S(VI)) are typically recommended to accurately characterize redox conditions in natural waters (Schuring et al., 2000). B. The assumptions regarding redox conditions for the 3D solute transport model should be clarified. C. The amount of pyrite (e.g., % by weight) assumed for the purposes of modelling should be clarified, given the potential role of pyrite as a reducing agent in limiting the transport of COPCs. **Reference**: [1] Schuring J.; Schulz, H. D.; Fischer, W.R.; Bottcher, J.; and Duijnisveld, M.H.W. 2000. Redox: Fundamentals, Processes and Applications. Springer: Berlin.	2. Clarify assumptions regarding initial redox conditions for the 3D solute transport model. 3. Provide the % reactive pyrite by weight assumed for models in the text. Justification for proportions used, such as analytical data, should also be provided. **Reference**: [2] Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.			
IR-83	-	CNSC	Geology and Groundwater	Appendix 7-A, Section 7.4.2.2 and Appendix K	**Context:** Leaching of uranium from the ore zone will generate voids within the ore zone, which could fail and collapse. Failure of the voids would cause displacement in overlying rocks, which will lead to the eventual ground subsidence. Based on the developed geological model, a geomechanical study was conducted to assess potential maximum vertical displacement in the overlying rock formations and predict the ground subsidence. While a layer of altered sandstone is modeled above the ore zone, the desilicified zone, a zone that is comprised of completely to partially unconsolidated sands and has very low rock quality, high fracture intensity, and high friability, and low strength in the area overlying and east of the Phoenix deposit, appears not to have been included in the model for geomechanical modeling. The evaluated displacement/deformation in the overlying rock formation and the resulted ground subsidence would not be conservative without including the desilicified zone.	Please provide details whether and how the desilicified zone is considered in the geomechanical modeling of the detailed strip model. Such details should include figures and the linkage between the geomechanical model including the determination of strength parameters of the desilicified zone and the geological model including information on the core delineation of the desilicified zone.		Accepted	n/a

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					Rationale: Stability of the ore zone rock matrix and the potential displacement/deformation in the overlying rock formations when voids in the extracted ore zone collapse are critical for protecting the overlying aquifers, preventing substantial ground subsidence, safeguarding casing integrity, and mitigating plug-off of the remaining ore as well as efficiently mining extraction. The deformed zone in the overlying rock formations will change in hydraulic conductivity that will impact on the assessment of potential effects on groundwater flow and contaminant transport in the zone. Therefore, the rock mass behavior including and above the ore zone should be adequately understood and the potential displacement/deformation should be assessed and quantified with adequately defined geological model.				
IR-84	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.5.2.4 (p. 2.35, Appendix 7-C) that "In addition to calibrating to water level elevations targets, the model was calibrated to estimates of groundwater discharge to Whitefish Lake. A match between simulated and observed flows helps to support that groundwater recharge rates are reasonable, and to provide validation for water budget assessments. Baseflow calibration targets were developed using point streamflow measurements collected upstream and downstream of Whitefish Lake. Figure 2-10 (p. 2.26, Appendix 7-C) shows the locations of the baseflow calibration targets, and Table 2-7 (p. 2.35, Appendix 7-C) illustrates the model-simulated groundwater discharge rates in relation to the estimated range of baseflow from stream measurements. The simulated baseflow to Whitefish Lake is in good agreement with the estimated representative baseflow". **Rationale:** It is not clear in Figure 2-10 (p. 2.26, Appendix 7-C) where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. Additionally, it is not clear how the groundwater discharge to Whitefish Lake is simulated, since the model domain does not cover the whole Whitefish Lake.	1. Please clarify in Figure 2-10 where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. 2. Please clarify how the groundwater discharge to Whitefish Lake is simulated considering that the model domain does not cover the whole Whitefish Lake.		Accepted	n/a
IR-85	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** Section 2.7.3 (Appendix 7-C) mentions Wells A, B and C, and Figure 2-17 (p. 2.43, Appendix 7-C) illustrates the predicted drawdown ranges at Well B and Well C. **Rationale:** It is not clear where Well A, Well B and Well C are located.	Please provide the locations of Well A, Well B and Well C illustrated in a Figure.		Accepted	n/a
IR-86	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.7.3 (p. 2.41, Appendix 7-C) that "Both the pumping demand and the recharge changes were incorporated into a transient simulation performed using the calibrated groundwater flow model. The model simulation was started at the beginning of mine construction, with initial conditions taken from the calibrated model. The simulation period was extended for 40 years to include the entire period of construction, operation, and decommissioning, and extending through 17 years post decommissioning". **Rationale:** It is not clear what is the difference between the calibrated model and transient model in terms of parameters (such as the K values for the mining zone), boundary conditions, etc.	Please clarify the parameters, boundary conditions and any other aspects as used in the transient model that are different from the calibrated model.		Accepted	n/a

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IR-87	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** In Section 2.8 (p. 2.45, Appendix 7-C) Parameter uncertainty assessment, only parameters for certain zones (part of each specific hydro-stratigraphic unit as shown in Figure 2-19, p. 2.46, Appendix 7-C) related to the pathway from the ore zone toward Whitefish Lake were allowed to vary in order to find combinations of parameter values that met statistical calibration criteria. If each hydro-stratigraphic units within the whole model domain were treated as parameter zones that can have varied hydraulic conductivity values, a different combination of parameter values could be obtained that meet statistical calibration criteria too. **Rationale:** The parameter values for parameter zones between the mining area and Whitefish Lake is important in determining the hydraulic connection between the mining area and Whitefish Lake. Parameter values in other parameter zones could also be important. For example, if the K values for the intermediate sandstone aquitard are significantly larger than in the current calibration results, the interaction between the upper sandstone aquifer and the lower sandstone aquifer could be more active, and the mined-out zone could be more active hydraulically and groundwater in the minded-out zone could have a shorter residence time than in the current calibrated model. Additionally, it is noted that Figure 2.19 (p. 2.46, Appendix 7-C) illustrates the parameter zone for the intermediate sandstone aquitard. However, Figure 2.20 (p. 2.49, Appendix 7-C) did not include the intermediate sandstone aquitard in the results.	It is recommended that the parameter zones in the Parameter uncertainty assessment include hydro-stratigraphic units in the whole model domain to investigate the possible combination of parameter values that could make the groundwater in the mined-out zone more active hydraulically.		Accepted	n/a
IR-88	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** The conceptual hydrogeological model includes upper sandstone aquifer, intermediate sandstone aquitard, and lower sandstone aquifer. The desilicified zone above the ore zone have enhanced hydraulic conductivity. The boundary condition for the lower sandstone aquifer on the west (upstream) side was assigned to have specified head, which provide source of water for the lower sandstone aquifer. As a result of the conceptual model setup, the upper sandstone aquifer is hydraulically active and the groundwater residence time within the upper sandstone aquifer is relative short. In contrast, the lower sandstone aquifer (and the ore zone) is hydraulically inactive, and the groundwater residence time in the lower sandstone aquifer is relatively long (as shown in the particle tracking results in Figure 7.6-2 (p. 7-71, main EIS report), and the simulated plume for chloride in Figure 7.6-7(p. 7-86, main EIS report)). It is stated in Section 2.6.4 (Appendix 7-C) that "As noted above in section 2.6.3, it is estimated that 99% of the groundwater discharge to Whitefish Lake is derived from groundwater that has only flowed through shallow deposits (i.e., Overburden and Upper Sandstone Aquifers). Contribution of deep groundwater flow through the Desilicified Zone within the Intermediate Sandstone Aquitard is estimated to be < 1% of the groundwater discharging to Whitefish Lake". This simulation result is reflective of the conceptual model.	It is recommended to conduct the following work to demonstrate if the mined-out zone is hydraulically active: 1. Determine the groundwater residence time in the lower sandstone aquifer and compare it with the simulated residence time in the numerical model. 2. Conduct additional particle tracking to demonstrate where groundwater originating from the mined-out zone flow towards (forward tracking) and where groundwater flowing towards the mined-out zone originates from. This would help determine why groundwater in the mined-out zone is not hydraulically active. 3. Conduct sensitivity analysis to investigate the effect of higher K values for the intermediate sandstone aquitard and the K and porosity values of the mined-out zone on the plume migration.		Accepted	n/a

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					Section 7.3.3.3 (p. 7-42) states that "The Lower Sandstone Aquifer is characterized spatially by two types of groundwater. The first groundwater type is most like that observed in the Local Flow System. This reflects hydraulically active fractures and fault systems that allow fresh recharge water to penetrate and mix with deeper waters in the aquifer. The second type of groundwater is within the zone of thermal alteration around the ore zone ……". The hydraulic connectivity of the ore zone with the upper sandstone aquifer has important implication on the groundwater restoration. The ore zone is not hydraulically active locally because it is enclosed by a clay zone before the mining operation. But if it is located within a hydraulically active area, or on a groundwater flow pathway that is hydraulically active, the mined-out zone (with much larger porosity and hydraulic conductivity) could become active hydraulically after mining operation is finished. Figure 7.6-7 (p. 7-86, main EIS report) shows that the chloride plume is most persistent within the mined-out mining area. This seems to indicate the mined-out zone is hydraulically inactive after the mining operation is finished. It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." So, there is possibility that the unplugged borehole could increase the hydraulic connection between the upper and lower sandstone aquifer. **Rationale:** It is important to understand if the larger area containing ore zone is hydraulically active. Additional confidence would be gained if there is any other evidence that support that the area containing the ore zone is not hydraulically active, and groundwater residence time in the lower sandstone aquifer surrounding the ore zone is comparable with the simulated results. Table 2-4 (p. 2.16, Appendix 7-C) shows the effective porosity (0.01-0.05) of the ore body. Figure B7 (p. B.8, Appendix 7-C) shows that the calibrated K values for the mined-out zone is 1x10-6 m/s. Section 3.5.2 (p. 3.24, Appendix 7-C) states that "The same average linear velocity was assumed for the mining area (source zone), following from the discussion in Section 4.4.2, where the hydraulic conductivity value in this zone following mining was set to 5x10-6 m/s, and a porosity of 0.2 is assumed for the ore zone (Table 4-2)". It is not clear what the justification is for the selection of the porosity and K values for the mined-out area, and whether they are conservative. It is also not clear, what the potential impact on the groundwater flow and COPCs transport would be If the mined-out zones collapse.				

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IR-89	-	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone	**Context:** The Proponent states that a hydraulic conductivity value of 5x10-6 m/s was uniformly assigned to the model layers representing the Desilicified Zone. They additionally state that this value is consistent with packer and pumping tests screened in this unit that have interpreted hydraulic conductivity values ranging from 1x10-6 to 3x10-5 m/s (Appendix C), with a geomean of 6.0x10-6 m/s. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on fish and fish habitat. **Rationale:** The Desilicified Zone is a critical layer in the hydrogeological model as it represents a key potential pathway of contaminants to Whitefish Lake. The base case hydraulic conductivity value (5x10-6 m/s) is even lower than the geometric mean, not to mention the highest value found. When simulating geochemical processes and contaminant transport within this important pathway a more conservative approach should be employed. Modifying this parameter will affect travel times and distribution of COPC in the subsurface.	1. Provide an in-depth rationale for choosing a value of 5x10-6 m/s as the base case for the hydraulic conductivity, in both the PH REdox EQuilibrium (PHREEQC) and Finite-Element Ground Water Flow (FEFLOW) models. 2. Provide a rationale for keeping the sensitivity analysis within one order of magnitude considering the lack of physical data on the Desilicified Zone. Alternatively, provide contaminant transport simulation results with more conservative hydraulic conductivity (e.g., more than 3x10-5 m/s) values in the Desilicified Zone. See also related: IR-96.	The Desilicified Zone is a critical layer in the hydrogeological model because it represents a key potential pathway of contaminants to Whitefish Lake. There is a limited amount of field data for the Desilicified zone. A sensitivity analysis should allow the model to test slightly outside of the observed field data values. Following a supplementary submission provided by Denison on July 2nd, this IR is accepted for the purposes of the EA review, subject to the addition of a commitment to: • revisiting and updating the groundwater models as necessary, as more data becomes available through the EA follow-up monitoring program to improve confidence on the hydraulic values of the desilicified zone. This commitment must be provided in the updated commitment report, as part of the final EIS submission package. Denison should also take this commitment into account when developing the EA follow-up monitoring program.	Accepted	n/a
IR-89	IR-89-R1	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone IR-89 Response from Denison	**Context:** The Proponent states that the range of hydraulic conductivities considered in sensitivity analysis was limited to values that fit within a calibration constrained uncertainty analysis of the model. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on the aquatic environment. The Proponent clarified the details of the calibration-constrained uncertainty analysis that was used for parameter bounding within the model, with hydraulic conductivity sensitivity bounds determined based on model calibration values that were supported by the available physical data. **Rationale:** ECCC agrees that calibration constrained uncertainty analysis using hydraulic head field data is useful to determine probable upper limits of K values. However, there is always some degree of uncertainty in groundwater data and models. Sources of such uncertainty may include errors, lack of complete and representative field data to determine key parameters, or any number of heterogeneities associated with groundwater systems over large scales. Such uncertainties will always exist and can be accounted for by conducting a sensitivity analysis that accounts for the lack of physical data in the Desilicified Zone by running modelling scenarios using parameters that are outside of the calibration constrained values.	Expand the sensitivity analysis of hydraulic conductivity outside of calibration constrained parameters to account for the lack of physical data in the Desilicified Zone.	See IR-89 (above).	Accepted	n/a
IR-90	-	ECCC	Fish and fish habitat	Appendix 7-C, Section 2.4 and 2.6	**Context:** Hydraulic conductivities and hydraulic gradients play an important role in groundwater flow, geochemical modeling, and contaminant transport for the PHREEQC and FEFLOW models. Although there is an important vertical component	1. Explain if the vertical and lateral hydraulic gradients and hydraulic conductivities are assumed to be equivalent.		Accepted	n/a

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					to the contaminant transport, there is no distinction made between lateral and vertical hydraulic conductivities of hydraulic gradients. **Rationale:** According to the conceptual model, there is an important vertical aspect to the groundwater flow thus incorporating any vertical hydraulic gradient or hydraulic conductivity information into the calibration would increase confidence in the results. Providing a distinct value for vertical hydraulic conductivity will improve the accuracy of the model in regards to the transport of contaminants to Whitefish Lake through the Desilicified zone, which is important to understand potential impacts to aquatic life.	2. Provide a rationale for not distinguishing between vertical and lateral hydraulic gradients. 3. Alternatively, provide both lateral and vertical hydraulic gradient estimates and the implications on contaminant transport.			
IR-91	-	NRCan	Fish and fish habitat	Appendix 7-C, section 2.5.2	**Context**: The numerical model calibration quality plot (Appendix 7-C, sec. 2.5.2.1, Figure 2-13) contains a small error. The vertical (simulated heads) and horizontal (observed heads) axes do not have the same scales (499 to 521 masl versus 499 to 522 masl). Therefore, the line of ideal fit is offset. **Rationale**: As a result, NRCan notes that observed heads in the 510-512 masl range are underpredicted by the model. NRCan also notes that the calibration statistics (Appendix 7-C, sec.2.5.2.3) are highly leveraged by two data points from open boreholes south of Kratchkowsky Lake where simulated values are largely controlled by the nearby constant-head boundary in the Lower Sandstone aquifer (520 masl).	The Proponent should correct the scales on the axes of Figure 2-13 in Appendix 7-C. The Proponent should also comment on the effect on calibration of the clustering of most observation wells in the ore zone.		Accepted	n/a
IR-92	-	CNSC	Geology and groundwater	Appendix 7-C, Section 3.2.1, Mineralogical Composition	**Context:** Table 3-2 summarizes the clay content of the Athabasca Group sandstones and the Paleoweathered Zone. Although minimum, maximum and median values are provided, the number of samples and variability of the dataset are not. Rationale for incorporating illite into reactive transport modelling and excluding kaolinite/dichlorite is provided in the text. From p. 3.29 in Appendix 7-C: "The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 7.68%; Table 3-2) and using portable infra-red mineral analysis indicating median illite content by mass is 13.1% (data not shown)" From p. 3.30 in Appendix 7-C: "Using the minor amount of illite compared to the more dominant chlorite is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone". This conservative assumption appears contrary to assumptions for the desilicified zone (DSZ) and Athabasca Group sandstones "Illite was used to represent the total clay content, which varies from 1.74% to 5.85% by mass in the hydrostratigraphic units within the Athabasca Group sandstones and Desilicified Zone". **Rationale:** Information is missing in the EIS regarding the clay composition of hydrostratigraphic units. Results from infrared mineral analysis are not reported.	1. Please provide in Table 3- the number of samples and variability of the datasets used to estimate the clay content of hydrostratigraphic units for the model. Include results from infrared mineral analysis in the text if the information is used to support assumptions for modelling. 2. Please provide further information/discussion within the EIS relating to the assumptions of clay content in hydrostratigraphic units for modelling. Provide further justification and rationale as to why total clay content in the Athabasca Group sandstones and Desilicified Zone is assumed to be illite, and how this assumption is conservative. This discussion could include a comparison of the properties (cation exchange capacity, surface area) of illite vs. kaolinite vs. dichlorite for the anticipated range of subsurface conditions (pH, redox, U concentrations, etc.).		Accepted	n/a

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					The assumption for the solute transport model is that all clays in the downgradient DSZ are illite. However, clay content in the Read Formation (Lower Sandstone Aquifer) downgradient of the ore zone is low in illite (0.42%) compared to kaolinite (0.52%) and dichlorite (1.18%). A value of 3.9% illite clay by weight is used for the DSZ, but Table 3-2 indicates median content is 2.42% illite. It is not clear why illite was used to represent total clay content for the DSZ, as opposed to the conservative assumptions used for the Paleoweathered Zone, nor has any basis or justification been given.				
IR-93	-	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-10: Properties of Adsorbing Mineral Phases	**Context:** In Appendix 7-C, section 3.5.6.2.2 Ion Exchange and Surface Complexation, the consideration of ion exchange and surface complexation and the corresponding parameters and chemical reaction are discussed. **Rationale:** The site density of sorbent Geothite was reported in Table 3-10 to be 1.6E3 mol/kg. Taking into account the specific surface area of 60 m2/g, this equals to 1600/6E4 mol/m2, or 0.0266 mol/m2, 1.6e4 sites/nm2. This value largely overestimates the site density of goethite, which is reported to be in the range of 2~6 sites/nm2. The reference used in the EIS report indicates the similar range of variation for this specific parameter. There are plenty of similar studies on SCM of iron oxides in literature. It is suggested to consult with more than one single study to enhance the reliability of model parameters. The overestimation of sorption site density will directly result in underestimation of the affected COPCs' concentrations in pore fluid. This will result in underestimation of COPC transport plume in the affected underground space, and potentially the dissolved concentrations in the hydrogeological sink.	Please provide additional evidence to justify the model parameter of site density for goethite, applied to the numerical model. If necessary, the reactive transport modelling should be re-run to update the contents presented in the EIS report.		Accepted	n/a
IR-94	-	CNSC	Geology and Groundwater	Appendix 7-C, Numerical modelling: post-decommissioning evaluation, Section 3.5.5, Subsurface Conditions Incorporated	**Context:** It is reported in this section the assumed subsurface conditions that were applied in the geochemical site conceptual models. Critical phenomenon of pH tail was mentioned. Inclusion and exclusion of corresponding geochemical reactions were discussed briefly. **Rationale:** It was reported that the residual reduced minerals of uraninite and pyrite were not included in the modelling of the remediated mining area. The argument was based on consideration of the upstream groundwater, passing through the mined zone, will not be oxidizing and groundwater conditions are expected to be similar to pre-mine conditions. However, this ignores the pH tail effect that releases proton H+ sorbed to solid surface during ISR flooding. By ignoring this process, there is a potential risk of underestimating the source terms for some key COPCs. Exclusion of uraninite and pyrite in remediated mining area modelling is contradictory to pH-tail effect. The justification is not sufficient in the current form.	Please provide additional evidence to justify the approach for excluding uraninite and pyrite from the analysis of remediated mining area. This may require the results from additional modelling.		Accepted	n/a

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IR-95	-	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-11	**Context:** The Table 3-11 reported the Solid-Phase Concentrations and Partitioning Constants for COPCs. Data were both measured and simulated. **Rationale:** It is unclear how the partition coefficients of various COPCs upon desilicified and paleoweathered rocks were obtained. It was not reported at what pH were these K_d analyzed. Sorption of chemicals on solid phase is known to be pH dependent. It is unclear whether pH influence was considered in the measurement and analysis of apparent partition coefficients. In addition, uptake of metals on clay is highly nonlinear, and always has a maximum capacity. Even with a very strong affinity towards specific metal ions, the sorption will be saturated at elevated concentrations. Therefore, assuming a linear correlation needs to be cautious of the concentration range of target COPC species, and the applicable sorption capacity of the clay mineral. In the current model, only the linear form of sorption is considered, although with discussion of K_d value selection. Additional rationale is needed to justify if the applied methodology is sufficient for assessment.	Please justify the choice of applying a linear form partition coefficient for the modelling and assessment, and whether it provides a conservative approach to the assessment results. Clarity around the experimental conditions during the measurement of partitioning coefficient of various COPCs on the target rocks may help support this assumption.		Accepted	n/a
IR-96	-	CNSC	Geology and groundwater	Appendix 7-C, Section 4.4.4, Sub-Domain Model Transport Boundary Conditions	**Context:** From the text, "Transport parameters were specified for diffusion (1x10-9 m2/s), longitudinal dispersivity (10 m along the plume trajectory), and transverse dispersivity (5 m)". The source of this information is not provided in Appendix 7-C. It is unclear if the values used are defaults in the modelling software, from literature, from small-scale laboratory tests, or are site-specific values determined through tracer tests. **Rationale:** The use of a calibrated flow model does not imply that the solute transport model is calibrated. The transport parameters (such as effective porosity, dispersivity and reactive transport parameters) can only be calibrated by matching simulated and observed spatial and/or temporal distributions of a solute. Sensitivity analysis indicates that decreasing longitudinal and transverse dispersivities by a factor of two resulted in exceedances of groundwater criteria for both selenium (Se) and cobalt (Co). Given the clear influence of these values on contaminant transport, it is important that transfer parameter values are justified in the solute transport model. In addition, the influence of large-scale heterogeneity on dispersion and solute transport predictions should be discussed, to identify any uncertainty in the model predictions, and provide confidence that the applied model is adequately representing groundwater flow and solute transport. Further guidance on solute transport modelling can be found in BC MOE (2012) [1]. **Reference**: [1] British Columbia Ministry of the Environment (BC MOE). 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report no. 194001, 385 p.	1. Please provide the source of the numerical value used for diffusion and longitudinal and transverse dispersivity, and provide justification if default values by the model code were used. 2. Please provide a discussion on the influence of large-scale heterogeneity on dispersion and solute transport predictions in the modelling report. See also related: IR-89.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* CNSC staff appreciate the comprehensive information provided relating to longitudinal dispersivity and variation based on scale. However, it should be noted that guidance from Gelhar et al. (1992) and the BC MOE (2012) indicate that horizontal transverse dispersivity values should be approximately 1 order of magnitude lower than longitudinal dispersivity values, and vertical transverse dispersivity values should be approximately 2 orders of magnitude lower than longitudinal dispersivity. For the model presented in the EIS, transverse dispersivity is represented by a singular value of 5 meters, with the supporting rationale that the Gelhar et al. (1992) identified 5 meters as a representative value. It is important to note that the Gelhar et al. (1992) paper considered 5 meters to be representative for horizontal transverse dispersivity and identified that vertical transverse dispersivity is smaller than horizontal transverse dispersivity. Additionally, it is important to note that Petrotek (2021) used a transverse dispersivity of 1 m in their numerical models of the ore zone aquifer. CNSC staff thus request that Denison provide further information relating to why horizontal and vertical transverse dispersivity are represented using a singular value, and how this value is considered appropriate to represent both dimensions. **Reference:** Petrotek 2021. Groundwater Model Report Phase 1, Phoenix Deposit Wheeler River Project. Prepared for Denison Mines. December 2021.	Accepted	n/a

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IR-97	-	ECCC	Fish and fish habitat	Appendix 7-C, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b	**Context:** Appendix 7, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b present contaminant transport simulations of chloride, selenium, cadmium, and uranium. All simulations use initial condition concentrations at t=0 (or end of mining operations. In the 3D FEFLOW contaminant transport model it is not clear why initial condition concentrations were chosen rather than a constant concentration boundary. It is also unclear if mining activities will cause mobilization of the contaminants beyond the end of operations. **Rationale:** The choice of boundary conditions may impact the predicted transport of contaminants that reach Whitefish Lake through groundwater, which may have impacts to aquatic life.	1. Explain and clarify if mining operations will mobilize contaminants beyond operations? 2. Clarify if the source of contamination, (e.g., uranium, selenium) will cease after operations? 3. For the 3D model please provide the rationale for using initial concentrations rather than constant concentration boundary conditions for contaminant concentrations.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, if required.* It should be noted that the fate and transport simulations of the COCs are dependent on groundwater flow. Therefore, the Proponent's conclusions on the transport of COCs, may need to be revisited depending on how IR-89 is resolved.	Accepted	n/a
IR-98	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 8, Aquatic Environment	**Context:** It states in EIS in Section 8.3.7.1 (p. 8-151) that "Cameco's Key Lake Operation will overlap spatially and temporally with the Project". **Rationale:** It is not clear whether there is the possibility that planned Denison discharges would eventually flow into and influence a background reference lake used by Key Lake operation.	Please provide supporting information to demonstrate whether discharges from the proposed operation will not eventually flow into a reference lake used by another existing operation.		Accepted	n/a
IR-99	-	CNSC	Aquatic environment	Section 8, Water Quality, Table 8.2-13	**Context:** Table 8.2-13 shows the maximum concentration of hazardous and radiological COPC's in surface water throughout the local study area. However, the concentration for all constituents is stated as mg/L. **Rationale:** It is unusual for radiological COPC's to be displayed in mg/L, radiological constituents are typically displayed in Bq/L	Please use Bq/L when displaying concentration of radiological COPC's. If this was a typographical error in the table, please indicate as such and revise the table to indicate values are indeed in Bq/L. Please also review other tables displaying concentrations of radiological constituents to ensure this error is not repeated in other tables.		Accepted	n/a
IR-100	-	HC	Indigenous Peoples' health / Socio- economic conditions	Section 8, (p. 8-195) Section 8.5.3, Table 8.5-2, (p. 8-226)	Mercury is excluded as a COPC in the assessment. Inadequate consideration of mercury and methylmercury in fish and other country foods, and use of incorrect Hg-related health guideline values can underestimate the risks to human health among country food consumers. **Context:** Section 8 states "Mercury has not been identified as a COPC for the Project as it is currently not present in the receiving environment (i.e., background condition) at detectable concentrations and will not be produced as part of the mine process; therefore, it will not be discharged to the aquatic environment. However, it is understood that potential nutrient enrichment-related effects are possible and can be linked to increases in mercury in the environment" (p. 8-195). Table 8.5-2 shows that there is mercury present in the tissues of Northern Pike and White Sucker sampled in the waterbodies within the local study area and in Russell Lake. These fish are regularly consumed by nearby communities according to the ERFN 2017 dietary survey. In Section 8.5.3, fish tissue concentrations are	1. Include mercury (including methylmercury) as a COPC in the assessment given the baseline presence of mercury in sampled fish, the potential increase of methylmercury in receiving waters due to nutrient enrichment resulting from the Project, the significant fish consumption by the local population and that country foods, particularly fish, are an important source of dietary exposure to mercury. 2. Assess health risks from fish consumption by calculating hazard quotients for baseline and predicted methylmercury levels in country foods using Health Canada's pTDI for methylmercury (Health Canada, 2007). 3. Clarify whether mercury data represented throughout the EIS represents total mercury, inorganic mercury or methylmercury. **Suggestions for mitigation and follow-up measures:** Health Canada recommends including methylmercury in the list of COPCs to be monitored in fish throughout all project phases.	The July 2nd, 2024 supplementary submission for IR-100 and version 2 of the Commitment Register (July 17th) included a commitment to assess health risks from fish consumption by comparing fish tissue data collected during operation from the monitoring program against Health Canada's mercury guideline of 0.5 ug/g wet weight, as applicable (ID 8-44). Reviewers note an apparent contradiction between use of the provisional tolerable daily intake (pTDI) and the commercial guideline for mercury in fish. The Proponent states that the health risks from fish consumption will be assessed by comparing mercury concentrations from monitoring activities to the Health Canada maximum level for mercury in retail fish. As noted in HC's review of the Round 2 Response, the mercury guideline for commercial fish (0.5 ppm) may not be protective of human health because fish consumption patterns of local Indigenous populations may differ from that of the general Canadian population who generally obtain fish from retail sources. The health risks of mercury exposure should be assessed using local fish consumption rates and the provisional tolerable daily intake (pTDI) value of 0.2 µg/kg bw per day. Denison are expected to remove reference to the use of	Accepted	n/a

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					compared to Health Canada's human health risk- based maximum permissible mercury concentration (0.5 µg/g wet weight), which is applicable to most species of commercially sold fish rather than country foods. **Rationale:** It is recommended that mercury be listed as a COPC considering it is in fact present in fish tissue under existing conditions, the significant consumption of fish by the local Indigenous communities, and its toxicological significance to human health. Further, the Health Canada provisional tolerable daily intake (pTDI) value of 0.2 µg/kg/bw/day (Health Canada, 2007) is a more appropriate reference level when evaluating consumption of mercury in fish by Indigenous people, as it allows for the consideration of food consumption patterns in the risk assessment that differ from the general population and is protective of the most sensitive sub-group (i.e., developing foetus). It is important to note that methylmercury, rather than inorganic mercury, is generally the predominant mercury species present in fish and is also the most toxicologically significant form. The assumption of 100% of mercury in fish and other country food items being present as methylmercury ensures that the potential health risks are not underestimated. It is unclear, however, if the mercury data presented throughout the EIS represent total mercury, inorganic mercury or methylmercury.	See also related Advice to the Proponent: AD-31.	commercial guideline for mercury in fish to remove apparent contradiction with provisional tolerable daily intake in the final EIS submission package, and this IR can be resolved for the purposes of the EA process. *The following outstanding issue will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: • Local fish consumption rates should be discussed and refined as needed during planned engagement with Indigenous Nations and communities.		
IR-101	-	ECCC CNSC	Fish and fish habitat	Section 8.1.1.3, Section 8.2.1.3 Aquatic Environment	**Context:** In Section 8.1.1.3 Spatial and Temporal Boundaries the Project Area, Local Study Area (LSA) and Regional Study Area (RSA) are established as they pertain to surface water quantity. The same is done in Section 8.2.1.3 for surface water quality. In Section 8.1.1.3 Figure 8.1-4, the locations of the Project Area, LSA, RSA and surface water features and monitoring stations are provided. However, the locations of wetlands located near the Project area and within the LSA and RSA have not been provided. The location of wetlands within or near the Project footprint, as well as the other wetlands existing within the LSA can be confirmed from Part II_S9 Terrestrial Environment, Section 9.2.3.3 Figure 9.2.-8, including the wetland classifications. There appears to be at least one shallow open water wetland and several bogs located within the Project Area. There is no consideration of wetlands or potential effects to wetland hydrology, surface water or sediment quality throughout the aquatic environment assessments. There is no baseline information regarding wetlands and their status as fish habitat and ecological function, or assessment of potential effects to flow rates, water levels, water quality, sediment quality, or biota. **Rationale:** There is currently not enough information provided for ECCC to provide advice on the potential risks of the proposed Project to wetland hydrology, surface water and sediment quality within the LSA. This pathway of effects is important to assess in terms of potential effects to wetland habitat availability and quality due to changes in flow rates, water levels, water quality, sediment transport, sediment	1. Provide baseline information regarding wetland characterization within the Project Area and LSA, including: locations, wetland type, size, water surface elevation, depth, water flow pathways, and the presence of wildlife receptors including presence of fish/fish habitat within the Aquatic Environment section of the draft EIS. If this information is available in annexes or baseline studies, summarize it within the main body of the Aquatic Environment section of the draft EIS with references to respective documents for review. 2. Provide baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint. 3. Provide an assessment of potential effects to wetlands within the LSA and potential effects to ecological receptors during all phases of the proposed Project. 4. Provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.	Denison has not adequately responded to the request to identify potential effects to sediment quality to support identification of project-related effect pathways to wetlands, in either the February 10th, 2024 responses to IRs or the July 2nd, 2024 supplemental submission. The K_d values could differ significantly in wetland environments compared to in lake/stream measurements where all samples were taken and there are discrepancies in wetland classification within the EIS and information provided in IRs with the actual classification standards for various wetland types. For further explanation, the descriptions of the wetland areas provided in the February 10th response do not correspond to the information provided in the supplemental round of responses received from Denison. For example, Figure 2 of Appendix 8-F: Wetland Effects Assessment Report identifies a black spruce treed bog (ecotype BS17) between Whitefish Lake North and Whitefish Lake Middle (La-5), where effluent will be discharged. According to the Canadian Wetland Classification System (Warner & Rubec, 1997), bogs are defined as receiving water only from precipitation, with no hydrological connections to groundwater or littoral areas. This does not match with the response of "*littoral areas and these wetland portions are not cut-off from or isolated from the main basin of the lake.*" The response also does not correspond to the BS17 ecotype described in Appendix 9-B: Terrestrial Environment Wildlife and Vegetation Baseline Inventory.	Not Accepted	**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments and updated EIS sections associated with the IR response in this table are available in Appendix A.** Denison reaffirms the approach taken with baseline sediment data as utilized in the EIS and more specifically in the ERA (e.g., pooled sediment data from locations in an unimpacted system in the same watershed where land use and type is homogeneous) as an appropriate and acceptable basis to define

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					quality and potential effects to terrestrial and aquatic receptors. It is necessary to evaluate if changes in groundwater and surface water runoff flows and routing will affect water levels and habitat availability within wetlands. Potential effects from COPCs and radionuclides to surface water and sediment, or potential effects to ecological receptors within wetlands have not been evaluated.		The uncertainty introduced as to the conditions on site complicates the discussions on baseline conditions and potential impacts in wetlands which the Proponent assumes to provide fish habitats. Bogs and fens (ecotypes BS17, BS18, BS19, BS21) are identified in and around Whitefish Lake and these wetlands will have different water and sediment chemistry than lakes and creeks. For example, the partitioning coefficients of sediments in a fen would not be expected to be the same as those in a lake, though both may be depositional environments, sediments in the fen would be richer in organic matter because of the vegetation present. Organic matter in sediment is an important factor affecting soil-water partitioning coefficients. Because of this, the sediment in wetlands is likely to adsorb more metals than sediment found in lakes. For this reason, it is important to understand baseline conditions and model impacts in order to ensure the aquatic environment will not be impacted by the project's planned discharges. The Proponent should clarify if the wetlands were misidentified in the Terrestrial Environment Wildlife and Vegetation Baseline Inventory. If they have been misidentified, then corrections should be made to the Baseline Inventory and Wetlands Assessment Report, and information provided in the Proponent's round 3 response should be integrated in Section 8.3 of the EIS. If they have not been misidentified, then the Proponent should respond to round 3 information requests considering the wetland environment. <u>In order to resolve this IR, Denison are expected to:</u> 1. Update wetland classification in the LSA according to the Canadian Wetland Classification System (Warner & Rubec, 1997). Focus should be applied to updating areas with hydrological connections to groundwater and littoral sources, which may have been misclassified as bogs. This should include any sub-classification of wetlands currently categorized as Shallow Open Water in Appendix 8-F: Wetland Effects Assessment Report. Updates should be made as necessary to all relevant reports, including the Terrestrial Environment Wildlife and Vegetation Baseline Inventory as needed. 2. Update habitat mapping for wetlands to reflect any changes in wetland classifications, particularly for wetlands that may include fish and fish habitat. 3. Update Table 8.3-3 and 8.3-4 in Section 8 of the EIS to include more specific information on wetlands that may contain fish and fish habitat, such as information on wetland type & extent, vegetation, substrate type, organic matter content, etc. 4. Provide a table with summary statistics (grain size analysis and sediment quality) from sediment sampling specific to each individual sampled lake or stream, rather than summary statistics for all waterbodies and watercourses pooled together. 5. Provide the source reference for the K_d values used for the ERA in Table 3-6 and the specific characteristics of sediments (i.e. grain size and composition) of the regional study areas as they compare to LA-5, the LSA and the RSA.		existing conditions (and the variability thereof) and to identify potential Project effects to sediment and evaluate the significance of these effects. The IMPACT model predicts how constituents travel through the environment and concentrations of constituents change as a result of interactions with natural flows and lake sediments. The Kds applied in the model have largely over predicted the baseline sediment concentrations throughout the lakes demonstrating that the model and model inputs are conservative, and impacts (i.e., incremental changes in constituent concentrations resulting from Project emissions to the aquatic environment) have not been under predicted. For context on a sensitivity analysis for sediment quality predictions, refer to Appendix 10-A, Section 6.2.2 Effluent Discharge Rate. A sensitivity analysis of key model parameters was undertaken to understand the degree to which the results or conclusions of the risk assessment would vary if parameters differed from what was assumed. In this section, sediment

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							6. Conduct a statistical analysis with a power analysis comparing sediment characteristics (grain size analysis and sediment quality) from the various sub-samples taken within each waterbody to conclude if there are any significant differences between sub-sampling stations, and determine if there is within-lake variation in sediments. Denison should provide the methodology they will use to conduct the statistical analysis and power analysis for CNSC review and acceptance prior to completing the analysis. Based on the results of this statistical analysis, Denison should: a. If the results determine that there is enough statistical power to confirm there is no within-lake variation in sediment characteristics within LA-5, Denison should then complete a statistical analysis and power analysis comparing LA-5 to other sampled areas to determine if there is any between-lake variation in sediment characteristics. b. If the results determine that there is not enough statistical power, or that there is enough statistical power but there is significant within-lake variation between sub-samples in LA-5, Denison will require the additional baseline data that Denison has already committed to collecting, to update the modelling during the EA phase to support conclusions on significance of effects to the receiving environment. This IR relates closely to IR-107 that demonstrates that there is not enough baseline data to support conclusions on significance of effects.		predictions are shown for a scenario where effluent is released at the maximum upper bound rate of 81 m^3/hr and the maximum concentrations of COPCs in the receiving environment increases up to 120%. It is also a conservative prediction in that it assumes effluent is released during decommissioning at the same upper bound flow and quality as during operations. In this sensitivity analysis, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines, with the exception of cadmium, molybdenum, selenium and vanadium; however, the predicted exceedances for cadmium, molybdenum, selenium and vanadium are all below their probably effect level (PEL), no-effect (NE2), or severe effect level (SEL) values, therefore, adverse effects to benthic communities are not anticipated under the upper bound discharge scenarios. Importantly, monitoring programs will be implemented to assess the environmental performance of the Project relative to the predictive assessment that has been completed in

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									support of the EA process. Such monitoring is needed since there is always some level of uncertainty associated with EA predictions (and it is noted that uncertainty analysis has been completed as part of the EIS and considered within the context of assessing the significance of effects). Specific to this IR, sediment sampling will be completed to verify the accuracy of predicted effects and the effectiveness of proposed mitigation measures. Monitoring and follow-up programs will be integrated within Denison's overall Environmental Management System (EMS) framework and implemented through the various programs, plans and procedures that would be developed therein. Denison is committed to achieving continual improvement in environmental performance through its EMS. As part of this overall commitment to continual improvement, monitoring programs will be implemented via an adaptive management approach. Adaptive management is a systematic process for continuously improving environmental management practices by learning from their

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									outcomes. It provides the flexibility to address/accommodate new circumstances, to adjust monitoring, to identify and implement new mitigation measures, or to modify existing measures throughout all Project phases. Further, it provides a means to confirm that the monitoring elements remain valid, meet regulatory requirements, and be responsive to evolving objectives. At the EIS stage, the conceptual plan is for sediment sampling at Whitefish Lake South (near-field), at an upstream reference location (Whitefish Lake North), and at downstream locations (far-field) every three years. The far-field monitoring locations will be located in Whitefish Lake South prior to its discharge to McGowan Lake. The details of the sediment monitoring program will be refined as the Project advances. Sediment constituent concentrations will be compared to the values used in the EIS and to applicable regulatory criteria or objectives. As noted, above sampling effort will be predetermined that meet the rigor required of federal / provincial

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									requirements as described in relevant technical guidance documentation for operational monitoring. In general, applying equally to sediment quality as with all other environmental aspects that have been considered in the EIS, where an environmental monitoring program identifies predicted effects are greater than anticipated, Denison would evaluate whether these effects could result in changes to the conclusions in this EIS. If changes are confirmed, then Denison would evaluate the need for revised mitigation actions and management practices to manage effects. As highlighted above, Denison's interpretation of monitoring data would include reference to environmental performance criteria. An exceedance of environmental performance criteria would trigger Denison to respond to further investigate the potential issue. Based on this investigation, where need for revised mitigations is identified these measures would be developed and implemented. It is expected that the adaptive management process would be informed by input sought

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									from Indigenous people, stakeholders, and regulatory agencies. The following section provides a response to each to the specific IR questions: 1. The project's ecosite classification is outlined in Section 9. Ecosite classification was completed using the Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlin et al. 2010) Ecosite information was transferred directly into Appendix 8-F which originated in January 2024 during the EIS review process in response to FIRT IRs. Refer to Section 9 for the wetland assessment and Appendix 9-B for the terrestrial baseline report with information on ecosite mapping in Section 2.1.3 and ecosite characterization methods and results in Section 2.2. The measurable parameter for the wetlands assessment in Section 9 was change in areal extent of wetlands; this was also considered in Appendix 8-F. The EIS guidelines do not require use of the suggested classification scheme (Canadian Wetland Classification System

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									(Warner & Rubec, 1997). Denison used information from the province's land classification system and have fulfilled that EIS requirement. Effectively, to be conservative in one assessment (assessing change in areal extent of wetlands in Section 9) we have introduced questions and confusion in Appendix 8-F. The data was fit for purpose for Section 9 and to be consistent, it was carried over into Appendix 8-F without any adjustments or reclassifications. This IR is not questioning the assessment of changes in areal extent of wetlands, but the purported under estimation of risk through the effluent modelling. As such, no updates to the wetland classifications are warranted at this time. Further, Denison has committed to completing additional wetland studies (see response to point 2). 2. Additional wetland surveys will be completed after the EA stage, per commitment 8-46 in Denison's commitment register (i.e., "To further supplement existing information that exists for

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									the LSA wetlands, Denison is committed to undertaking wetland surveys including the collection of water quality, sediment quality, benthic invertebrates and fish and fish habitat surveys prior to the construction to provide an updated baseline for assessing the success of mitigation measures and to assess potential effects of the project on wetlands. These locations will then be further considered as part of the EMP for continued monitoring for these media and biota.”). Appendix 8-F has been updated and specifically, a new appendix (Appendix A) has been added. This new appendix provides photos and text to orient the reviewer to the in-lake wetlands of interest. While some of these in-lake areas were conservatively classified as wetlands in the terrestrial assessment (EIS Section 9), from an aquatic perspective, these in-lake wetlands of interest are littoral / nearshore zones in the lake and connecting channels. The balance of this IR response outlines the rationale for why the CNSC’s suggested wetland mapping updates to the EIS

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									would not change any EIS conclusions and are not required at this stage for EA determination. 3.Any wetlands that were present within water bodies, were mapped as part of the baseline program and results would be incorporated into the existing fish habitat summaries provided in Tables 8.3-3 and Table 8.3-4. Refer to Section 8.3.3 for the existing environment methods and results. It is noted in the EIS that detailed information regarding fish and fish habitat baseline data collection and analyses are provided in Appendix 8-D, Appendix 8-B, and additional information pertaining to wetlands is provided in Appendix 8-F. 4. Sediment grain size results for McGowan Lake, Whitefish Lake south, Whitefish Lake north and Russell Lake are summarized in EIS Section 8 Table 8.4-2, and sediment chemical composition results are summarized in Table 8.4-3. The baseline sediment grain size and chemistry analysis for all stations within the baseline study area are

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									provided in Appendix 8-D Aquatic Baseline, Tables A-3 and A-4 of Appendix A, respectively. 5. A summary of the source reference for the Kds is provided in Attachment IR-101 (Round 4), and a discussion on sediment grain size for the Wheeler River and regional study area is also provided. 6. Based on discussions between the CNSC and Denison in September 2024, the primary request from the CNSC was related to additional information on the IMPACT Kds, which has been provided as part 5 of this response. The requested power and additional statistical analyses can be completed as part of licensing and will include results from pre-operational sediment sampling. Any pre-operational sediment sampling results will be included in the environmental risk assessment (ERA) update to support Denison's application for a licence to operate. Additionally, the pre-operational sediment sample results in combination with existing data will be the basis of future comparisons of

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									measured data from effluent exposed and reference areas. Such comparisons would be based on statistically based study designs that meet the rigor required of federal / provincial requirements as described in relevant technical guidance documentation for operational monitoring.
IR-102	-	ECCC CNSC	Fish and fish habitat	Section 8.1.3.1 Appendix 8-C, including Appendix II, Table 1 (p. 2)	**Context:** Only one measured-results dataset for baseline stream flow exists that is relevant to the Project data from the Water Survey of Canada (WSC) station for Wheeler River (06DA005), and the Proponent used constructed records. The Proponent states that data from 06DA005 was used to extend local hydrometric station records and calculate baseline water quantity metrics. However, this was done through a complex combination of daily data correlation or monthly unit area runoff relationship, with or without offset, where some stations were based off constructed records instead of the real long-term dataset at 06DA005 (see Section 8.1.3.1 and Appendix II of Appendix 8-C, Table 1, p.2 (PDF p. 569)). Appendix 8-C references previous reports in its own appendices, but no equations are shown and there is no description of the accuracy of the fit, or explanation for not referring back to the one dataset (WSC station). Subsequent statistics calculated from these constructed records (e.g., 7Q10 needed for SK water Licenses) would be affected by this uncertainty. **Rationale:** Fish habitat can be altered by changes to depositional and erosional patterns in streams. Confidence in the Proponent's estimate of baseline water quantity, and by extension Project effects to fish habitat, cannot be established without a complete description of the method applied, as well as a discussion of its accuracy.	1. Provide more information on the extension of Project hydrometric station data using WSC station 06DA005. 2. Discuss the accuracy of any correlations/relationships and justify any deviations from simple unit area runoff relationships in the estimation of baseline water quantity values for the Project hydrometric stations. Constructing records from records that are themselves constructed is not recommended. 3. If baseline water quantity metrics need to be revised, discuss (if any) resulting changes to the effects assessment.		Accepted	n/a
IR-103	-	ECCC CNSC	Fish and fish habitat	Section 8.1.3.4 Climate Change Influenced Extreme Events	**Context:** The Proponent notes that Intensity duration frequency (IDF) curves are used to estimate the size of water management structures around a site and that the IDF curves are often specific to climate monitoring stations. The Proponent used the IDF_CC Tool 5.0 developed by the Institute for Catastrophic Loss Reduction (2021) which generates Intensity Duration Frequency (IDF) curves at ungauged locations in order to estimate future IDF curve values under influences of climate change. This tool generates sub-daily values at ungauged locations by interpolation and distance weighing from gauged locations. **Rationale:** IDF trends exhibit random behavior at some locations and correlated behavior at other locations. The choice of gauged locations will infer the statistics	Provide the gauged stations used to generate the sub daily duration values found in Table 8.1-6: Baseline of Intensity Duration Frequency data.	As Denison has added a commitment related to updating the IDF (1 in 100 year 24-hour rainfall) and demonstrate climate change resilience of the project (conduct climate risk and resilience assessment) in version 2 the Commitments Register (ID 8-50), this IR has been accepted for the purposes of the current EA process. *The following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.* If future projections of IDF are going to be used in design, then the Proponent is advised to consult the CSA (2019) guidance and provide revised estimates of their potential changes over the project's duration.	Accepted	n/a

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					for the ungauged locations, including the IDF trends. Without identification of the gauged locations, it is not possible to assess if the modelled data is realistic or not. If the modelled data is not accurate the design of water management structures on the site may not be sufficient resulting in the potential for impacts to the Project from flooding or extreme weather events.		The Proponent should perform a statistical analysis of precipitation using historical data at the location of interest including, confidence intervals to consider uncertainty using the approach outlined in CSA (2019). Additionally, ECCC calculated that the IDF value for a 24h 100-year event is 91.2 mm at 95% confidence interval (using 10 years (2011-2021) of historical precipitation data at Key Lake). However, the same IDF value for a 24h 100-year event was presented as an average value of 67.2 mm with no confidence interval in the IR-103 Attachment. The Proponent value is neither representative nor conservative and the proponent should update the current value based on a new statistical analysis that considers uncertainty and longer record of historical precipitation. See also AD-72 in the Advice to Proponent table.		
IR-104	-	ECCC	Fish and fish habitat	Section 8.1.3.4.2 Probable Maximum Precipitation (PMP) Events Appendix 8C	**Context and Rationale:** The Proponent notes: "The probable maximum precipitation (PMP) event is a design standard value for an extreme rainfall event. The PMP event does not have an estimated return period but is instead based on the theoretical maximum amount of water that a storm could produce based on the maximum persisting dew point." The Proponent provides a PMP value of 489.3 mm, which is based on data and methodologies available in 1999, taken from the Atmospheric Environment Branch Report (1999), Report Number AHSD-R99-01. The Proponent references Appendix 8C for details. Appendix 8C contains no supplementary information other than what is already provided in Section 8.1.3.4.2. The assumptions and methodologies presented in the report are the results of time series analyses available in 1999. As time series evolve so do the derived statistics. In order to assess potential flood risks and impacts to the Project from flooding, data that is current and representative of the changing climate is needed. The Proponent should explain why they've used data from 1999 rather than using up to date data, describe what alternative methods for determining PMP they have considered, and describe how they will support their use of 489.3 mm as a PMP, or describe how they will generate a refreshed PMP. The main factor that influences the statistical data output is the length of the time series hence the reason to keep the statistical data. The PMP values can be substantially (>10%) different if two decades of data is used in the statistical analysis.	1.Provide a revised PMP value (using up to date data) or justify the use of a PMP that is based on data and methodologies from 1999 as opposed to a more recent time series analysis. 2. Describe the alternative methods for determining PMP values that were considered. Include descriptions of both "statistical" outcomes and "rational" outcomes as applicable. **Technical Discussion Required**: Yes	Response to IR-104 is accepted by CNSC staff based solely on the Denison's response (E-DOC#-7220826, p.47/112) that states: "Despite Denison's reiteration that the PMP is adequate for the EA level design basis, Denison is committed to revisiting the estimates per CNSC's recommendations, as applicable, for the licensing phase of the Project." *This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* There are an additional 24 years of meteorological datasets since the 1999 study thus all historical rainfall extremes including those since 1999 study should be considered to estimate up to date PMP at the Project site The proponent's justification on whether the 1999 or 1994 PMP estimates are current and conservative should be substantiated based on meteorological data analysis. An estimation of updated PMP is achievable by the proponent as meteorological data is freely available and accessible from ECCC and the proponent should provide a revised PMP. The Proponent should also clarify how recent the data used to calculate the PMP or the time series is and explain the use of an older data set that will not produce as accurate of a PMP value as a more recent data set would produce, even when estimates are conservative. Specifically, a. Explain the rationale for the use of the data set which was used to derive the PMP. B. Clarify if the PMP and/or the time series was calculated using more recent data. This will allow for an accurate evaluation of the validity of results derived from the data sets selected by the Proponent.	Accepted	n/a
IR-105	-	Directorate of Fisheries	Fish and fish habitat	Section 8.1.4.1, Potential	**Context:** Table 8.1-8 and Table 8.3-6 in the EIS indicates a potential for freeze wall operation to influence groundwater interactions and surface water quantity and as	1. Provide a more fulsome analysis of the potential impact of freeze wall operations on local and semi-regional groundwater		Accepted	n/a

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		and Oceans (DFO)		interactions between project and valued component/key indicators Surface Water Quantity Section 8.1.4.2.2, Surface Water Taking 8.3.4.1, Potential interactions between project and valued component/key indicators	a result, impact fish and fish habitat. Section 8.1.4.2.2 references Section 7 Geology and Groundwater for details on potential impacts. In addition, IR-63 notes the groundwater model does not describe the pathway in which groundwater would pass around the freeze wall during operation and any resulting potential effects on groundwater discharge to Whitefish Lake. **Rationale:** As per IR-63, the groundwater model analysis is insufficient to make conclusions on the potential effects of the freeze wall on groundwater discharge into Whitefish Lake. DFO requires this information to fully understand if altered groundwater regimes will result in changes to Whitefish Lake water levels and any potential impacts to fish and fish habitat as a result of changing water levels.	regimes, and subsequently to fish and fish habitat within Whitefish Lake. The analysis should provide a rationale of how the scope of the groundwater model is relevant to and able to detect changes at the scale of fish and fish habitat. 2. If impacts to fish and fish habitat in Whitefish Lake are predicted to occur due to changes in the groundwater regime, describe any mitigation measures that could be used to avoid these impacts. 3. If impacts are predicted that cannot be avoided, characterize residual effects on fish and fish habitat.			
IR-106	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 8.1.4.2.3, Surface Water Discharge	**Context:** It is stated in this section under construction that all site contact water will be held in the Clean Waste Rock Pond. **Rationale:** It is unclear from this section what will happen to the contact water held in the Clean Waste Rock Pond, and whether it will be removed from site or released at a later time. What is the contingency plan if more contact water is produced during construction than the Clean Waste Rock Pond has capacity for.	Please indicate what will happen to the contact water stored in the Clean Waste Rock Pond during construction activities, will it be released after the wastewater treatment plant is installed? Further, please describe the contingency plan if contact water produced exceeds estimates and will exceed the volume of the clean waste rock pond?		Accepted	n/a
IR-107	-	CNSC ECCC	Aquatic environment	Section 8.2.3.3, Existing Surface Water Quality	**Context:** Under the methodology and metrics section (8.2.3.1) it is stated baseline water quality was sampled in 2016, 2018, and 2019. Looking at the data in Appendix A of Appendix 8D it seems that some waterbodies have little data available for baseline characterization. For example, Whitefish Lake only has 3 and 5 samples taken between its two sample stations, with sampling frequency seeming intermittent. **Rationale:** The amount of data available for baseline water quality characterization does not seem sufficient to adequately characterize the baseline and the variation it would experience. An effective baseline characterization is vital to ensure water quality is indeed not being affected by the Project. In addition, it is not clear if data quality objectives were applied to determine baseline information was adequate. To meet CEAA 2012 requirements, and CNSC expectations outlined in REGDOC 2.9.1, Environmental Principles Assessments and Protection Measures, the applicant is required to complete a characterization of the baseline environment. As described in REGDOC 2.9.1 Appendix B.2, Characterization of the Baseline Environment for Environmental Assessment Under CEAA 2012, the "baseline information should be sufficient to support the use of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity"	Please clarify which data quality objectives were used for the baseline characterization data. Please provide justification whether the number of datapoints collected with inconsistent frequency in baseline surface water characterization is sufficient to meet data quality objectives and to adequately characterize the baseline, and whether Denison is confident that the data collected is enough for a robust water quality baseline characterization. **Suggestions for mitigation and follow-up measures:** CNSC recommends that additional water samples are collected and analyzed at a consistent frequency to ensure a robust baseline	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided.		**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments associated with the IR response in this table are available in Appendix A.** **Denison recognizes this IR is under discussion and have provided the following response IR-107 received in September 2024.** *Note: Denison and the CNSC had a number of meetings and discussions on this Round 4 IR between Sept. 16, 2024 and October 9, 2024. The response provided here is focused on the*

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					In addition, the "applicant or Licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed."				*central questions coming out of these discussions.* Routine surface water quality sampling has started at the Wheeler River Project site. Denison made the commitment to collect additional pre-operational surface water quality data in commitment 8-48 and this work has been initiated. The list of surface water quality sampling stations, sample frequency, and analyte list is included in Attachment IR-107 (Round 4). For the CNSC's consideration, a comparison of June, July, August, and September 2024 water samples collected at Whitefish Lake (LA-5) is provided in Attachment IR-107 (Round 4). As shown in the table, the results collected in 2024 are within the range (minimum to maximum) of pooled results for both the full LSA dataset and key assessed lakes. The majority of minor differences between recently collected samples and pooled datasets are related to differences in analytical detection limits. We note that a low-level trace metal analysis was used in 2024 and this resulted in lower detection limits for some parameters compared to previous results. We note that pooling of data to establish a background is not an uncommon approach. For example, such an approach is contemplated by Guidance

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									on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives (CCME 2003). This procedure acknowledges the use of "regional" data to derive background concentrations assuming the sites from which data are used "… are generally located nearby the site under consideration but have not been adversely affected by human activities." This description is accurate for the Wheeler River Project aquatic LSA which is in an unimpacted, remote area of Saskatchewan's boreal forest. We refer the reviewer to Appendix 10-A, Appendix A Section 3.2 for consideration of modelled average water baseline concentrations of COPCs and a comparison to measured values. The plots show trends over time for selected COPCs and the generally good agreement between the measured and modelled concentrations. Based on the data presented and methodology provided in relevant guidance, the baseline water quality data collected are suitable for the purposes of the EIS and the application of additional conservatisms in the use of the data provide a conservative (i.e., protective) framework for evaluating potential effects. As shown in Attachment IR-107 (Round 4), surface water

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									quality sampling will be conducted monthly during the open water period and twice under ice. Per CNSC licensing requirements, the new water quality data along with updated effluent quality data will be integrated into the risk assessment supporting Denison's application for a CNSC licence to operate and prior to effluent release to the environment.
IR-108	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.3.3 Aquatic Environment	**Context:** Tables 8.2-2 and 8.2-3 provide summaries of the baseline surface water quality in the LSA. No justifications for the selection of water quality guidelines have been provided. COPCs that require calculations based on other parameters such as hardness, pH, or temperature to derive guidelines (i.e., ammonia, cobalt, zinc, etc.) should be indicated within the table, with a note specifying the parameter values used in the calculations, so that thresholds may be confirmed. No baseline data for un-ionized ammonia has been provided, which is a Schedule 4 substance requiring monitoring under the MDMER. For cobalt, manganese, and vanadium, Federal Environmental Quality Guidelines (FEQGs) and/or CCME Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life have not been included. A guideline of 26 mg/L has been provided for molybdenum as a Saskatchewan Environmental Quality Guidelines (SEQG), however the actual SEQG is 31 mg/L and the CCME CWQG is 0.073 mg/L. **Rationale:** In order to assess potential changes to surface water quality from Project related activities, ECCC requires that data on all parameters that require MDMER effluent and receiving environment monitoring be provided for assessment, including accurate water quality guidelines where available.	1. Update Tables 8.2-2 and 8.2-3 to include all COPCs that require effluent characterization and receiving environment monitoring under the MDMER. 2. Update Tables 8.2-2 and 8.2-3 to include missing or corrected water quality guidance thresholds, and information on values used to derive thresholds for COPCs that are dependent on general parameters.	A number of additional corrections were provided in the supplementary information provided by Denison on July 2nd, 2024. However, the following remains outstanding: • In Table 8.2-3, the long-term benchmark for ammonia as N is 5.74 mg/L for all stations except SA-4, SA-5 and SA-6, where it is 6.98 mg/L. Additionally, the TDS long-term benchmark of 500 mg/L based on SEQG, found in Table 8.2-8 is not included in Tables 8.2-2 or 8.2-3. This IR is accepted for the purposes of the EA review, and the following must be corrected in the final EIS submission package: 1. In Table 8.2-3, confirm if the long-term benchmark of 6.98 mg/L for ammonia as N for stations SA-4, SA-5 and SA-6 is correct and provide justification as to why the benchmark differs at these stations. 2. In Table 8.2-2 and 8.2-3, confirm the correct long-term benchmark for unionized ammonia as it currently differs between various stations. 3. For consistency, update Tables 8.2-2 and 8.2-3 to include the Total Dissolved Solids (TDS) benchmark utilized in Table 8.2-8.	Accepted	n/a
IR-108	IR-108-R1	ECCC	Change to an environmental component due to	Section 8.2.3.3 Aquatic Environment IR-108 Response from Denison	**Context:** Incorrect benchmark environmental quality guidelines and guidelines that cannot be verified remain within the updated Tables 8.2-2 and 8.2-3 provided in the Proponent's response. The Proponent provided an Aluminum Saskatchewan Environmental Quality Guidelines (SEQG) value of 0.005 mg/L in both tables. This is incorrect and appears to be the guideline for irrigation, not the guideline for protection of aquatic biota. The Proponent provided a Molybdenum SEQG of 26 mg/L in both tables. This value is incorrect. The correct SEQG for Molybdenum is 31 mg/L and the Canadian Water Quality Guideline (CWQG) is 0.073 mg/L. The Proponent provided a Nitrate SEQG of 13.29 mg/L in both tables. This value is incorrect. The correct SEQG for Nitrate is 3 mg/L and the CWQG is 13 mg/L. **Rationale:** In order to verify the benchmark environmental quality guidelines that are calculated based on environmental modifying factors such as pH, hardness and	1. Update Tables 8.2-2 and 8.2-3 to include footnotes with the concentrations of environmental modifying parameters such as pH, hardness and DOC used to derive guidelines for Aluminum, Cadmium, Copper, Lead, Manganese, Nickel and Zinc. 2. Update Tables 8.2-2 and 8.2-3 to include the correct benchmark guideline value for Aluminum, Molybdenum and Nitrate. Include the concentrations of environmental modifying parameters needed for deriving guidelines. If the most stringent guideline value is not selected for use, provide a rationale for use of the chosen guideline. 3. Update Tables 8.2-2 and 8.2-3 to include the calculated	In follow up to outstanding corrections following the Feb 10th submission, supplementary information provided by Denison on July 2, 2024 resolved these issues.	Accepted	n/a

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					dissolved organic carbon (DOC), the specific concentrations of these environmental modifying parameters used in the calculations must be provided. Additionally, incorrect benchmarks for Aluminum, Molybdenum, and Nitrate remain within the updated tables provided by the Proponent. No benchmark was provided for Manganese. It is not clear if Total Chromium or Hexavalent Chromium was measured as the table does not specify, and the benchmark provided was for Hexavalent Chromium. This information is required to understand potential changes to surface water quality from Project related activities and facilitate threshold confirmation. Use of the incorrect threshold could allow for effluent to be discharged at the wrong concentration.	guideline value for manganese and the environmental modifying parameter concentrations used to calculate the guideline. A benchmark environmental quality guideline has not been provided for Manganese, however a chronic CWQG guideline exists that can be derived based on environmental modifying parameter concentrations. Update Tables 8.2-2 and 8.2-3 to specify if Total Chromium or Hexavalent Chromium was measured. See also related IR-115-R1.			
IR-109	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment	**Context:** In this section it is stated "Treated water from the IWWTP will be pumped to the three Effluent Monitoring and Release Ponds (each 3,300 m3). These ponds will be designed to hold effluent for 72 hours for testing before discharge to the environment" (p. 8-75). It is unclear what procedure will be followed if effluent in monitoring ponds does not meet discharge requirements following testing. Additionally, it is also stated that "Treated water in the Effluent Monitoring and Release Ponds will be monitored prior to release to a surface waterbody or injected into groundwater via deep well injection." However, the MDMER pursuant to the Fisheries Act requires all mine effluent and seep. From the mine site that contain deleterious substances be discharged through a final discharge point. **Rationale:** In order to fully understand effluent management, more information is required regarding the procedure for managing effluent in monitoring ponds that does not meet discharge requirements. It is unclear how effluent that does not meet discharge requirements will be managed if it needs re-treatment and re-testing prior to discharge. ECCC reminds the Proponent that Project effluent from all final discharge points must meet federal legislation requirements.	Provide further information regarding management of effluent in monitoring ponds that does not meet the requirements for discharge under the MDMER.		Accepted	n/a
IR-110	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment Appendix 8-E, Section 2.1	**Context:** It is stated that the diffuser at the final effluent discharge point will be located in approximately 3m of water. However, in Figure 8.2-5 displaying the location of the proposed diffuser and lake bathymetry, the diffuser location seems to be located in 2-2.5m of water. A similar image in Figure 1 Section 2.0 of Appendix 8-E also indicates that the diffuser seems to be located in 2-2.5m of water. Additionally, while thermal effects are unlikely, this cannot be confirmed until a more detailed diffuser design is provided for review. **Updated Rationale:** The Proponent should confirm the location and depth of the proposed diffuser in order to confirm that modelling predictions for effluent discharged into the receiving environment are accurate. A review of the final discharge design is necessary to confirm the location and depth of the proposed diffuser and modelling predictions for effluent discharged into the receiving environment.	Provide confirmation of the diffuser depth and location. ECCC requests the opportunity to review the finalized diffuser design once it is available.	Denison has captured a commitment in version 2 of the Commitments Register (July 17, 2024) that the final diffuser configuration will not change the environmental assessment conclusions of risk to aquatic receptors and that water quality will remain below guidelines (ID 8-9), so this IR has been accepted. Note, if there are deviations from predicted effluent and near-field surface water concentrations of COPCs and risk to aquatic receptors due to the finalized diffuser design, this is expected to be addressed through Denison identifying and implementing mitigation measures (e.g., treatment) to ensure that the environmental assessment conclusions of risk to aquatic receptors will not change and that water quality will remain below guidelines. This must also be factored into Denison's EA Follow-Up Program *Any outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.*	Accepted	n/a

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IR-111	-	CNSC	Fish and fish habitat	Section 8.2.4.2.2, Controlled Discharge	**Context:** This section of the EIS indicated that the scenario was assessed using a conservative assumption of a continuous freshwater withdrawal rate of 40.5 m3/hr, and a continuous effluent discharge rate of 81.0 m3/hr. **Rationale:** The withdrawal rate assessed is half of the effluent rate, it is unclear from the text where the other half of the volume of effluent is coming from, if not drawn from the lake.	Please clarify where the other half of the total volume of effluent discharged is from in the water balance between water intake and effluent.		Accepted	n/a
IR-112	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.2, Aquatic Environment Appendix 8-E, Section 1.2.1 Appendix 10-A (ERA), Section 3.1	**Context:** This section of the EIS states that, "for the purpose of assessing the scenario of greatest potential effects, the Project was assessed as having a continuous freshwater withdrawal rate of 40.5 m^3/hr and a continuous effluent discharge rate of 81.0 m^3/hr." (p. 8-21) However, several sentences later it is stated that, "The approach to assessing Project-related effects on the Surface Water Quality VC was conservative for the following reasons: The assessment was based on a continuous (year-round) discharge rate at an expected average effluent discharge of 0.0101 m3/s (or 36.5 m3/hr) throughout Construction, Operation, and Decommissioning…" This is a continuous theme throughout Section 8, Aquatic Environment, where the discharge rate for the surface water quality assessment changes between 36.5 m3/hr and 81.0 m3/hr. However, in Appendix 10-A (ERA) the 36.5 m3/hr discharge rate is the only value used for the near and far-field modelling. It should be made clear in the main body of the draft EIS that the average effluent discharge rate of 36.5 m3/hr has been used as the input for the near- and far-field modelling for effluent, surface water and sediment quality predictions. The maximum upper bound discharge rate is 81 m3/hr; however, modelling for effluent, surface water and sediment quality was not completed for this discharge rate. **Rationale:** It remains unclear throughout the draft EIS that all predictions of COPC concentrations in effluent, and receiving environment surface water and sediment are based upon the effluent discharge rate of 36.5 m3/hr, and not the maximum upper bound discharge rate of 81 m3/hr. All conclusions about risk to the environment and aquatic and terrestrial biota must make this clear. If the Proponent wishes to make conclusions based on the maximum upper bound discharge rate of 81 m3/hr, modelling needs to be conducted using this rate of discharge.	1. Confirm that the surface water quantity, quality, and aquatic biota risk assessments and modelling, were conducted using the discharge rate for 36.5 m3/hr within the draft EIS. 2. Revise any statements or conclusions in the draft EIS to improve clarity about the usage of the maximum upper bound discharge rate of 81 m3/hr. Remove statements regarding use of the discharge rate of 81 m3/hr during modelling and risk assessments to the receiving environment as needed.		Accepted	n/a
IR-113	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment	**Context:** No quantitative assessment of climate change has been conducted. Representative concentration pathways (RPC) projections for climate change have not been integrated with near-and far-field modelling to assess impacts to surface water quality or sediment quality in the future. **Rationale:** Changes in air and water temperatures, precipitation, snow melt, ice formation, etc., due to climate change can all influence COPC concentrations in	Provide a quantitative analysis of the potential impacts of predicted COPCs from mine effluent to surface water and sediment quality with climate change scenarios for the Project lifespan incorporated into modelling. Include modelling predictions regarding the influence of changes to air and water temperatures, precipitation, snow melt, ice formation, etc., on COPC concentrations in surface water and sediment.	In order to resolve this IR, CNSC Staff expect that Denison: Make a commitment to not discharge during unusually low flow scenarios, and, Make a commitment to complete a sensitivity analysis during licensing after the BATEA has been completed.	Accepted	n/a

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					surface water and sediment. It is not possible to assess the potential impacts from climate change on predicted surface water and sediment COPC concentrations with the current information.		These commitments must be reflected in the final EIS submission package. *This IR has been accepted for the purposes of the current EA process, the outstanding issue below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent suggests that the requested quantitative analysis is not necessary and contends that potential climate change effects on water quality should instead be addressed through mitigation measures, monitoring and adaptive management. The Proponent's approach does not sufficiently characterize the range of potential effluent and water quality predictions. Climate change analysis is lacking, and a sensitivity analysis was not conducted in order to further understand uncertainty and drivers of the model results. Further, some aspects of water quality modeling are not sufficiently conservative, including use of the geometric mean (instead of the 95th percentile) as the baseline concentration for constituents, and pooling data from all lakes, which would mask any differences between the lakes. It is therefore not known whether water quality exceedances may be predicted under climate change scenarios. Without estimating the potential influence of climate change on water quality, it is unclear whether the proposed water quality mitigation measures are adequate. Climate change may impact the assimilative capacity of the receiving waterbody, therefore the present day 7Q10 or low flows may vary under future climate conditions. A sensitivity analysis would further refine predictions of how the 7Q10 or low flows may vary with climate change and therefore provide insight into how water quality may be impacted as well. In order to resolve this issue, Denison will be expected to: • Conduct a sensitivity analysis of low flows (7Q10 low flow, monthly low flow and monthly average flow) and high flows to assess how low and high flows may change under future climate conditions and the potential implications on water quality predictions made during the EA phase.		
IR-113	IR-113-R1	ECCC	Fish and fish habitat	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment IR-113 Response from Denison	**Context:** The Proponent states the following, *"The PMP is very conservative (e.g., assumes effectively a full year of precipitation in one event) under both existing and future conditions (climate change)"*. This statement suggests that the PMP value utilized considers future climate changes such as possible changes in the frequency or intensity of extreme precipitation events. **Rationale:** As noted by the Proponent, increases in extreme rainfall are anticipated with a warmer climate. For precipitation extremes across Canada, the relative change in event frequency is expected to be larger for more extreme and rarer events. Given that the extreme precipitation is expected to intensify in the future	Clarify if climate change has been considered in the PMP value provided. If it has not been considered, discuss how potential increases in PMP have been and/or need to be considered in the Project design. **Reference:** Kunkel, K., Karl, T. R., Easterling, D. R., Redmond, K., Young, J., Yin, X., & Hennon, P. (2020). Probable maximum precipitation and climate change. *Geophysical Research Letters*, 1402-1408.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent has not clarified if climate change has been considered in the PMP value provided or discussed how potential increases in PMP have been or need to be considered in the Project design. Thermodynamic effects on atmospheric moisture will lead to intensification of local extreme precipitation in the future. Probable maximum precipitation (PMP)	Accepted	n/a

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					(Kunkel et al. 2013), the Proponent should consider how these potential changes will influence design values such as PMP.		is defined as the greatest accumulation of precipitation for a given duration meteorologically possible for an area (Kunkel et al., 2013). PMP values may increase with climate change. In the response to IR-113 R1, the Proponent states that "the design basis PMP is robust and inclusive of projected total annual precipitation under a high carbon scenario". It is unclear from this statement how the analysis provided indicates that the PMP is inclusive of climate change. The Proponent should clarify how the analysis that they provided shows that the design PMP considers climate change, and indicate if or how the potential for increased PMP has informed site water management for the mine life and into post-closure and considered in the development of mitigation measures. **Reference**: Kunkel, K. E., Karl, T. R., Easterling, D. R., et al. 2013. Probable maximum precipitation and climate change. Geophysical Research Letters 40(7), 1402–1408. Available at: 10.1002/grl.50334		
IR-114	-	ECCC CNSC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.2.4.2.4	**Context:** Tables 8.2-9, 8.2-10 and 8.2-13 demonstrate predicted maximum effluent concentrations of COPCs and maximum predicted receiving environment concentrations in the near- and far-field. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, TSS and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. For zinc, it is unclear how guidelines have been calculated when CCME thresholds can only be derived with hardness values <250 mg/L. Additionally, water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. Mercury has been identified as a COPC of interest to Indigenous groups for the proposed Project. Table 8.2-8 indicates that background concentrations of mercury in LA-5 are low, and predicted effluent concentrations are also low. However, no information has been provided on background methylmercury concentrations or expected atmospheric deposition of mercury from Project related emissions. Predicted effluent concentrations of 3915 mg/L of sulphate are quite high, and sulphate is known to increase mercury methylation rates in aquatic environments. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment. ECCC recommends the use of the most stringent guidelines for the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC	1. Update all tables to include all COPCs with required monitoring under the MDMER including acute and chronic thresholds. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. 3. Provide baseline data on the concentrations of methylmercury in surface water, sediment and fish tissues (i.e., large- bodied sports fish and small-bodied forage fish) in the LSA and RSA receiving environment to establish a baseline prior to potential Project impacts. 4. Provide an assessment of risk from methylmercury to ecological receptors due to changes in sulphate concentrations in effluent, and potential deposition of mercury from Project related atmospheric emissions in the receiving environment.	In a supplementary submission provided on July 5th, 2024, Denison provided corrections to some tables. However, errors and conflicting information remain within and between tables. <u>In order to resolve this IR, Denison are expected to correct the following issues:</u> 1. Provide the following updates to Tables 8.2-8, 8.2-10, 8.2-13, and 8.2-14 to correct the errors outlined. Additionally, in Table 8.2-13 MDMER Schedule 4, the maximum authorized effluent concentration limits are not appropriate for use as short-term benchmark water quality guidelines. The Schedule 4 limits are only applicable to effluent and represent concentrations in effluent that cannot be exceeded at end-of-pipe, not to receiving environment surface water concentrations, and are not a reliable indicator of acutely lethal concentrations of constituents in receiving environment surface water. • Tables 8.2-8 and 8.2-10: A. Temperature: long-term screening criteria is "ambient temp" and should be updated to "narrative", as has been used in updated Tables 8.2-2. The narrative is already included in the footnotes of Table 8.2-8 and 8.2-10, so the tables should be updated as well. • Table 8.2-13: A. Cadmium: both short-and long-term benchmarks are erroneous and should be corrected to values found in updated Table 8.2-2. B. Chloride: long-term benchmark is erroneous and should be corrected to value found in updated Table 8.2-2.	Not Accepted	**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments associated with the IR response in this table are available in Appendix A.** 1) The updates were completed as requested. In Table 8.2-13 MDMER Schedule 4 maximum authorized effluent limits were removed and tables updated. Tables 8.2-8 and 8.2-10 a) Table were updated to include "narrative" rather than "ambient temp" as requested. Table 8.2-13: A) Cadmium values were checked and were correct, however, chloride values were incorrect and had the

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					exceedances of water quality thresholds. Increased sulphate availability can lead to increased methylation rates of mercury and methylmercury in sediment and surface water. Methylmercury is a toxin that can bioaccumulate within the food chain and present risks to aquatic biota and wildlife consuming aquatic biota. Potential changes to methylmercury concentrations in water quality, sediment and fish tissues should be assessed due to the proposed sulphate loadings in effluent. Additionally, in accordance with the MDMERs, Denison will be required to demonstrate that their effluent quality meets the limits in the MDMER. Denison is expected to provide the predicted effluent quality for lead, nickel, and un-ionized ammonia to demonstrate compliance with the MDMERs.		C. Iron, Lead-210, and Uranium-234 & -238: long-term benchmarks are missing and should be the same values found in updated Table 8.2-2 or Table 8.2-8. D. Alkalinity and nitrate have been added to the table as requested, however predicted maximum concentrations are only presented for Whitefish Lake Middle and South. The proponent should describe why there are no estimates for these parameters in other lakes, and how they intend to fill these gaps. • Table 8.2-14: A. The removal of constituents of potential concern from future centuries review need to be justified by the proponent. Otherwise, all parameters included in Table 8.2-13 should also be included in Table 8.2-14. Presently alkalinity, nitrate, uranium-234 & -238 are missing. B. Uranium: the long-term screening concentration is erroneous and should be corrected to the value found in all other tables. • Footnotes: A. The footnotes for each table should reflect what is in the table. B. All tables: acronyms used in the references that need explanations in the footnotes include: "CCME", "HC", "BC MOE", "FEQG" and "MDMER". C. All tables: explanations in the footnotes for acronyms that were not used in the tables: "SSWQO", "TKN", and "TOC". Removing these would increase clarity. D. Footnote "*" should be removed. It explains how ammonia concentration is calculated and is not referred to in Tables 8.2-8, 8.2-10 & 8.2-13. In Table 8.2-14 it is associated by cadmium, which does not make sense. E. Footnote (4) should be removed. It states the short-term screening criterion for chloride limit is "*Based on water hardness >0 to <17 mg/L*". This appears erroneous since neither the CCME guideline nor the SEQG is hardness based. F. Tables 8.2-13 & 8.2-14 do not refer to the footnotes "TDS", "narrative", (4) and (7), and removing them would help clarity. 2. CNSC/ECCC staff agree that the minor baseline exceedances of copper concentrations in water do not constitute the use of a guideline that is a magnitude of order greater than the copper FEQG. The copper FEQG guideline is the most restrictive guideline and based on current science and site-specific conditions, whereas the CCME guideline is quite dated and does not incorporate the use of site-specific environmental modifying factors. As there are background concentrations of copper that do exceed the copper FEQG, there is the potential that biota may already be stressed due to these exceedances. However, there is not currently enough baseline characterization data within the immediate receiving environment to		cadmium footnote associated with them. This was corrected. B) Chloride long term benchmark was corrected to the value found in Table 8.2-2. C) Iron, Lead-210 and Uranium-234 and Uranium-238 long-term benchmarks were missing but have been added as per the values consistent with Table 8.2-2 and 8.2-8. D) Alkalinity and nitrate were not collected for other locations during baseline assessments. It is intended that these constituents will be added to the pre-construction water sampling suite of parameters to ensure consistency and completeness for additional analysis conducted for licencing. Table 8.2-14 A) **Nitrate**: Nitrate was not included in the Geochemical Reactive Transport Model (Appendix 7C of the Final EIS) as it is not considered a COPC associated with the ISR mining process for this project. Nitrate concentrations

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							conclude the level of risk to receptors and if there are consistent exceedances of water quality guidelines. Following the principles of the Precautionary Approach, to be conservative Denison are expected to: A. Update the screening criteria used for the EIS and ERA (and all relevant tables) to utilize the more stringent FEQG guideline of 0.0002 mg/L as calculated using the currently available baseline data. B. Update the ERA effects assessment for copper to utilize the FEQG with regards to selected Toxicity Reference Values (TRVs) and risk characterization to receptors. C. Collect further baseline data in the immediate receiving environment (LA-5) to adequately characterize copper concentrations in water and sediment quality and any potential exceedances of baseline water quality guidelines.		were below laboratory reported detection limits in the metallurgical testing, where tested, as shown in Table F-2 of Appendix 7C of the EIS. Further, nitrate concentrations are, with one exception for a groundwater monitoring well in overburden (GWR-036), below or very close to the laboratory reported detection limit, as shown in Table D-2 of Appendix 7C of the Final EIS. Baseline nitrate concentrations are low (< 0.5 mg/L) in surface water bodies assessed for the project, as reported in Table 8.2.2 of Chapter 8 of the final EIS. Nitrate concentrations are thus expected to remain at baseline levels in future centuries. A note has been added to Table 8.2-14 to indicate that nitrate is not a COPC in the future centuries and as such is expected to remain at

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									baseline levels. **Alkalinity:** was included in the Geochemical Reactive Transport Model (Appendix 7C of the Final EIS) but not included in the future centuries assessment in IMPACT. Using the output from the geochemical reactive transport model (i.e., the mass flux of alkalinity, reported as "C" in Table 4-4 of Appendix 7C of the Final EIS), the approach and input parameters used in the IMPACT model (described in Appendix A to Appendix 10-A of the Final EIS), and assuming that alkalinity (as bicarbonate ion primarily at the circumneutral pH value Whitefish Lake) does not interact with the sediments, maximum alkalinity values in Whitefish Lake (LA-5) were calculated to be 8.1 mg/L as CaCO3 versus the mean baseline value of

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									7.7 mg/L as CaCO3 (Table 8.2-2 of Chapter 8 of the Final EIS). This value has been included in Table 8-2.14, is within the range of baseline alkalinity values observed in that lake (3-15 mg/L as CaCO3 in Whitefish Lake South (LA-5)) and represents a 5.2 % increase from mean baseline concentrations. The alkalinity in the future centuries was not calculated for the other lakes as changes with respect to baseline conditions will be negligible (i.e., not outside of the range of values in each lake observed at baseline). **U-234 and U-238**: Uranium was modelled in the future centuries scenario and U-234 and U-238 (Bq/L) were calculated. The results have been added to Table 8.2-14. B) Uranium long-term screening value was updated to be

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									consistent with all other tables Footnotes: A) Footnotes for each table have been updated B) All table acronyms have been explained as applicable. C) Acronyms that were not used in a table were removed from the footnotes D) "*" has been removed from the document where explaining ammonia concentration calculation. E) Confirmed that this statement was correct. Footnote 4 was removed from all tables, and all footnote numbering adjusted to reflect changes. F) TDS and "Narrative" footnotes were removed. Footnote 7 was missing in the table, so was added. Footnote 4 removed from all tables. 2) A) The screening criteria used for the EIS and ERA (and all relevant tables) has been updated to utilize the more stringent FEQG guideline of 0.0002 mg/L.

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									See Attachment IR-114 Round 4. B) The TRVs have been re-evaluated using the FEQG Biotic Ligand Model. See Attachment IR-114 Round 4. C) Denison is committed to collection of further baseline data in the immediate receiving environment (LA-5) to adequately characterize copper concentrations in water (refer to response to Round 4 IR-107 for water quality results from Whitefish Lake from June to September 2024) and sediment quality and any potential exceedances of water quality guidelines and this information will be further presented and analyzed as part of licensing.
IR-115	-	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1	**Context:** Table 8.2-8 demonstrates baseline concentrations of COPCs in LA-5 South Whitefish Lake, their respective water quality guidelines from applicable sources, and proposed Project thresholds. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, Total Suspended Solids (TSS) and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. Water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. The water quality objective selected for molybdenum is the 31 mg/L SEQG rather than the CCME guideline of 0.073 mg/L. **Rationale:** ECCC recommends the use of guidelines that will ensure the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds.	1. Update Table 8.2-8 to include all COPCs with required monitoring under the MDMER. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. 3. Provide additional information to justify the use of the selected water quality guideline for molybdenum.	Please see the response to IR-115-R1 (below).	Accepted	n/a
IR-115	IR-115-R1	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic	**Context:** In the Proponent's response to item two, it is mentioned that the derived water quality thresholds used in Table 8.2-8 and in the assessment (Section	1. Update Table 8.2-8 to include the following COPCs: un-ionized ammonia, aluminum, iron, manganese,	In a supplementary submission from July 5th, 2024 Denison has provided updated information.	Accepted	n/a

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				Environment Appendix 10-A (ERA), Section 3.1.1.1 IR-115 Response from Denison	8.2.4.2.3, Aquatic Environment; Appendix 10-A (ERA), Section 3.1.1.1) are based on hardness concentrations found in effluent. The Proponent mentions that hardness derived from IWWTP discharge will consider IWWTP discharge on the receiving environment and provide “a reasonable estimate of expected hardness in effluent”. However, this does not consider induced hardness (i.e., hardness concentration increases in the receiving environment over the lifecycle of the Project) from effluent contributions as a Project effect; the receiving environment baseline concentrations of hardness have been altered due to inputs from Project effluent. Providing only one estimate of expected effluent hardness in the receiving environment is not an appropriate means of conducting the effects assessment. Additionally, the following COPCs have not been included in the updated table provided in the Proponent’s response: un-ionized ammonia, aluminum, iron, manganese, thallium and total dissolved solids (TDS). It is noted that these COPCs are also subject to monitoring requirements under the *Metal and Diamond Mining Effluent Regulations* (MDMER). **Rationale:** Background concentrations of un- ionized ammonia, aluminum, iron, thallium, manganese and TDS are required to determine potential effects to the environment. The Proponent will also require this information to satisfy their obligations under the MDMER. The purpose of the surface water quality assessment is to determine if changes to the receiving environment over the project lifecycle will have significant adverse effects on biota. Changes from baseline in hardness concentrations in the receiving environment due to the deposition of effluent is a Project related effect and therefore providing a single baseline water quality threshold which is applicable only to one set of conditions is not an appropriate method to evaluate impacts across a shifting hardness baseline. Water hardness is an environmental modifying factor, various concentrations of hardness influence the toxicity of other COPCs in the aquatic environment. Using water quality thresholds that have been derived from high effluent hardness concentrations will not be protective of aquatic biota, particularly in the early stages of the project lifecycle when receiving environment water quality will be similar to baseline water quality.	thallium and total dissolved solids (TDS). 2. Update Table 8.2-8 to include background concentrations of total hardness (in mg/L CaCO3) in the receiving environment. 3. Provide rationale that all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. See also related IR-108-R1	Denison will be required to update the screening criteria for ammonia, aluminum. iron and lead during licensing review of the ERA. These updates are not anticipated to impact the conclusions of significance to the EA, and therefore are not required at this time. *Any outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.*		
IR-116	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.5, Section 8.4.4.2.5 and Section 8.5.4.2.3	**Context:** Tables 8.2-14, 8.4-9 and 8.5-5 demonstrate predicted mass flux (in mg/s) of COPCs in groundwater during the future centuries scenario. The table does not provide any information on actual surface water concentrations of COPCs or accumulation in concentrations over time. It is not possible to determine what the COPC concentrations in surface water and sediment will be during the future centuries scenario with the current information. Additionally, only a subset of parameters have been provided in this table based on	1. Provide the predicted water and sediment quality concentrations of COPCs in the receiving environment for the future centuries scenario. 2. Include data for a greater suite of COPCs that were assessed as having potential to be at elevated concentrations in groundwater.		Accepted	n/a

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					parameters that were elevated in effluent after treatment. Groundwater may have a variety of different COPCs with elevated concentrations as it will migrate directly from the ore body area and not receive treatment. **Rationale:** It is not possible for ECCC to assess the predicted concentrations of COPCs in surface water and sediment, and therefore risk to aquatic biota during the future centuries scenario with the provided information.				
IR-117	-	CNSC	Human health with respect to hazardous contaminants	Section 8.2.4, Table 8.2-9	**Context:** CNSC staff note that some of the effluent quality predictions in the EIS are quite high for a uranium mine and mill facility compared to the existing facilities. For example, the upper bound effluent quality of molybdenum is 2.5 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.213 mg/L. Also, the upper bound effluent quality of copper is 0.022 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.002 mg/L. **Rationale:** Surface water quality models should be based on the anticipated effluent quality. From discussions with Denison, it appears that the effluent quality predictions may change based on the results of more bench scale tests that are still being conducted and continued optimization of the design of the water treatment plant.	Please provide the anticipated effluent quality of the constituents of potential concern during normal operations. Once Denison has refined the effluent quality predictions, Denison is expected to update the inputs into the surface water quality model.		Accepted	n/a
IR-118	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.6.1, Section 8.4.6.1 and Section 8.5.6.1, Aquatic Environment	**Context:** It is unclear if Tables 8.2-16, 8.4-12, 8.5-7 and 8.5-8 take into consideration potential effects from groundwater seepages of COPCS to surface water and sediment quality in the future centuries scenario. No information regarding the future centuries scenario has been provided in the rationale summary for ratings. **Rationale:** Groundwater seepage of COPCs may have future impacts to surface water quality, sediment quality and aquatic receptors; however, the extent of residual effects is unclear without further information.	Provide further information regarding how groundwater seep. Of COPCs may have future impacts to surface water quality, sediment quality, and aquatic receptors, and any residual effects that may persist.		Accepted	n/a
IR-119	-	CNSC	Fish and fish habitat	Section 8.3.1.2, Table 8.3-1, Sediment quality	**Context:** Sediment quality isn't considered a key indicator for fish and fish habitat, but the accumulation of contaminants in sediment porewater without habitat alteration is similar to the key indicator 'change in surface water quality from baseline conditions' that is considered. **Rationale:** It is not clear whether sediment was just considered for physical disturbance, and why chemical changes are missing from key indicator list for fish and fish habitat.	Please provide the rationale for exclusion of sediment quality from the key indicator list for fish and fish habitat.		Accepted	n/a
IR-120	-	CNSC	Aquatic species	Section 8.3.3 and 8.5, Aquatic Environment	**Context:** Although downstream impacts are not predicted by Denison it is important from an ecosystem perspective to establish baseline locations to monitor for potential cumulative effects to the aquatic environment due to the Key Lake and Wheeler River Operations to ensure the aquatic environment is being protected from cumulative impacts.	If Denison has not collected baseline aquatic studies in the far-field downstream receiving environment of Russell Lake, please provide a rationale for why.	Response is accepted, but also see AD-51 in the Advice to Proponent table.	Accepted	n/a

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					Denison should consider adding a far-field exposure location and collecting baseline aquatic ecosystem baseline data in Russell Lake including: • Water quality/chemistry • Sediment chemistry/quality • Benthic invertebrate chemistry /community • Large-bodied fish tissue/chemistry **Rationale:** Russell Lake is identified as part of the RSA for the aquatic environment, but it appears that no detailed aquatic baseline data was completed in far-field location in Russell Lake. In addition, several Indigenous Nations and communities and local resource users have indicated that Russell Lake is an important body of water both culturally for traditional use and was once used as commercial fishery.	If a far-field Russell Lake location was sampled as part of baseline data collection, more information about the process and results with regards to sampling at Russell Lake should be included in the EIS. This information would be valuable to help determine potential cumulative effects downstream in the Russell Lake drainage system (due to the Key Lake Operation) which has been identified as a key concern and area of interest by several Indigenous Nations and communities.			
IR-121	-	CNSC	Fish and fish habitat	Section 8.3.3.1, Methodology and Metrics	**Context:** In the description of methodology for fish communities and spawning surveys, there's no mention that could be found for an any evaluation of fish condition, other than sexual condition. **Rationale:** Exposure to other pre-existing stressors could result in abnormal conditions or deformation(s) in existing population, but the extent of existing conditions should be evaluated to ascertain whether the rate is increasing as a result of proposed activities once in operation.	Please provide reference to where fish condition is considered or provide a justification for its exclusion.	Response is accepted, but also see AD-52 in the Advice to Proponent table.	Accepted	n/a
IR-122	-	CNSC	Fish and fish habitat	Section 8.3.8, Monitoring and Follow-up	**Context:** Section 8.3.8 of the EIS states: "Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development." **Rationale:** Tracking changes in fish communities / populations in reference lakes over time should be conducted, as reference lakes can be used to differentiate natural temporal variation with potential project impacts.	Please include reference lakes, and if it is provided, please reference where in the EIS these are discussed. If there are no reference lakes, these should be included in the monitoring program.	Response is accepted, but also see AD-53 in the Advice to Proponent table.	Accepted	n/a
IR-123	-	ECCC	Change to an environmental component due to radiological contaminants	Section 8.4.3.2.3, Aquatic Environment Appendix 8-D, Table 3-5	**Context:** Table 8.4-3 provides a summary of the baseline concentrations of COPCs in sediments in the LSA. Sediment quality thresholds and justification for the selection of those thresholds have not been provided. Table 3-5 in Appendix 8-D does provide benchmarks but the selection of benchmarks is not discussed, and the most stringent guidelines are not used for some COPCs. Additionally, there is no data provided for sediment concentrations of mercury, which is a COPC that requires surface water quality monitoring and effluent characterization under the MDMER. **Rationale:** Further information should be provided regarding any exceedances of sediment quality thresholds in baseline concentrations of COPCs, which should be recommended for further assessment of risk due to effluent discharges.	1. Provide sediment quality thresholds and justification for the selection of those thresholds for comparison against measured baseline COPC concentrations in the LSA. 2. Provide data on baseline concentrations of mercury in sediment. 3. Identify any COPCs with baseline concentrations that exceed sediment quality thresholds in the LSA.		Accepted	n/a
IR-124	-	ECCC	Change to an environmental component due	Section 8.4.4.2.3, Aquatic Environment	**Context:** Table 8.4-7 provides maximum concentrations of surface water COPCs in sediment. The following COPCs, which are required to evaluate the risk from effluent to sediment quality, were not evaluated:	1. Provide the information on baseline exceedances of COPCs in sediment. 2. Provide an assessment of risk for any COPCs that have	Following review of a supplementary submission provided on July 2nd, 2024, concerns remain related to:	Accepted	n/a

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			to hazardous contaminants		1. COPCs that have monitoring requirements in receiving environment surface water and effluent under the MDMER, 2. COPCs that exceed water quality guidelines in effluent, and, 3. COPCs that have baseline concentrations that exceed sediment quality thresholds in the receiving environment. **Rationale:** Due to the lack of information on COPCs with baseline concentrations that exceed sediment quality guidelines, and COPCs that require monitoring under the MDMER, a determination on risk to sediment quality and aquatic biota cannot be made.	baseline exceedances of sediment quality thresholds in the receiving environment. 3. Provide an assessment of risk from any COPCs that require monitoring in the receiving environment and effluent under the MDMER. Please include any COPCs in effluent that will exceed water quality guidelines.	• Denison's assessment of water/sediment quality for near field and regional receiving waterbodies using low flow scenarios based on return periods beyond 100 years, as well as near field and regional models. • The 7Q10 is considered acceptable low flow to provide conservative predictions for the assessment of water/sediment quality. • The modeled results for maximum concentrations of COPC's shown in tables 3.3 and 3.5 of Appendix 10-A, which show that copper may exceed the new FEQG in freshwater for both operational and post decommissioning phases of the project. For the purposes of this review, this IR is accepted, and these outstanding concerns will be addressed in responses to IR-113 (through sensitivity analysis) and IR-114. See also AD-76 in the Advice to Proponent table.		
IR-124	IR-124-R1	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.4.4.2.3, Aquatic Environment IR-124 Response from Denison	**Context:** In the Proponent's response it is stated, "Schedule 5 parameters will be monitored as per the MDMER once under this regulation (i.e., meeting regulated criteria of discharge to the environment [50 m3/day). Please refer to Table 8.2-13 of attachment IR-114. In these cases, COPCs including Schedule 4 parameters were below screening criteria." If concentrations of Schedule 5 parameters in effluent exceed water quality thresholds, these parameters are necessary for ECCC to examine in the risk assessment to determine the potential for effluent to be acutely lethal and for adverse effects to aquatic biota. These parameters will also be required to be characterized under Section 4, 5 and 7 of the MDMER. As per CSA N288.6-22 Section 7.2.5.2.1, "Screening of environmental concentrations of chemical and radiochemical substances released to the environment should be performed to identify COPCs for further evaluation in the risk assessment. Both measured concentrations and concentrations calculated from release rates may be used in the screening analysis. The screening concentrations should be compared to screening criteria, and chemicals that exceed screening criteria should be identified as COPCs." As per CSA N288.6-22 Section 7.2.5.4.2, "If COPCs exceed the screening level for one medium, they should be carried forward into the EcoRA for all media that are likely to contribute to exposure. For example, for a given COPC, if a water screening benchmark is exceeded, the same COPC should be carried forward for sediment if its concentration was above the detection limit." Additionally, updated Table 8.2-13 of attachment IR-114 has been found to be insufficient due **to** maximum concentrations in surface water for mercury, aluminum, total suspended solids, iron, thallium, manganese, nitrate and phosphorus being absent and the use of incorrect water quality thresholds.	Provide an assessment of risk from any MDMER Schedule 5 parameters that are required to be characterized in effluent and in surface water quality in the receiving environment and that have effluent concentrations that will exceed water quality guidelines derived from environmental baseline conditions.	See response for IR-124.	Accepted	n/a

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					Rationale: Due to the lack of information on COPCs with concentrations that exceed water quality thresholds in effluent, a determination on risk to sediment quality and aquatic biota cannot be made.				
IR-125	-	CNSC	Fish and fish habitat	Section 8.5, Aquatic Environment and Fish health	**Context:** Indigenous Knowledge studies and information collected in relation to the Project clearly identified the importance of water quality and fish health to local Indigenous peoples and is discussed throughout the Draft EIS. For example: • "Russell is one lake where I commercially fish. How will this effluent impact the water quality, fish health? Will I be able to sell fish from here? If there is going to water" pollution, I just want to know" (19-LK-ERFNTrap-134.255) " • "How are you going to protect the water quality? We are concerned about mercury in fish, other animals, etc. Is there mercury or arsenic in the uranium solution?" (p. 8-53) **Rationale:** Several Indigenous Nations and communities and local resources users have indicated Russell Lake is an important body of water both culturally for traditional use and was used as commercial fishery in the past and from an aquatic ecosystem perspective.	One of the many mitigation measures mentioned throughout the aquatic environment section states: "Denison will work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system." (p.10-32) Has Denison considered the collection of additional baseline fish tissue species that are of importance to Indigenous Nations and communities and local cabin owners from Russell Lake? Assuming the species would be walleye (commercially and recreationally) and lake white whitefish that is traditionally an important species consumed. Please provide more information on the engagement to date on the development of the Surface Water Management Program and Monitoring program that Denison is developing and engagement to date with interested Indigenous Nations and communities in the region on fish and fish health.	Response is accepted, but also see AD-51 in the Advice to Proponent table.	Accepted	n/a
IR-126	-	ECCC	Aquatic species	Section 8.5.3 Appendix 10-A (ERA), Section 5.3.1.1.8	**Context:** The Proponent has used the US Environmental Protection Agency (US EPA) guidelines for the assessment of selenium fish tissue concentrations in Section 8.5.3 of the draft EIS and in the Environmental Risk Assessment (ERA) in Appendix 10-A (ERA) of Section 10. **Rationale:** ECCC's Federal Environmental Quality Guidelines of 6.7 ug/g dry weight fish whole body tissue for selenium should be used, as it is more protective than the US EPA guidelines.	Update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA (Appendix 10-A (ERA) in Section 10) as needed using ECCC's FEQG.	Following a supplementary submission by Denison on July 2nd, 2024, it has been determined that item one and two of this IR have been resolved, but item three remains outstanding. Denison has not provided the information requested to address Item 3 of the Round 3 IR. Including the estimates of error for the predicted selenium concentrations in fish is necessary as the maximum predictions for Northern Pike in Whitefish Lake North and Middle are within 1-2 ug/g dw of the Egg/Ovary FEQG guideline of 14.7 ug/g dw. <u>In order to resolve this IR, Denison are expected to:</u> 1. Provide an estimate of error associated with the Northern Pike BAF. 2. Include this estimate of error for the results in Table -IR-126-2 and consider this in the effects assessment.	Not Accepted	**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments associated with the IR response in this table are available in Appendix A.** 1. An estimate of the error associated with the Northern Pike BAF is included in Attachment IR-126 Round 4 (see Appendix A to this IR response table). 2. An estimate of the whole body and egg-ovary concentrations using the range of uncertainty (low to high) is included in Attachment IR-126

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									Round 4 (see Appendix A to this IR response table). Denison will include the information on selenium BAF sensitivity analysis from this IR response in Appendix 10-A of the final EIS (new subsection 6.2.3).
IR-127	-	CNSC	Aquatic environment	Appendix 8-E, Section 1.2.1, Hydrological Inputs	**Context:** Within this section it states that the 7Q10 low flow rate used in the mixing assessment "was provided verbally to Ecometrix by NewFields Canada during a project meeting on 26 April 2022" **Rationale:** The statement that this value was provided verbally is not an infallible method of communicating data, as the value could have been misheard, misremembered, or recorded improperly.	Please verify that the 7Q10 value used in the assessment is the correct value determined by NewFields.		Accepted	n/a
IR-128	-	CNSC	Current use of lands and resources for traditional purposes	Section 9 Various pages in section 11.1, Land and Indigenous Resource Use Section 12 Section 14	**Context:** The increased road traffic (14-18 trucks per day during construction/operations) may have indirect impact on ungulates, furbearers and wood land caribou presence/absence for traditional and subsistence hunting have been raised to CNSC staff when meeting with Indigenous Nations and communities and are presented in the EIS. **Rationale:** The increased traffic and therefore dispersal of game (moose, woodland caribou) due to increased traffic has been raised as a concern with respect to increased mortality on wildlife and decreased ability to practice traditional rights.	How have the potential residual impacts with respect to increased traffic and noise (due to current and future operations) been communicated to Indigenous Nations and communities who use the road #914 for cultural and traditional activities (such as moose harvesting, berry picking and small game and birds)? Please provide any additional information on the engagement that has taken place to date with Indigenous Nations and communities with respect to concerns and potential impacts on current use of lands and resources due to increased road traffic, and any mitigation measures proposed by Indigenous Nations and communities to minimize the potential impacts.	Response is accepted, but also see AD-54 in the Advice to Proponent table.	Accepted	n/a
IR-129	-	CNSC	Current use of lands and resources for traditional purposes	Section 9 Section 10 Section 11, including Section 11.1.4.3.1 (p. 11-46) Section 12 Section 16	**Context:** ERFN indicated they are concerned about declining moose populations from an influx of hunters; more people may be accessing the area year after year, and worried populations may be affected by the Project (21-EN-ERFN-473.13). Further, the EIS highlights that: "Vehicle collisions are the most likely source of direct mortality for moose. Effective mitigation measures (e.g., breaks in snowbanks; speed limits; and exclusion fencing around contaminated waste pads and ponds) will be implemented to reduce moose mortality." (p. 11-46) **Rationale:** The Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012 notes: "The views of affected Aboriginal groups on mitigation be considered and included in the EIS. This could assist in ensuring that the environmental effects on the current use of land and resources for traditional purposes are at an acceptable level for the community."	Please provide additional information on the discussions Denison has had with Indigenous Nations and communities on how to mitigate any residual project impacts on their traditional harvesting activities of large game such as moose. More information is required to determine if Denison has engaged directly with ERFN/KML and other Indigenous Nations who utilize the area to harvest moose to determine current baseline harvest numbers that provide subsistence, continued cultural identity and community well-being, as well as discussions on how the Project could potentially impact moose populations and the harvesting of moose for traditional practices.	Response is accepted, but also see AD-62 in the Advice to Proponent table.	Accepted	n/a

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					Sources for indirect moose mortality (e.g., increased hunter access, changes to health due to sensory disturbances, changes to predator-prey dynamics) may result in mortality outside the Wildlife LSA. The residual effect of change in moose mortality is likely to occur. Although mitigation measures are expected to reduce, but not fully eliminate, the residual effect on moose. The potential residual impact on the moose and other large game populations in the broader regional study area may potentially impact Indigenous treaty rights, culture, and community well-being if the harvesting of moose and large game declines due to increased traffic, noise, and vehicle mortality or increased outside hunting pressure.				
IR-130	-	H. Mulye	Physical stressors (noise and vibration) on wildlife	Section 9, Terrestrial Environment	**Context:** Sensory disturbances such as noise have been identified as stressors for selected wildlife (Ungulates, Furbearers, and Woodland Caribou), birds and amphibians in the Project area. However, there is no consideration of impacts from vibrations on these species. Also, impacts of noise and vibration on reptiles have not been assessed in the Project area. **Rationale:** While noise has been qualitatively assessed for selected wildlife, birds, and amphibians, there is no consideration of project-related vibrations as a sensory disturbance/physical stressor. Sensitive terrestrial species (specifically, herpetofauna, amphibians, invertebrates, and caribou) can be impacted by vibrations emanating from the operation of heavy machinery, blasting activities, and other anthropogenic activities at the Project site. Also, impacts of physical stressors (noise and vibration) on reptiles were not assessed. These species should be included in this assessment due to their sensitivity to noise and vibrations.	Please provide a discussion of impacts of physical stressors (specifically vibrations) on wildlife, birds, and amphibians in the Project area. Specific mitigation measures and/or monitoring for impacts from project-related vibrations should be considered, as appropriate. Also, include reptiles in the assessment of project-related noise and vibrations as sensory disturbance/physical stressor, or a justification for their exclusion.		Accepted	n/a
IR-131	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** As per the requirement outlined in Section 79 of the Species at Risk Act (SARA): *The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans. This is accomplished by ensuring that the Proponent has identified, avoided, lessened and will monitor effects to species at risk.* As per the CNSC's Generic Guidelines for the Preparation of an EIS pursuant to the Canadian Environmental Assessment Act, 2012: "*The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the Proponent intends to implement them and the environmental outcome the mitigation is designed to address. The EIS will describe mitigation measures in relation to species and/or critical habitat listed under the Species at Risk Act (SARA). These mitigation measures will be consistent with any SARA permit, applicable*	Identify all species at risk listed on Schedule 1 of the Species at Risk Act and their critical habitat that are likely to be affected by the Project and describe how they may be adversely affected by the Project. Describe what measures will be taken to avoid or lessen the effects of each Project activity and stage, and how these effects will be monitored to ensure they are avoided or minimized.		Accepted	n/a

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					recovery strategy and/or action plan". The draft EIS neither lists the adverse effects to all listed schedule 1 SARA species, nor outlines the measures that will be taken to avoid or lessen these effects. The Proponent references that additional species-specific mitigations will be detailed in environmental management plans but has not provided those plans for review.				
IR-132	-	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale:** ECCC has identified that three species at risk arthropods (yellow banded bumble bee, transverse lady beetle, and nine-spotted lady beetle) have ranges overlapping the Project area and these were not mentioned in the draft EIS.	1.Conduct an effects assessment for arthropod species at risk. 2. Explain what mitigation measures will be used to minimize potential effects.		Accepted	n/a
IR-133	-	ECCC		Section 9, Terrestrial Environment	**Context and Rationale:** There is potential for some species at risk (e.g., myotis species, barn or bank swallows, common nighthawk) to be attracted to and use mine infrastructure (buildings, roads etc.) once constructed for nesting, roosting, or foraging. Details on mitigation measures and adaptive management with respect to attraction to Project components should be identified to assess residual and cumulative impacts to species at risk.	For all Project phases, describe the mitigation measures and adaptive management to prevent and minimize effects on species at risk that may utilize mine infrastructure.		Accepted	n/a
IR-134	-	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale**: The draft EIS states in multiple places that vegetation clearing may occur year-round. In order to correspond with the timing of emergence from hibernation, tree clearing should not be conducted during the bat roosting period. If maternity roost trees are removed after pregnant females have established a roost area, there is a higher likelihood of abortion than there would be otherwise. Species-specific mitigations are required to protect bat SAR.	Provide important roosting dates for bat species at risk in the Project area.	The Proponent provided a complete response regarding the roosting dates for bat species at risk, however follow-up IRs are required. See follow-up IR-134-R1.	Accepted	n/a
IR-134	IR-134-R1	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context:** The Proponent has committed to conduct pre-construction and pre-clearing surveys for multiple species, however the timing and methods for the surveys were not provided. Knowing the survey methodology for pre-construction and pre-clearing for little brown myotis and northern myotis is important for assessing cumulative impacts, effectiveness of adaptive management strategies as well as determining how bat species were considered in the EIS. **Rationale:** ECCC can determine whether the methodology the Proponent will use to collect data is appropriate and if the methodology would contribute to a more complete understanding cumulative effects and adaptive management strategies. A clear outline of how timing has been considered and incorporated into the methodologies is required to understand how sensitive periods for bats, such as roosting, have been considered in the EIS. An understanding of the methodologies and how these sensitive periods are being considered is required to evaluate the	The information provided by the Proponent regarding the roosting dates and potential habitat for bats is complete, however, the information related to the pre-construction and pre-clearing surveys is missing details on important habitat features for bat species at risk. As two Species at Risk Act (SARA) schedule 1 listed bat species, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis) have been identified in the Project area, effects need to be identified, avoided, lessened and monitored.	Following a supplementary submission by Denison on July 8th, 2024, this IR has been resolved. The response on bats is sufficient.	Accepted	n/a

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					effectiveness of mitigation strategies and adaptive management strategies which are being developed by the Proponent.				
IR-135	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** The mitigation measures for birds and wildlife presented in the draft EIS are very general. Additional detail is required for a complete assessment of residual and cumulative Project effects to birds and wildlife. The Proponent has committed to providing a number of plans including, a Decommissioning Plan, a Spill Response Plan, a Waste Management Plan, a Surface Water Monitoring Plan, a Remediation and Closure Plan, a Radiation Protection Plan, a Soil and Vegetation Monitoring Plan, a Wildlife Monitoring Plan, and a Woodland Caribou Management Plan. In order to assess potential affects to migratory birds and wildlife from Project related activities, ECCC requires details on species-specific mitigation measures, and monitoring plans.	The following information should be included in the various plans and should be provided for review during the environmental assessment: 1. For all Project phases, describe the species-specific mitigation measures and responses to prevent and minimize effects on migratory birds or species at risk (SAR) birds and mammals that may utilize mine infrastructure. 2. Explain how light pollution will be managed and what specific mitigation measures will be used to minimize effects to migratory birds and SAR birds and mammals. 3. Provide details on what methods will be used for erosion control and how they will prevent sediment from entering waters frequented by migratory birds or SAR. Explain what actions will be taken if the erosion control measures are not successful. 4. Provide details on noise and other sensory disturbance monitoring and mitigations if noise levels surpass thresholds. 5. Describe time windows and species- specific mitigations related to maintenance activities such as vegetation management, road or building repair and stream crossing replacements.		Accepted	n/a
IR-136	-	CNSC	Soil Salvage Monitoring	Section 9.1.8.2	**Context:** The Proponent plans to salvage and stockpile soil and organic matter/peat in order to use it in reclamation activities during decommissioning. Periodic monitoring of the stockpiles is proposed to be conducted to verify that soil and organic matter/peat are delineated, stripped, handled, and stockpiled as recommended, and to evaluate the stability of salvaged soil, e.g., in relation to potential erosion and/or degradation. It is unclear whether monitoring includes soil quality in terms of concentrations of COPCs. **Rationale:** It is expected that project-related activities (road and airport traffic, drilling) can result in open-source (i.e., fugitive) dust and process-source dust (incl. radionuclides), which can accumulate and result in changes in soil quality of the stockpiled soil and organic matter/peat as described in Sections 9.1.4.2.2 and 9.1.4.2.3).	Please clarify if COPC concentrations monitoring is planned to be performed for stockpiled soil and organic matter/peat.		Accepted	n/a
IR-137	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat,	Section 9.2.1.3, Spatial and Temporal	**Context and Rationale:** The CNSC's Generic Guidelines for the Preparation of an EIS Pursuant to the Canadian Environmental Assessment Act, 2012 states that: "The EIS will describe the spatial boundaries, including local and regional study areas, for	Provide a biologically relevant rationale for the delineated study boundaries (LSA and RSA) for all different valued components. Include the following information:		Accepted	n/a

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			Vegetation and Wetlands	Boundaries for Vegetation and Ecosystems, Listed Plant Species and Wetlands Section 9.3.1.3.1, Spatial Boundaries for Ungulates, Furbearers and Woodland Caribou 9.4.1.3.1, Spatial Boundaries for Raptors, Migratory Breeding Birds, and Bird Species at Risk	each VC to be used to assess the potential adverse environmental effects of the Project and provide a rationale for each boundary. Spatial boundaries will be defined taking into account the appropriate scale and spatial extent of potential environmental effects, community knowledge and Indigenous knowledge, current or traditional land and resource use by Indigenous groups, ecological, technical, social and cultural considerations.” The information provided in the EIS does not enable a biologically relevant assessment of the Project’s effects. The Proponent did not provide rationale for the selection of study areas for individual vegetation, wildlife or migratory bird valued components (VC). Different VCs may have different spatial boundaries for the LSA and/or RSA. For wildlife and bird VCs, the LSA is defined as a 1.7-km buffer from the Project area, and the RSA is defined as a 6.6-km buffer around the LSA. There is no information on how the spatial boundaries were derived. Specific to Woodland Caribou, boreal population (hereafter referred to as boreal caribou): <u>Project Footprint</u>: In a scientific assessment of critical habitat (Environment Canada, 2011) [1] ECCC demonstrated that the application of a 500-m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale. Adding a 500-m buffer to the Project footprint is required to represent functional habitat loss. The draft EIS does not appear to use a buffer for their Project area. The draft EIS (Section 9.3.1.3.1) states: “Project Area: the area within which the Project and all components/activities are located (i.e., the area of maximum physical disturbance). The Project Area covers 169.6 ha and is not VC-specific, but consistent throughout the EA.” (p. 9-168) <u>LSA</u>: The defined LSA for boreal caribou has to consider avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance. This required information is not detailed in the draft EIS. Adverse effects of Projects including predator and prey access to undisturbed areas, reduction in connectivity, and sensory disturbance to individual boreal caribou can vary and extend several kilometers depending on Project activities and ecological context. At minimum, the LSA should capture the above- mentioned effects. For boreal caribou, the Project footprint should be defined as the immediate area to be cleared, plus a 500-m buffer to represent functional habitat loss. Following this guidance, the LSA should be defined as a buffer of the Project footprint with the 500-m buffer.	• Descriptions of how the RSA and LSA boundaries were derived for all VCs. Specific to boreal caribou: <u>Project Footprint:</u> • Include a 500-m buffer of area of maximum physical disturbance to represent functional habitat loss for boreal caribou <u>LSA</u>: • Include a description of how the LSA takes into account boreal caribou avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance to individuals. <u>RSA</u>: • Include a description of how the RSA used in the draft EIS is an accurate representation of the SK1 boreal caribou range; **or** • Re-do the assessment with the RSA at the scale of the range See also related IRs: IR-154 and IR-156.			

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					RSA: The Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada states: *Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:* • *Assess the impact of all disturbances (anthropogenic and natural) at the range-scale;* • *Monitor habitat conditions, including the amount of current disturbed and undisturbed habitat, and amount of habitat being restored;* • *Account for planned disturbances; and* • *Assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.* The proposed Project's cumulative effects for boreal caribou are possible at the scale of the SK1 boreal caribou range. The RSA used for boreal caribou for this Project is only 40,173.6 ha, compared to the SK1 range, which is 18,034,870 ha. As such, it is too small to capture cumulative effects to this species and does not follow the Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) or the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. **Reference**: [1] Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011).				
IR-138	-	CNSC	COPC in Lichen	Section 9.2.4.2.2 Appendix 10-A (ERA)	**Context:** A quantitative assessment using modelling dispersion and uptake of COPCs in the environment was completed for the Project as part of the ERA, to support conclusions drawn in the EIS. In Appendix 10-A (ERA), COPCs in plant tissue was estimated for lichen. Table 5-5 of the ERA (p. 5.24) named "Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model" lists the exposure pathway for lichen as direct contact on soil. **Rationale:** Airborne COPC can deposition on lichen and subsequently enter the food chain; therefore, the "contact with air" pathway should be considered. In fact, lichen species are frequently used to monitor the deposition and accumulation of airborne contaminants (e.g., dust, metals). It is also noted that based on sampling results of the 2017 baseline studies, lichen frequently contain higher concentrations of COPC than blueberry (compare Table 9.2-6 and Table 9.2-7 in the EIS), especially at sampling sites with elevated concentrations (e.g., RSV9 and RSV10).	Please include the exposure pathway of direct deposition (dry and wet) of airborne contaminants on lichen in the quantitative ERA, or justify why this exposure pathway was not considered. See also related: IR-189.		Accepted	n/a
IR-139	-	ECCC	Change to an environmental	Section 9.2.5.2.7, Waste and	**Context:** In this section, the Proponent outlines various measures to mitigate air emissions, including implementation of the air quality programs within the	Confirm if vehicles and equipment will be equipped with Tier 4 engines where feasible.	Response is accepted, but also see AD-55 in the Advice to Proponent table.	Accepted	n/a

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			component due to hazardous contaminants	Hazardous Materials Management	Environmental Management System, regular maintenance and inspection of equipment, and elimination of unnecessary idling of equipment. However, the intention to use industry-standard emission control systems has not been substantiated. **Rationale:** For the protection of air quality, it is important to specify the emission standards that equipment will have (e.g., Tier 3 or Tier 4 engines). Vehicles and equipment with Tier 4 engines have much lower emissions of contaminants than those with Tier 3 engines. If non-Tier 4 engines are used, ECCC recommends that best management practices are followed, including proper maintenance of the engine and anti-idling measures.				
IR-140	-	CNSC	Change in the Areal Extent of Wetlands	Section 9.2.6.4	**Context:** Predicted residual effects on the areal extent of wetlands include the direct effect of loss of wetlands and several indirect effects of alteration of wetlands. As stated in the EIS, wetlands can exhibit low resilience and high susceptibility to disturbance. At the same time, wetlands tend to support a high species diversity, and are considered to have a moderate to high potential to support listed plant species. Lastly, wetlands are rare on the landscape compared to terrestrial ecosites (see Table 9.2-5). **Rationale:** Several wetland ecosites (BS19/24, BS25, BS27) occur only in small areas (< 30 ha) in the RSA but are predicted to experience disturbance of 6-64%, most notably the ecosite BS19/24 where 0.8 of 1.2 ha are predicted to be disturbed. It is noted that wetlands are scattered throughout the landscape as shown in Figure 9.2-8. More information is requested regarding the ecological impact of this disturbance.	1. Please provide a discussion on the ecological impact of disturbance to rare wetland ecosites. 2. Please provide information on whether adequate other habitat is available for species impacted in these disturbed sites in close proximity, taking into account the home ranges of susceptible species. 3. Please provide additional information on whether wetland connectivity is maintained through the landscape within the LSA/RSA. See also related: IR-141. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison conduct monitoring of species present in wetlands before and after disturbance, with a focus on listed plant species.		Accepted	n/a
IR-141	-	ECCC	Wetlands	Section 9.2.6.4.1	**Context and Rationale:** The Proponent states that: "Direct loss of wetlands has been mitigated by reducing the size of the Project Area to the extent practicable during Project design. However, up to 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA are anticipated to be removed from the Project Area during Construction (Table 9.2-16)." Information is not provided on whether wetlands in the terrestrial RSA are considered ecologically, economically or socially important to the region. Information on the regional importance of the wetlands that will be lost is needed in order to assess effects, including a wetland compensation plan if the wetlands are considered regionally important.	1. Provide information that accounts for whether wetlands are considered ecologically, economically and socially important to the region. 2. If the above is affirmative provide a wetland compensation plan to offset the loss. Consistent with the Operational Framework For Use of Conservation Allowance [1] a minimum ratio of 2:1 should be the starting point when determining the amount to be offset. [1] Available at : https://publications.gc.ca/site/eng/9.696852/publication.html See also related: IR-138.		Accepted	n/a

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IR-142	-	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.3.2.1 Scientific Literature Review – Wolverine Section 9.3.5 Mitigation Measures Section 9.3.6 Residual Effects Evaluation	**Context:** The Proponent did not conduct any field work to identify potential wolverine dens in the Project area and therefore did not present any mitigations for the potential impacts to wolverine dens. In Section 9.3.3.2.1, the Proponent states: "Denning females are sensitive to disturbance during denning season in February to April and may abandon their dens and, in some cases, their litter, which may decrease their reproductive success. " In Section 9.3.6, the Proponent states: "In the Project Area, 145.0 ha or 100% of available wolverine habitat is assumed to be removed and will not be available to wolverine for the duration of the Project (Table 9.3-13). Similarly, 145.0 ha (3.4%) of available wolverine habitat within the Wildlife LSA is anticipated to be removed, all from the Project Area, during site clearing in Construction. In the Terrestrial RSA, up to 0.5% (145.0 ha; from the Project Area) of available wolverine habitat is anticipated to be removed during site clearing in Construction." The residual effect assessment estimates that 8.2% of available wolverine habitat within the Terrestrial RSA may be altered or lost (Table 9.3-20). **Rationale**: As Wolverine is a Species at Risk Act Schedule 1 listed species, effects need to be identified, avoided, lessened and monitored. Mitigations, such as setback distances, should be used to protect important habitat features, such as dens. Wolverine occupy large home ranges and, therefore, need vast tracts of undisturbed land to maintain viable populations. The species avoids most human footprint types and linear features.	1. Please provide additional information on whether the lost and/or altered wolverine habitat overlaps with wolverine home ranges. 2. Describe any important wolverine habitat feature (i.e., dens) that may be lost as a result of the Project. 3. Assess the need for pre- construction/pre-clearing surveys to identify any wolverine denning sites. 4. Please provide additional information on whether the remaining, available, undisturbed wolverine habitat size is suitable to maintain populations.	The information provided by the Proponent is complete, however, a follow up IR regarding survey methods for all pre-construction and pre-clearing surveys is required. See follow-up IR-142-159-167.	Accepted	n/a
IR-142 IR-159 IR-167	IR-142-159-167-R1	ECCC	Wildlife and Wildlife Habitat	**Reference to EIS:** Section 9.3.3.3, Baseline Studies Section 9.3.5 Mitigation Measures IR 142, 159, and 167 Responses from Denison	**Context:** The Proponent has committed to conduct pre-construction and pre-clearing surveys for multiple species, however the timing and methods for the surveys were not provided. **Rationale:** Knowing the survey methodology for pre-construction and pre-clearing surveys across multiple species is important because the Proponent is intending to collect data so that ECCC can determine whether the methodology used to collect the data is appropriate and if the methodology would contribute to understanding cumulative effects and adaptive management. Understanding how timing has been considered and incorporated into the methodologies is required to understand how sensitive periods, such as nesting, breeding, foraging and migration, have been considered in the EIS. An understanding of the methodologies and how these sensitive periods are being considered is required to evaluate the effectiveness of mitigation strategies and adaptive management being developed by the Proponent for each species mentioned in IR-142, IR-159 and IR-167.	Provide survey methodology and timing for all preconstruction and pre-clearing surveys, including avian and species at risk surveys (caribou, wolverine).	The Proponent notes that they will use visual searches for several bird SAR. This includes Bank Swallow, Barn Swallow, Common Nighthawk, and Horned Grebe. While visual observations are an appropriate method for detecting Barn and Bank Swallow nests, it is not suitable for detecting Common Nighthawk. The province of Saskatchewan provides appropriate protocols for detection of Common Nighthawk. The Proponent also notes that they will conduct call-playback or visual searches for Olive-sided Flycatcher and Short-eared Owl. While the call-playback surveys would be more likely to detect individuals in areas to be cleared, the visual searches are unlikely to be effective for these species. The Proponent should consider following the provincial detection survey protocols for Short-eared Owl and Olive-Sided Flycatcher. In order to resolve this IR, Denison are expected to: 1. Modify the Table in "Attachment IR-142, IR-159, IR-167-R1 (Round 3)" to incorporate appropriate protocols for detection of Common Nighthawk, Short-eared Owl, and Olive-Sided Flycatcher, as suggested by ECCC. 2. Incorporate the Table into the EIS documentation, e.g., Appendix 9-D.	Not Accepted	**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments and updated EIS sections associated with the IR response in this table are available in Appendix A.** 1. To address this part of the Round 4 IR, the wildlife species at risk pre-clearance sweep methods and timing table (now included in the final EIS Appendix 9-D as Table 4-1) has been

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							3. Update any related commitments for pre-clearance / pre-disturbance surveys in their commitments register. See also AD-77 in the Advice to Proponent table.		updated. Refer to Appendix A. In this table, the column "survey techniques" has been updated as follows: - common nighthawk – "visual search" changed to "call-playback" - short-eared owl – "call-playback or visual searches" changed to "call-playback." - olive-sided flycatcher – "call-playback or visual searches" changed to "call-playback." A reference to the Saskatchewan SDSPs have been added to the last column of Table 4-1. Finally, a footnote has been added to the table: "Surveys will be completed by qualified professional biologists; in their capacity as professional biologists, they will refer to available guidance such as the Saskatchewan species detection survey protocols to develop details of the surveys (e.g., selecting the appropriate time of day for the survey)." 2. The table is now available in the final EIS (Appendix 9-D Table 4-1). Refer to Appendix A.

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									3. Existing commitment 9-3 has been updated and now reads (additions in **bold**): "To adequately address potential effects, regardless of the wildlife, seasonal or species-specific sensitivities, pre-disturbance wildlife clearance surveys (i.e., not species-specific surveys) will be completed prior to any work commencing. Results of the wildlife clearance surveys will be used to inform the design and delineation/establishment of suitable setback distances (i.e., specific to species, habitat, life-cycle sensitivities), work delays and/or other species-specific mitigation measures at that location, with discussions with ENV as appropriate. **The details on the methodology of species-specific pre-clearance sweep protocols and timing are provided in the Appendix 9-D of the final EIS.**"
IR-143	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies	**Context and Rationale:** The baseline caribou data is insufficient to understand potential Project impacts to this species. Presence/absence detection was provided by camera traps, incidental observations, winter track and pellet survey. Additional information and analyses on caribou use of the landscape during all life stages of the Project area is required to assess impacts and to determine significance of impact from the Project to caribou.	Provide details on the baseline caribou data including: • Revision of map 9.3-8 to include all observations, categorized by type, season and year (see also IR-145); and • Description of seasonal use of the LSA, RSA and caribou range. • Description of Project areas used by caribou. • Description of future studies planned to assess habitat use by caribou. Include specific details on how many additional years of aerial surveys will be completed to assess the caribou baseline conditions.	See also AD-81 in the Advice to Proponent table.	Accepted	n/a

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						Utilizing additional data noted above and specified in IR-145, explain how caribou use of the area could be affected by the Project throughout all seasons and life stages (e.g., calving, post-calving, rutting, wintering). See also related: IR-152.			
IR-144	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies – map 9.3-8	**Context and Rationale:** The mapping of caribou observations during baseline studies provided in Figure 9.3-8, "Caribou Sign Observations in the Wildlife Study Areas," is insufficient to enable conclusions to be drawn. ECCC is not able to review the spatial aspect of caribou observations without a map of all available observations. Additional information is available, as stated in Section 9.3.3.3.3: *"A total of 200 observations were made between 2017 and 2019 and recorded as either caribou sign (i.e., tracks, pellets, and evidence of feeding activity based on ground feeding craters and arboreal feeding evidence) or photographs (collected through the wildlife camera study) to document caribou presence in the LSA and RSA. Most observations occurred in the Terrestrial RSA, with observations concentrated in the north and southeast portions.* *Three observations occurred in the southeast portion of the Wildlife LSA, and no caribou sign was observed in the Project Area. Figure 9.3-8 provides an overview of some caribou sign observed during the baseline studies."*	Update map 9.3-8 to show all caribou observations during baseline studies, broken down by type of observation (camera, incidental, pellet, track) and season/year when the observation was made. Include additional data from the Province of Saskatchewan (see also IR-145) to help characterize caribou use on a spatial map.	See also AD-81 in the Advice to Proponent table.	Accepted	n/a
IR-145	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Woodland Caribou	**Context and Rationale:** The Proponent has not provided sufficient information on how caribou use the landscape, including identification of areas for different life stages of caribou (calving, post-calving, rutting and wintering). The University of Saskatchewan published a report entitled Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield. This report contains information on habitat types that are used during different life stages. Additionally, Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 20202 [1] details habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The scientific literature review (Section 9.3.3.3.1) on Woodland Caribou states: "While calving areas have not been documented within the SK1 range, it is recognized that caribou may use open fen and treed bog habitat types for calving during the spring/summer period. In Saskatchewan, caribou habitat used during the calving season in the SK2 range demonstrated a strong selection for treed muskegs, but avoidance of jack pine, mixed hardwood stands, and roads (Dyke 2008)." ECCC is not able to verify the Proponent's effects assessment without sufficient information on important habitat or biophysical attributes for caribou within the study areas.	1. Provide, based off existing literature or available data and the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada: • information on known important habitat features or biophysical attributes in Project areas for different caribou life stages (calving, post-calving, rutting, wintering), • a map(s) of the type and spatial extent of important caribou habitat features or biophysical attributes of the study areas as defined in Appendix H of the Recovery Strategy, ○ mapping should be at the RSA/LSA level as well as larger-scale mapping at the scale of the Project footprint. 2. Assess the potential direct and indirect effects based on additional information on caribou from bullet A above. See also related IRs: IR-143 and IR-152. **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent contact the Province of		Accepted	n/a

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					[1] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/woodland-caribou-boreal-2020.html#toc0	Saskatchewan to enquire about obtaining caribou telemetry data in the Project area. The data can be analyzed to determine important habitat features in the Project area.			
IR-143 IR-144	IR-143-144-R1	ECCC	Wildlife and Wildlife Habitat	Section 9.3.3.3, Baseline Studies IR-143 and 144 Responses from Denison	**Context:** In the IR-143 response, the Proponent states: “As described in the EIS, caribou may use open fen and treed bog habitat types for calving during the spring/summer period. Information from Indigenous Knowledge (IK) was included in the EIS, including potential calving areas in the Terrestrial RSA.” The Proponent provided a revised Map 9.3-8 to display these features. **Rationale:** While the revised Map 9.3-8 shows seasonal use, it is challenging to see the overlapping spatial and temporal features. The map is not adequate for fully understanding the seasonality of the data. The scale provided does not allow for a proper assessment of seasonal use, including differentiation of habitat use such as calving, movement or wintering habitats. Some habitats, based on use, may be more used for more critical functions than others and this information cannot be adequately assessed based on the information provided.	Provide individual maps by season and survey type or with larger scale insets that show areas with overlapping spatial and temporal features.		Accepted	n/a
IR-143 IR-145	IR-143-145-R1	ECCC	Wildlife and Wildlife Habitat	Section 9.3.3.3, Baseline Studies IR-143 and 145 Responses from Denison	**Context:** Information presented on boreal caribou in the study areas in the Proponent’s response is insufficient to: • characterize and determine the risk of Project impacts, • and • calculate the appropriate level of offsetting required. Information on important habitat features and how caribou are using the landscape is required to complete an assessment of the Project impacts. Although the Proponent provided a map showing telemetry points (provided by the Province of Saskatchewan), the map lacked sufficient detail to assess habitat use and important biophysical features of the Project area. The IR-145 response states: “Available habitat was determined as the ecosites in which caribou / caribou sign were detected most frequently during the baseline studies, and the EIS used a precautionary approach by assuming caribou use of these areas during all seasons and life stages.” As a part of the analysis, calving areas are particularly important to delineate if information is available as a key part of all life stages. In the draft EIS, the habitat types that are considered non-habitat for caribou are open bogs (BS20), leatherleaf shrubby fens (BS22), graminoid fens (BS24), open	1. Provide maps at the Project Development Area (PDA)/Local Study Area (LSA)/Regional Study Area (RSA) scale showing caribou habitat quality. 2. Provide maps at the PDA/LSA/RSA scale showing areas with the appropriate biophysical attributes for calving and other life stages, such as important wintering habitats and movement corridors. Indicate the source of telemetry data (i.e., University of Saskatchewan and/or the Province of Saskatchewan).		Accepted	n/a

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					fens (BS25), rush sandy shorelines (BS26), sedge sandy shorelines (BS27) and waterbodies. **Rationale:** Woodland caribou are known to use treed bog and open fen (Section 9.3.3.3.1 of the draft EIS), however open fens and bogs are excluded from the identified available Woodland Caribou habitat, based on not detecting presence or not detecting presence as frequently. Mapping of important caribou habitat features is required to assess important potential impacts to caribou. In the absence of telemetry data, mapping of habitat quality, based on a combination of known ecosites and known important biophysical features will provide a reasonable alternative where known important caribou habitat features cannot be mapped.				
IR-146	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3.1, Woodland Caribou, Scientific Literature Review - Predation	**Context and Rationale:** The information on impacts of predation and apparent competition for caribou in relation to the proposed Project are insufficient. In the section on caribou predators (9.3.3.3.1), the Proponent provided details on densities of wolves and their overlap with caribou and speaks of apparent competition. The Proponent did not examine other predators, such as black bear. The analysis on impacts of predation and apparent competition is insufficient since known predators have been omitted without explanation from the assessment of effects. ECCC is not able to verify the Proponent's effects assessment since important species have not been considered in the assessment.	Provide further information and analyses on all potential predators of caribou, including impacts from apparent competition.		Accepted	n/a
IR-147	-	ECCC	SAR – Boreal Caribou	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** The process of in-situ recovery mining will likely create changes to the surface topography and potential ground subsidence as well as changes to groundwater elevations. These changes can affect the plant communities and ecosite types. In Section 9.3.4.2.1 the Proponent states that: "Following decommissioning and reclamation, wildlife habitat is expected to recover to baseline conditions." A more thorough explanation regarding post-decommissioning landscape is required to assess Project impacts.	1. Provide further rationale and/or analysis regarding the return of wildlife habitat to baseline conditions post-decommissioning. Incorporate other environmental impacts including: • Ground subsidence and impacts on wildlife habitat • Changes to aquifers and impacts on wildlife habitat 2. Describe reclamation activities/measures, including temporal information that will be implemented to help in the recovery to baseline conditions.		Accepted	n/a
IR-148	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** ECCC analyzes disturbance for caribou at the range level, in this case within the SK1 range. However, the Proponent did not provide an adequate assessment of total disturbance at the range level. The draft EIS (Section 9.3.4.2.1 p. 9-211) reads: "The SK1 Boreal Shield Woodland Caribou Management Unit has relatively low levels of anthropogenic disturbance and was exposed to large fire disturbances in the past 40 years (ECCC 2019). Environment and Climate Change Canada (2019) identified this caribou population as being self-sustaining at a threshold of 40% undisturbed habitat with the total anthropogenic disturbance not exceeding 5% of their habitat. The current anthropogenic disturbance levels (without areas burnt by past forest fires) for the study areas are below this	Provide the following in order to support analysis of habitat disturbance: 1. Calculation of total disturbance including natural and anthropogenic disturbance at the range level. 2. Description of effects on existing habitat at the scale of the range (for < 40% undisturbed habitat in the SK1). Include: • an account (and GIS file if available) of existing habitat affected, using the following formula:		Accepted	n/a

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					threshold (with the exception of the already disturbed Project Area) and are estimated as: 24.8 ha (14.6%) for the Project Area, 168 ha (3.5%) for the Wildlife LSA, and 599 ha (1.5%) for the Terrestrial RSA." Analysis of habitat disturbance should be calculated at the range level in order to assess impacts and determine significance. Analysis should be consistent with the methodology described in the document Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) [1]. [1]https://publications.gc.ca/site/eng/401605/publication.html, p. 28/41	(Project footprint + 500m buffer) – overlapping (permanent alteration(s) + 500m buffer) 3. A map of the SK1 range showing all disturbed and undisturbed habitat, including predicted disturbance (direct and indirect) resulting from the Project. 4. Description of whether the Project is expected to compromise the ability of the range to be restored to the undisturbed habitat threshold, and provide a rationale for the conclusion. See also related: IR-154.			
IR-149	-	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.5.2, Additional Wildlife- specific Mitigation Measures	**Context:** The EIS describes that ongoing research is performed to inform the development of a Woodland Caribou Management Plan. This includes studies on the effectiveness of linear disruption features on predator/prey movements, and a field program for long-term reclamation planning. Moreover, it is stated that the Plan will include a detailed assessment of the need for habitat offsets. The draft EIS Section 9.3.5.2 states: "A wildlife monitoring plan and a Woodland Caribou Management Plan will be developed to address wildlife-specific mitigation measures based on proven and accepted mitigation following standard industry guidelines and BMPs. The plans will provide guidance to avoid or minimize potential adverse effects of the Project on wildlife and wildlife habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered." **Rationale**: The draft EIS does not present sufficient species-specific mitigation measures for boreal caribou. ECCC is not able to assess potential residual impacts to caribou without specific mitigations. Since the Woodland Caribou Management Plan is still under development, it is difficult to judge whether the measures will be adequate to mitigate and/or offset potential project effects on Woodland caribou and its critical habitat.	Provide the Woodland Caribou Management Plan, to demonstrate effective mitigation of potential project effects, along with wildlife-specific mitigation measures for review. The Plan should be informed by and consistent with the Boreal Caribou Recovery Strategy and demonstrate that avoidance and minimization measures will be applied to mitigate for predicted Project effects to boreal caribou and its critical habitat prior to considering offsetting measures. That is, the Plan should follow the mitigation hierarchy and information should be provided as outlined below: 1. AVOID: Describe all measures that will be taken to avoid effects to boreal caribou and avoid the destruction or alteration boreal caribou critical habitat. 2. MINIMIZE: Describe all measures that will be taken to minimize the effects to boreal caribou and minimize the destruction of boreal caribou critical habitat. 3. RESTORE ON-SITE: describe the measures that will be taken to restore disturbed areas of the Project, related to construction, operation and maintenance, on boreal caribou critical habitat, remaining after considering the avoidance and minimization measures. 4. Characterize the risk of the adverse effects that are likely to result from the Project on boreal caribou and its critical habitat after avoidance minimization, and onsite restoration measures have been considered. 5. OFFSET: Describe the measures that will be implemented outside the Designated Project area to mitigate adverse effects, destruction or alteration of boreal caribou critical habitat by the Designated Project during construction and operation.	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided. See also AD-83 and AD-85 in the Advice to Proponent table.		

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						6. Characterize the risk of the adverse effects that are likely to result from the Project on boreal caribou and its critical habitat after avoidance, minimization, onsite restoration, and offset measures have been considered. Describe all relevant uncertainties on the effectiveness of the measures to address adverse effects on boreal caribou and the rationale for the selected measure, in light of the mitigation hierarchy. See also related IRs: IR-157.			
IR-149	IR-149-R1A	ECCC	Wildlife and Wildlife Habitat	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149 IR-149 Response by Denison	**Context:** Much of the information presented in the Conceptual Caribou Management Plan is qualitative in nature and does not present specific details regarding a quantitative assessment of impacts following measures to avoid, minimize, and restore on-site and then assess residual effects and determine the offset required to counterbalance the remaining impacts. This is required to understand if offsetting is sufficient to address impacts to caribou. The Proponent also does not provide details on methods that will be used for pre- disturbance wildlife clearance surveys. ECCC is aware that that the Proponent will be participating in restoration trials as part of the 'Developing Eco-restoration Together' program. **Rationale:** ECCC requires the quantitative details on the assessment of impacts to be included within the Conceptual Caribou Management Plan to adequately assess how the Proponent has applied the mitigation hierarchy. Details on the methods that will be used for pre- disturbance wildlife clearance surveys will also be required to verify that the Proponent has adequately considered how they have avoided, mitigated, or restored impacts to caribou. While ECCC understands that the Proponent will be participating in restoration trials as part of the 'Developing Eco-restoration Together' program, however, more clarity on the Proponent's role in the program and the scope of the program is required. Details such as how the outcomes of these programs will result in mitigation measures and offsetting requirements and additional clarity on the scope of the program should also be provided so that ECCC can understand the objectives and deliverables of the program.	1. Provide a quantitative assessment of impacts following measures to avoid, minimize and restore on-site and then assess residual effects and determine the offset required to counterbalance the remaining impacts. 2. Provide details on methods to be used for pre-disturbance wildlife clearance surveys. 3. Provide details on the Proponent's role in the Developing Eco-restoration Together program and how that work may be used in offsetting requirements. 4. Provide the scope (i.e., quantitative habitat amount) of the Eco-restoration Together program.	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided. See also AD-82 and AD-85 in the Advice to Proponent table.		
IR-149	IR-149-R1B	ECCC	Wildlife and Wildlife Habitat	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149 IR-149 Response by Denison	**Context:** Section 4.2.2 of the Conceptual Caribou Mitigation plan states: "locating excessive noise generating activities such as the concrete batching operation as far away from sensitive wildlife locations as possible;". However, no specific mitigation measures are mentioned for impacts to caribou due to noise generated from the Project air strip. **Rationale:** Noise from the air traffic using the air strip will also generate excessive noise that can impact caribou. Additional information on the timing and frequency of air traffic, as well as specific mitigations related to impacts from air traffic,	1. Provide additional information on the timing and frequency of air traffic using the Project air strip. 2. Provide specific mitigations related to impacts from air traffic, including mitigations related to frequency and timing of flights.	Following the supplementary submission provided on July 8th, 2024, as well as the commitment (ID 9-36) provided in version 2 of the Commitments Register (July 17, 2024), this IR is accepted for the purposes of the EA review. However, the following must be corrected in the final EIS submission package: • Update the caribou management framework (EIS Appendix 9-E) to reflect the additional information and proposed mitigation measures, in the final EIS submission package. See also AD-78 and AD-85 in the Advice to Proponent table.	Accepted	n/a

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					including mitigations related to frequency and timing of flights, will be necessary to evaluate impacts to caribou due to air strip noise.				
IR-150	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.5.2.1, Best Management Practices for working in Boreal Woodland Caribou Range in Saskatchewan	**Context and Rationale:** In the draft EIS Section 9.3.5.2.1, the Proponent states: "Denison proactively initiated research to provide field-based findings on the effectiveness of linear disruption features on predator/prey movements." "Results will help the development of proactive and meaningful restoration strategies as an ongoing part of the overall Project (Omnia 2022). Additionally, the 2023 field program will support a program that uses the results from the 2021/2022 Caribou Trail Study in long-term reclamation planning. The program will be led by the University of Saskatchewan and is funded by Denison, an Indigenous-owned environmental company, the Northwest Communities Environmental Services (Métis owned), Mitacs, and the Natural Science and Engineering Research Council of Canada through an alliance grant. The Caribou Trail Study and the reclamation plan will culminate with the development of a Woodland Caribou Management Plan." ECCC is available to support the Proponent through review of study programs should those programs be made available during the review process. ECCC requests to see the 2021/2022 study to further our review of caribou use in the Project area.	Provide the report for 2021/2022 Caribou Trail study for long-term reclamation planning for ECCC review.		Accepted	n/a
IR-151	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4	**Context and Rationale:** In the analysis of residual and cumulative effects for woodland caribou, information and analyses on impacts to connectivity and movement across the landscape is lacking.	1. Using available reports and data, provide an analysis of impacts to landscape connectivity for woodland caribou at the LSA and Range scales. 2. Determine whether the Project is expected to result in a reduction of connectivity within or between the ranges and provide a rationale for the conclusion. Describe how movement corridor(s) may be affected by Project activities and infrastructure.		Accepted	n/a
IR-152	-	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4, Appendix 9-B	**Context:** Baseline studies for Woodland caribou include: • Winter Track Count Survey to assess presence, abundance, feeding activity, and ecosite affiliation; • Pellet Group/Browse Availability Survey to detect presence and abundance of caribou, and frequency of occurrence and abundance of lichen; • Covert Camera Survey to determine presence and use of linear features (roads, trails, and hand-cut lines). The Saskatchewan Conservation Strategy for Boreal Woodland caribou [1] states that caribou are very susceptible to predation during the calf-rearing period, and populations are extremely sensitive to even minor changes in mortality rates. **Rationale:** It is unclear if, or how, any data on seasonal and spatial use of habitat was considered in the residual effect analysis, for example summer/winter home	Please provide a summary of available baseline data on habitat use during all seasons and life stages, in particular sensitive stages such as calving, and how habitat use during all seasons and life stages was considered in the residual effect analysis. See also IR-145 and IR-143.	See also AD-82 in the Advice to Proponent table.	Accepted	n/a

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					ranges, sensitive life stages including calving (e.g., location of calving sites). It should be noted that the English River First Nation have identified caribou calving areas in the vicinity of the Project footprint. **Reference**: [1] Saskatchewan Ministry of Environment. 2013. Conservation Strategy For Boreal Woodland Caribou (Rangifer tarandus caribou) in Saskatchewan. Saskatchewan Ministry of Environment. Fish and Wildlife Technical Report 2014.				
IR-153	-	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4.1	**Context:** According to ECCC (2020), forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g., through loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and other food sources, although they may make limited use of burned areas to feed on new growth. The residual effects evaluation of alteration and/or habitat loss lists ecosites BS3 and BS7 (regenerating forest types) as available habitat in Table 9.3-22, which represent 43.5% of the Regional Study Area. **Rationale:** It is unclear whether the ecosites BS3 and BS7 (regenerating forest types) represent suitable habitat for Woodland caribou year-round. More information is required on the habitat quality (e.g., time since last forest fire) and suitability for different life stages of caribou. For conservatism, it is recommended to perform a second residual effect analysis not including regenerating forest ecosites.	1.Please provide further information on the suitability of ecosites BS3 and BS7 for Woodland caribou in different life stages. 2. Please provide the results of a residual effect analysis not including ecosites BS3 and BS7 for conservatism. 3. If 2 leads to habitat fragmentation, consider connectivity of habitat patches in the residual effect analysis.		Accepted	n/a
IR-154	-	CNSC	Woodland Caribou Alteration and/or Loss of Habitat	Section 9.3.6.4.1	**Context:** Lichen, the primary food source for Woodland caribou (up to 70% of the year-round diet), can be exposed to airborne contaminants and dust deposition at distances of 1–40 km (e.g., increased metal concentrations or dust were detected in lichen at distances of 1–40 km from a mine site [1, 2]). **Rationale:** Further information is requested on how the potential for contamination of the food source “lichen” is reflected in the applied buffers of direct and indirect disturbance for woodland caribou. **References**: [1] Watkinson et al. (2021). Effects of dust deposition from diamond mining on subarctic plant communities and barren-ground caribou forage. Journal of Environmental Quality 50(4): 990-1003. Doi: 10.1002/jeq2.20251. [2] Chen et al. (2017). Does dust from arctic mines affect caribou forage? Journal of Environmental Protection 8(3): 258-276. Doi: 10.4236/jep.2017.83020.	1. Please provide additional justification for how the potential for contamination of the food source “lichen” is reflected in the applied buffers for sensory disturbance. See also related IRs: IR-137, IR-148 and IR-156. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • COPC in Lichen monitoring is recommended in transects from the Project site to assess COPC concentrations and confirm whether the chosen buffer is conservative.		Accepted	n/a
IR-155	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1, Alteration and/or Loss of Habitat	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent presents figure 9.3-14 and table 9.3-22, which “depicts available woodland caribou habitat in the Project study areas” and provide a summary of available Woodland Caribou	1. Provide a biologically relevant explanation about how available caribou habitat was determined or determine		Accepted	n/a

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					Habitat in the Project Area, Wildlife Local Study Area, and the Terrestrial Regional Study Area. The Proponent does not provide a biologically relevant explanation on the ecosites that are considered available woodland caribou habitat. According to the amended recovery strategy for Caribou, all habitat within SK1 range has been designated as critical habitat. To align with best current knowledge and the amended recovery strategy, the map and table should show the biophysical attributes, as outlined in Appendix H of the recovery strategy.	available habitat based on new data from the province of Saskatchewan (See IR-145). 2. Consider referencing Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 to define important biophysical features.			
IR-156	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1 Section 9.3.7.3.1	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent identified that 142 ha of available caribou habitat within the Project footprint will be directly impacted or lost, while an additional 1,165 ha will be indirectly impacted by Project activities such as sensory disturbance. They assessed the residual and cumulative effect of alteration to habitat for woodland caribou as not significant: "The residual effect of alteration and/or loss of available woodland caribou habitat is not expected to result in a change that will alter caribou habitat integrity to the point where it would not be able to sustain the regional woodland caribou population. Therefore, the effect is assessed as not significant." Section 9.3.7.3.1 of the draft EIS states: "It is not expected that the cumulative effects of alteration and/or loss of habitat will alter the integrity of woodland caribou habitat within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions. Therefore, the cumulative effects resulting from the Project's residual effect interacting with residual effects from other projects and activities is predicted to be not significant." For the residual effect of alteration and/or loss of available caribou habitat (Section 9.3.6.4.1, Table 9.3-24), the Proponent assessed the magnitude as low, the geographic extent as local, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high and the likelihood as likely. The rationale provided by the Proponent is insufficient to determine the accuracy of these assessments, given the lack of data and the small size of the assessment area. ECCC does not support the residual effects assessment of low magnitude, given the uncertainties related to seasonal use by caribou in the Project area and the current level of disturbance in the SK1 range. For the cumulative effect of alteration and/or loss of available caribou habitat (Section 9.3.7.3.3 , Table 9.3-30), the Proponent assessed the magnitude as moderate, the geographic extent as beyond the RSA, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high, the likelihood as likely, the significance as not significant and the level of confidence as moderate. The rationale provided by the Proponent is insufficient to determine the accuracy of these assessments, given the lack to data presented for caribou and the small size of the RSA, compared to the SK1 region. ECCC does not support the conclusion of the cumulative effects assessments or for the level of confidence.	Provide a revised assessment of residual and cumulative effects, taking into consideration that the disturbance within the SK1 range is above the disturbance management threshold required for survival and recovery of the species. See also related IRs: IR-137 and IR-154.		Accepted	n/a

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					The Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 states that the range is currently at the 60% disturbance management threshold. Therefore, any activity likely to result in the alteration or destruction of critical habitat may impact on the species survival and recovery. In addition, the Proponent's assessment was based on information that was lacking data on calving, wintering and rutting areas, and connectivity and caribou movements. The absence of considerations of the regional context of disturbance does not provide a conclusion based on best available information.				
IR-157	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.9 Ungulates, Furbearer and Woodland Caribou Summary	**Context and Rationale:** The Proponent has committed to developing a Woodland Caribou Management Plan, which will include a "detailed assessment for the need for habitat offsets." The Woodland Caribou Management Plan will support ECCC's review of the Proponent's assessment of residual effects following mitigation and offsetting. This plan should consider ECCC's Operational Framework for Use of Conservation Allowances (ECCC, 2012). ECCC is available to assist the Proponent in the determination of appropriate offsets that would balance against Project adverse effects after the application of measures to avoid, minimize and restore on-site are adopted. Based on the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020, anthropogenic impacts to local caribou populations experience a lag effect, which occurs over extended periods. This lag effect needs to be adequately considered when proposing offsets. ECCC is available to assist the Proponent in understanding how critical habitat is described in the Recovery Strategy and the determination of appropriate offsets that would balance against Project effects based on the predicted impacts to caribou habitat.	Provide the Woodland Caribou Management Plan for review. The plan should clearly demonstrate efforts to avoid and minimize any Project effects and restore on-site any disturbed areas prior to the consideration of offsetting. Details on how severity of disturbance and vulnerability of the species were considered should be explained. See also related: IR-149. **Suggestions for mitigation and follow-up measures:** ECCC notes that the Woodland Caribou Management Plan should clearly explain efforts to address Project effects, including any contribution to cumulative adverse effects, after it has been determined that all options in the previous steps of the mitigation hierarchy (i.e., avoidance, and minimization,) have been fully considered and applied. In the Woodland Caribou Management Plan, provide details on how the factors outlined in the Operational Framework for Use of Conservation Allowances (ECCC, 2012) were considered in determining the offsetting amounts, including the severity of disturbance and vulnerability of the caribou population. Important factors including time lag (the amount of time from restoration work to when the habitat would be considered caribou habitat) would also need to be considered. ECCC typically recommends a minimum offset multiplier of 4:1 (offset outcome: area disturbed). This is a benchmark ratio applied to a project that is in the lower end of the risk spectrum, such as one with a low severity impact adversely affecting a low vulnerability ecological component. In general, the minimum 4:1 multiplier accounts for time-lags to restoration, uncertainty in outcomes, a precautionary approach, and the adverse impact itself in its specific context. Offset multipliers are variable and determined by project-specific circumstances and associated risks and uncertainties.	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided. See also AD-85 in the Advice to Proponent table.		

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IR-158	-	ECCC	Migratory birds	Section 9.4.1.2, Key Indicators and Measurable Parameters	**Context and Rationale:** In Section 9.4.1.2 the Proponent outlined key indicators for "Migratory Breeding Birds" which includes Waterbirds and Waterfowl, Upland Game Birds and Migratory Songbirds. These are broad categories, which do not allow for assessment of the variation in habitat requirements or ecology of individual species or guilds. **Updated Rationale:** The Proponent should identify additional focal species that can serve as indicator species by representing anticipated impacts to a broader guild of species. Indicator species should be demonstrably sensitive to the potential effect of interest, and suitable for inferring effects on other species. Species may be grouped into guilds for assessment based on similarities in ecology or vulnerability to Project effects, such as species at elevated risk of collision with vehicle traffic. By identifying focal species or guilds for each key indicator species within the Migratory Breeding Birds Valued Components (VCs), ECCC would be able to accurately review the Proponent's assessment of impacts and mitigation measures in order to assess the accuracy of the Proponent's conclusions and provide expert advice on the mitigation measures.	Identify focal species/guilds for each key indicator species within the Migratory Breeding Birds valued components. Provide an updated analysis of Project effects on migratory birds.	See also AD-79 in the Advice to Proponent table.	Accepted	n/a
IR-159	-	ECCC	Migratory birds	9.4.3.2.3 Baseline Studies – Migratory Songbirds Appendix 9-B, Section 2.10.2, Results	**Context and Rationale:** Information presented in the draft EIS is insufficient to accurately predict Project impacts to breeding birds. The Proponent collected a single year of breeding songbird point counts and aerial waterfowl surveys (including avian species at risk). A single year of surveys in which birds may be unusually scarce or abundant could severely compromise interpretation of post-construction monitoring data. Additionally, data presented in the draft EIS is from 2017 and ECCC advises that more recent data is needed for a comprehensive baseline to verify Project impacts. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal avian Modelling project contain information on avian densities and avian species at risk that could supplement field data. The national standard for major projects recommends a minimum of two years of field surveys to be provided, so that temporal variability can be considered when comparing post-construction against baseline records and other available data. **Updated Rationale:** ECCC recommends that for major projects, a minimum of two years of field surveys should be provided so that temporal variability can be considered when comparing post-construction against baseline records and other available data. More recent data is needed due to landscape changes that may have occurred since 2017 as well as cumulative effects that have occurred in that time. Additionally, if there was an unusually high population density of birds in 2017 due to extraneous circumstances, Project effects may be attributed to a non-	Supplement breeding bird point count data and aerial waterfowl data collected during 2017 with additional pre-construction field data or existing post-2017 data/modelling to provide a comprehensive baseline that can be used to verify Project impacts during construction and operational phases.	See also AD-80 in the Advice to Proponent table.	Accepted	n/a

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					existent decline in the population when the discrepancy can be due to natural variability. A more recent baseline will account for interannual variation and any regional effects and will allow for a more accurate review of mitigation and follow-up measures. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal Avian Modelling project contain information on avian densities and avian species at risk that could supplement field data.				
IR-160	-	ECCC	Migratory birds	Section 9.4.3.2.3 Baseline Studies – Migratory Songbirds	**Context and Rationale:** ECCC advises that the results of the field studies need to be interpreted/analyzed in the context of the study area. The Proponent presents results on areas with highest richness and diversity but does not make a link to habitat that will be lost or experience indirect effects. **Updated Rationale:** Results regarding the effects of the Project, including a discussion on habitat types that will be lost or indirectly impacted during the life of the Project, and a discussion on the overall impact on the avian community including results from baseline studies as well as other supplemental information as per IR-159 are required to assess the validity of the Proponent's conclusions and should be used in effects assessment.	Provide results interpreted in the context of Project direct and indirect effects. Include discussion on the habitat types that will be lost or indirectly impacted during the Project and the overall impact on the avian community, using results from the analysis of baseline studies and other supplemental data (as per IR-159). Discussion should support the conclusions of the effects assessment. See also related IRs: IR-161 and IR-162.		Accepted	n/a
IR-161	-	CNSC	Bird Species at Risk	Section 9.4.3.3 Appendix 10-A (ERA)	**Context:** For the assessment of effects on Bird Species at Risk (SAR), in the EIS it was decided to use representative species for certain SAR birds: • Olive-sided Flycatcher and Common Nighthawk were selected to represent Barn Swallow. • Yellow Rail and Rusty Blackbird were selected as substitutes for Horned Grebe. No further rationale is provided to demonstrate that the identified surrogate species are representative of the Barn Swallow and Horned Grebe in the EIS. For example, do they share a common diet? Moreover, in the residual effects assessment, limited discussion is provided on the conservatism of chosen suitable habitat types for both surrogate and represented species, in the calculation of habitat loss and alteration, as well as change in mortality. For example, how does habitat for Common Nighthawk and Barn Swallow overlap (do they use identical habitat types?) and how does this affect the calculation of habitat loss and alteration used to evaluate the magnitude of residual effect? Finally, in the ERA, Lesser Scaup is the surrogate for Horned Grebe. Yellow Rail is also represented by Lesser Scaup but Rusty Blackbird is represented by Olive-sided Flycatcher. **Rationale:** It is unclear what criteria were applied to select surrogate species for Barn Swallow and Horned Grebe, and how the chosen surrogates relate to Barn	1. Please provide additional information to justify the selection of surrogate species for Barn Swallow and Horned Grebe in the EIS. This should include a description of the similarity of SAR and associated surrogate species and any relevant uncertainties. 2. Please provide conservative estimates of habitat loss and alteration for the represented and not directly assessed species (Barn Swallow, Horned Grebe). 3. Please provide clarity as to why different surrogate species are used for Horned Grebe between the EIS and ERA. See also related IRs: IR-160 and IR-162.		Accepted	n/a

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					Swallow and Horned Grebe in terms of habitat type and range, nesting, and feeding requirements etc. There is also inconsistency with respect to the use of surrogate species for the Horned Grebe between the EIS and ERA supporting document.				
IR-162	-	ECCC	Migratory birds	Section 9.4.3.3, Bird Species at Risk	**Context and Rationale:** Not all avian species at risk present in the study area were included as Key Indicators in the avian species at risk (SAR) valued component (VC). Barn swallow and horned grebe were recorded in the study area, but not included as VCs. Additionally, bank swallow may inhabit the Project area. Impacts to Species at Risk Act Schedule 1 listed species need to be identified, avoided, lessened and monitored. In Section 9.4.3.3. the Proponent states: "It is acknowledged that the listed Barn Swallow (Hirundo rustica) and Horned Grebe (Podiceps auratus) could potentially occur in the Terrestrial RSA. Incidental observations occurred during the baseline studies (Appendix 9-B). To focus the effects assessment on a few key species (described in the following) it was decided to use Olive-sided Flycatcher and Common Nighthawk to represent Barn Swallow as well, and to use Yellow Rail and Rusty Blackbird as a substitute for Horned Grebe. Unlike Horned Grebe, Yellow Rail and Rusty Blackbird are also listed provincially." Barn swallow, bank swallow and horned grebe may have different nesting habitat requirements than the representative species discussed in the draft EIS. An explanation of how differing species are representative of one another is required, or if an explanation cannot be provided, the species should be assessed individually. **Updated Rationale:** The management plans for these three species demonstrate the variability in their habitat selection. The Management Plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada (Environment Canada, 2013) states "Yellow Rails inhabit shallow wetlands and other wet areas with grass-like vegetation. They breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes (Bookhout 1995, Alvo and Robert 1999, COSEWIC 2009), shallow prairie wetlands, and wet montane meadows (Peabody 1922, Sherrington 1994, Popper and Stern 2000). " The Management Plan for the Rusty blackbird (*Euphagus carolinus*) in Canada (Environment Canada 2015), states: "Rusty Blackbirds tend to select breeding sites with a combination of freshwater bodies with shallow water and emergent vegetation for foraging that are adjacent to wetlands with conifers or tall shrubs with cover for nesting (Matsuoka et al. 2010a, Matsuoka et al. 2010b, Greenberg et al. 2011)." The Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada (ECCC, 2022) states: "The Horned Grebe breeds in small	1. Explain how nesting habitat requirements of barn swallow is represented by common nighthawk and olive-sided flycatcher as a VC or assess individually each SAR that overlaps with the Project and is likely to be affected. 2. Explain how nesting habitat requirements of horned grebe are represented by yellow rail and rusty blackbird as a VC, or assess individually each SAR that overlaps with the Project and is likely to be affected. 3. Assess individually each SAR that overlaps with the Project and is likely to be affected. See also related IRs: IR-160 and IR-161.		Accepted	n/a

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					(generally 0.5 to 2 ha, but ranging from 0.24 to 18.2 ha), shallow (at least 20 cm deep, but on average 40 cm), and usually fishless, perennial wetlands, but they can also nest on larger lakes with shallow edges and sufficient emergent vegetation. Breeding sites usually contain at least 40% open water with beds of emergent vegetation, such as sedges (Carex spp.), rushes (Juncus spp.) and cattails (Typha spp.) (Faaborg 1976, Kuczynski et al. 2012, Routhier 2012, Stedman 2018)." Due to differing habitat selection and use, ECCC recommends that each selected VC is given an individual assessment with specific mitigation measures. This will allow for a more accurate review of the chosen mitigation measures.				
IR-163	-	ECCC	Migratory birds	Section 9.4.3.3.3, Baseline Studies – Avian species at risk VCs	**Context and Rationale:** The baseline studies and data analysis for species at risk (SAR) birds is insufficient to accurately predict Project effects. ECCC recommends the use of predictive modeling in relation to survey data and habitat attributes to produce distribution and density maps. Sites within the study area that support particularly high densities or diversity of an individual species, based on direct observation and, where appropriate, distribution or occupancy models, would greatly improve confidence in Project impact predictions. Additional information on specific habitat use or models of habitat used by SAR would facilitate a more complete analysis of Project effects.	Provide additional information, including mapping/modelling of specific habitat requirements for each avian species at risk or provide a justification of models used in the draft EIS.		Accepted	n/a
IR-164	-	ECCC	Migratory birds	Section 9.4.4.2.1, Alteration and/or Loss of Habitat – Migratory Breeding Birds	**Context and Rationale:** The discussion on impacts to migratory songbirds presented by the Proponent is not sufficient to understand the impacts on various guilds of birds (e.g., aerial insectivores, forest birds, wetland birds, habitat specialists). As per IR-158, focal representative species/guilds should be used as key indicators (KI) in the Migratory Breeding Birds Valued Component. A greater level of detail on Project impacts to migratory songbirds with differing habitat requirements is needed for a fulsome assessment of effects. **Updated Rationale:** A greater level of detail, including a discussion on impacts to different focal species and/or guilds within the Migratory Breeding Birds Valued Component, is required for a more fulsome assessment of effects and identification of mitigation measures. Additionally, mapping detailing important features or habitat types that will be lost due to the Project for different guilds of migratory birds will be required to assess Project effects. This information will be required in order for the Proponent to apply adaptive management, and for ECCC to review the adequacy of these management plans.	1. Provide further discussion on impacts to different focal species/guilds within the Migratory Breeding Birds Valued Component. 2. Provide mapping of important features or habitat types that will be lost due to the Project for different guilds of migratory birds.		Accepted	n/a
IR-165	-	CNSC ECCC	Birds (all species)	Section 9.4.4.2.2 Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment	**Context:** On p. 9-364 of the EIS, it is stated that exposure to hazardous materials through contact with contaminated waste ponds could affect avian health and contribute to mortality. However, the ERA places the avian receptors only in waterbodies and locations outside of the Project area (see Figure 5-2 in the ERA), i.e., Whitefish Lake, McGowan Lake, the inlet to Russell Lake, and Kratchkowsky Lake.	Please perform an ecological risk assessment with avian receptors located at the contaminated waste ponds, including: 1. Describe and analyze the possibility of birds, species at risk and other wildlife using the water or waste management facilities and provide an analysis to determine if there is a risk to wildlife that may access these areas.		Accepted	n/a

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				Appendix 10-A (ERA)	Further, there are insufficient details on the potential effects of the water quality in the water management and treatment facilities on birds, species at risk, and other wildlife, including the risk of bioaccumulation of contaminants. The Proponent should assess potential effects of water quality from these areas using applicable CCME guidelines. **Rationale:** It is unclear whether the ecological risk assessment based on the chosen exposure locations is protective and conservative for avian species potentially exposed to contaminated waste ponds on the Project site. While mitigation measures such as physical, visual, and/or auditory deterrents are proposed in Section 9.4.5.2.4, the possibility of avian species coming into contact with waste ponds cannot be excluded based on the available information in the EIS. The possibility of birds, species at risk, and other wildlife accessing the water management and treatment facilities for drinking water or other purposes is not discussed in the draft EIS.	2. Identify the potential toxicity of water management ponds to aquatic migratory birds and species at risk (SAR). 3. Describe what measures will be taken if the waters are found to be toxic to migratory birds and SAR. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison ensure adequate mitigation measures are implemented to minimize the potential for avian exposure to pond waters.			
IR-166	-	ECCC	Migratory birds	Section 9.4.5.2 Additional Avian Species-specific Mitigation Measures	**Context and Rationale:** Avian species-specific mitigation measures are not presented in the draft EIS. The Proponent has committed to providing a variety of environmental management plans. Section 9.4.5.2 reads: "Additional mitigation measures specific to the Raptors, Migratory Breeding Birds, and Bird Species at Risk VCs, in accordance with the Migratory Birds Convention Act, and tailored to Project features will be incorporated into various Project management and monitoring plans such as the, erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring, and Waste Management Plan." Migratory birds, the nests of migratory birds and/or their eggs can be inadvertently harmed or disturbed as a result of many activities, including but not limited to clearing trees and other vegetation, draining or flooding land, or using fishing gear; this is known as incidental take. This inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs is prohibited under the MBCA. Incidental take, in addition to harming individual birds, nests or eggs, can have long-term consequences for migratory bird populations in Canada, especially through the cumulative effects of many different incidents. For further details, please refer to the Avoiding Harm to Migratory Birds website at: https://www.canada.ca/en/environment-climate- change/services/avoiding-harm-migratory-birds.html In order to assess the effectiveness of species-specific mitigations and need for additional mitigations ECCC requires details on the species-specific mitigation measures proposed, and the monitoring plans.	Provide details on species-specific mitigations for species at risk (SAR) and other avian species that will include: • details on what activity restrictions will be implemented for migratory birds and SAR and when they will be applied; • details on mitigations used during regular maintenance activities such as vegetation management (e.g., mowing), access road repair (e.g., aggregate stockpiles), and infrastructure repair; • details on methods used to detect species listed on Schedule 1 of the *Migratory Birds Convention Act* (e.g., Pileated Woodpecker) and mitigations/setback distances and timing to reduce risk to these species.		Accepted	n/a

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IR-167	-	ECCC	Migratory birds	Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance	**Context and Rationale:** The Proponent has stated that when it is not practicable to clear outside of the breeding bird window, they will conduct pre-clearing surveys. Section 9.4.5.2.1 states: "Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting season, pre-clearing nest surveys will be conducted at that location within the Project Area." ECCC does not recommend the use of nest searches or pre-clearing surveys for active bird nests during the breeding season as a mitigation, given the difficulty associated with finding nests reliably and the high likelihood of disturbing nesting birds when searching. Instead, ECCC recommends that clearing and grubbing activities not be conducted during the breeding bird season. The Migratory Birds Regulations 2022 (MBR 2022) brings new scenarios that need to be considered: 1. Most migratory birds: - Nests are protected only when they are in use or when live eggs or chicks are present. 2. Migratory birds listed in MBR 2022 Schedule 1: - For the 18 species of migratory birds identified on Schedule 1, the MBR 2022 provide year-round nest protection until they can be deemed abandoned. 3. Migratory birds listed under SARA: - For some SARA listed migratory birds, the residence prohibition (s.33) will protect nests that are not active, but are re-used in subsequent years, and the critical habitat prohibition (s.58) will protect nests that are part of the critical habitat identification. Those prohibitions apply everywhere in Canada and at all times of the year. In these cases, a SARA permit will be required.	Provide the following information: • details on how vegetation clearing related to site development will be conducted to minimize risk to migratory birds and species at risk (SAR). • the timing window that will be used for vegetation removal to reduce risk to migratory birds and SAR	Response is accepted, but also see AD-57 in the Advice to Proponent table and follow-up IR-142-159-167-R1.	Accepted	n/a
IR-168	-	ECCC	Migratory birds	Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment	**Context and Rationale:** The Proponent mentions that avian deterrents will be used on power transmission lines, buildings and other Project infrastructure. However, the Proponent does not mention any deterrents that will be used for deterring birds from the water or waste management facilities. Details on deterrents for all Project components should be identified to assess residual and cumulative impacts to migratory birds.	Provide information on avian deterrents to be used to prevent birds or other wildlife entering water or waste management ponds. 2. Explain how proposed timing of use of deterrents will reduce risk of migratory birds making contact with treatment waters outside of the nesting season (i.e., during migration and stop overuse). 3. Explain which deterrents will be used, which deterrents were considered, and what alternative, adaptive measures will be considered if deterrents are unsuccessful for any Project components.		Accepted	n/a
IR-169	-	ECCC	Migratory birds	Section 9.4.6.3, Residual Effects Evaluation for Migratory Birds,	**Context and Rationale:** The analysis of available habitat types for migratory songbirds appears incorrect. In their interpreted ecosite mapping, the Proponent identified 25 different ecosite	1. Explain how information in Table 9.4-15 and map 9.4-11 were derived.		Accepted	n/a

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				Table 9.4-15 and Map 9.4-11	types. In their table 9.4-15 and map 9.4-11, the Proponent only lists 8 ecosite types that are available migratory songbird habitat. Section 9.4.6 Residual Effects Evaluation for Migratory Songbirds reads: "Considering the baseline data (Appendix 9-B), migratory songbird habitat is described in the following text without species-specific differentiation and referred to as available habitat for migratory songbirds. Based on the baseline study results, 66.8%, 52.2%, and 50.7% of the Project Area, Wildlife LSA, and Terrestrial RSA, respectively, are assumed to provide available habitat for migratory songbirds (Table 9.4-15)." All Project areas, except some anthropogenic features and open water, would be considered available habitat for migratory songbirds. Although some ecosite types may have lower density and diversity, it is expected that all ecosites provide migratory songbird habitat.	2. Explain why other habitat types were not considered as available habitat for migratory songbirds.			
IR-170	-	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation for Bird SAR, Table 9.4-19	**Context and Rationale:** The table and map presented by the Proponent do not appear representative of all available habitat for common nighthawk (CONI). Although CONI do preferentially use open areas such as gravel (often an anthropogenic disturbance) and regenerating forest, as identified in the draft EIS, they also use rock outcrops that can be within forested areas. As this area lies within the pre- Cambrian shield, there are likely rock outcrops that are also available habitat. As aerial insectivores, CONI select nesting areas in close proximity to wetlands or lakes where there is abundant forage. **Rationale:** Habitat requirements and preferences for all species at risk is required for developing effective mitigations and adaptive management.	1. Provide an updated table and map that considers all available habitat for common nighthawk. 2. Additionally, as part of environmental management plans the Proponent should include species-specific mitigations that are biologically relevant to all the species at risk for all Project phases and components.	Following the supplementary information provided by Denison on July 8th, CNSC staff determined that Denison has not provided the requested information on species-specific mitigation measures for each SAR. It is not adequate to group SAR together (e.g., all birds) due to the unique life history and habitat requirements of each individual SAR. Denison is expected to provide species-specific mitigation measures for each SAR separately. <u>In order to resolve this IR, Denison are expected to:</u> • Provide species-specific mitigation measures for each individual SAR. Denison may provide this information through revision of Section 3.3 and Table 4.1 in EIS Appendix 9-D. See also AD-77 in the Advice to Proponent table.	Not Accepted	**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments and updated EIS sections associated with the IR response in this table are available in Appendix A.** The requested updates have been made in Appendix 9-D of the final EIS (October 2024) which has been included here in Appendix A (refer to response to IR-142-159-167-R1).
IR-171	-	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation	**Context and Rationale:** Section 9.4.6.4 Residual Effects Evaluation for Bird SAR – Common Nighthawk reads: "Progressive reclamation is anticipated to begin during Construction. However, a conservative approach is used, with Common Nighthawk (CONI) habitat in the Project Area considered to be unavailable for the duration of the Project, only becoming available as habitat following Post-Decommissioning (i.e., during the regeneration of vegetation following Decommissioning)." CONI may nest on the roadsides of access roads within the Project area. As such, the Project area should still be considered available habitat for the duration of the Project and appropriate mitigations and adaptive management should be discussed for this species.	Develop mitigation plans appropriate for avoiding collisions of common nighthawks with vehicles, when and where nighthawks are observed foraging near or roosting on gravel roads. Demonstrate how the planned mitigation activities will result in reduced residual effects from this pathway.		Accepted	n/a
IR-172	-	CNSC	Birds (all species)	Section 9.4.6.4.2	**Context:** Populations of listed species may be less resilient to changes in mortality. CSA N288.6:22 Clause 7.2.4.3 states that effects on a few individuals of endangered, threatened, or vulnerable species would not be acceptable.	Please provide a discussion on mitigation measures with respect to their effectiveness in minimizing mortality for bird species at risk, for which effects on a few individuals would not be acceptable.		Accepted	n/a

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					The residual effects assessment for "Change in Mortality" for bird species at risk states that Project mitigation measures identified in Section 9.4.5 are expected to limit interactions between bird species at risk and potential sources of direct and indirect mortality. However, the mitigation measures are not discussed with respect to their effectiveness to limit interactions, specifically for bird species at risk. **Rationale:** It is unclear if the proposed mitigation measures are effective in preventing mortality in bird species at risk for which even only a few deaths could negatively impact the population.				
IR-173	-	ECCC	Migratory birds	Section 9.4.8 Monitoring and Follow-up	**Context and Rationale:** Monitoring and follow up programs are part of adaptive management and implementation of additional mitigations. In Section 9.4.8 the Proponent states: "Considering the Project planning, baseline survey results, and proposed mitigation measures, no follow-up programs are considered to be warranted at this time." Project impacts related to mortality of birds, such as collisions with the transmission line, mortality along roads and use of waste and water management facilities should be monitored during all phases of the Project and adaptively managed.	Provide details on the follow-up program to monitor impacts to avian mortality. The follow-up plan should include: • Monitoring of avian use of waste and water facilities • Monitoring of mortality along access roads • Monitoring of mortality related to transmission lines • Monitoring of effectiveness of avian deterrents.		Accepted	n/a
IR-174	-	ECCC	SAR – Bats	Appendix 9-B, Denison Mines Corporation Wheeler River Project, Terrestrial Environment, Wildlife and Vegetation Baseline Inventory, Section 2.1.4 Acoustic Bat Surveys	**Context:** The Proponent conducted acoustic surveys for bats and confirmed presence of two Species at Risk Act (SARA) schedule 1 listed bat species in the Project area, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis). However, the Proponent did not do an effects assessment of either of these bat species. **Rationale:** Although bats are present in the study area, no work was done to identify hibernaculum or maternal roosting sites. All species at risk that are expected to be present in the Project area should be assessed and species-specific mitigations detailed.	1. Conduct an effects assessment for little brown myotis and northern myotis, including the likelihood that tree clearing during the bat roosting period, is likely to 'kill', 'harm', or 'harass' Little Brown Myotis and Northern Myotis and its ability to carry out its life processes. 2. Describe and map locations of suitable myotis hibernacula and/or maternal roost habitat within the Local Study Area and Regional Study Area and explain how these habitats may be affected by Project activities. 3. Describe what mitigation measures will be taken to avoid the breeding period for bats. 4. Describe any pre-construction/pre- clearing surveys will be conducted to identify any hibernaculum and maternal roosting sites. Describe how monitoring will support adaptive management.	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided.		**Note: For the complete history of the FIRT's comments and Denison's responses to this IR, refer to Appendix A below. Any attachments associated with the IR response in this table are available in Appendix A.** **Denison recognizes this IR is under discussion and have provided the following response IR-174 received in September 2024.** 1. The frequency of detections was on a 5 minute interval. This has been clarified in Figure 2-9 of Appendix 9-F (see Appendix A). We can confirm the turquoise dots represent passes or buzzes that were uncertain (unable to distinguish echolocation call

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									characteristics between bat species) in all cases. 2. See **Attachment IR-174 (Round 4)** in Appendix A for the response to this IR along with supporting maps. 3. Methods for future pre-construction baseline bat surveys will build on the 2019 baseline (refer to EIS Appendix 9-B) and methods from the 2019 baseline are provided below along with information on how comparisons within year and between years will be completed. *Methods* Surveys will be commenced one half hour after sunset and ended one half hour before sunrise. Survey stations will be established 500 m apart along linear features where safe night travel was possible. Surveys will only be completed during appropriate weather conditions, with weather attributes (temperature, sky condition and wind (Beaufort scale)) recorded throughout the survey. Each survey site consists of a five-minute listening period using a Wildlife Acoustics Echo Meter Touch 2 Pro. The detector will be held with the microphone at a 45 degree angle and slowly rotated 360 degrees for the duration of the sampling period. If a bat is detected the detector is held

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									stationary for 15 seconds to avoid duplicate counts. Total detector hours will be calculated for the Project area and by ecosite/vegetation cover type. Ecosite/vegetation cover type for each survey point is established by utilizing the dominate ecosite/vegetation cover type within a 50 m radius of the survey point. *Acoustic Bat Call Analysis* Data will be analyzed using Wildlife Acoustics Kaleidoscope software. Echolocation call characteristics will be used to identify bat species. Call characteristics used to establish species included: minimum frequency maximum frequency call duration call slope call shape Call characteristics will be compared to reference calls in literature and call libraries (WDNR 2016, WNDD 2016, Keinath 2011, Adams 2003). In addition, reference calls within Omnia's call library will be used where possible. For future monitoring of bat species Denison will continue to inventory bat presence at given sites and this data will be analyzed to characterize: • Presence (occupancy)

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									• Relative abundance
									• Change metrics to be analyzed include:
									  ○ Annual and total change at specific site
									  ○ Annual and total change across all sites
									
									The analysis will be done using mean and 95% credible interval bars and will include covariates such as time of year (date), precipitation, temperature, forest cover, Ecosite and proximity to water/wetland. Appropriate statistical methods to compare pre-construction baseline and 2019 baseline data spatially and temporally will be employed and accompanied by power analysis.
									
									Results of acoustic bat surveys will be submitted to Saskatchewan's Conservation Data Centre.
									
									4. Commitment 9-37 has been updated in version 3 of Denison's commitment register (additions in bold) and now reads: "**Pre-construction baseline** acoustic bat surveys will be completed prior to construction, building on the 2019 surveys (Appendix 9-B). The surveys will determine the presence/non-absence, diversity and relative

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									abundance of bat species in the Project Area. **Results of acoustic bat surveys will be submitted to Saskatchewan's Conservation Data Centre.**"
IR-175	-	CNSC	Provincially Listed Species	Appendix 9-B; section 2.2.2	**Context:** Vegetation and wildlife habitat characterization field surveys were completed in 2017, based on which ecosite factsheets were prepared. The factsheets list observations of two provincially listed plant species with a rank of S3 (vulnerable/rare to uncommon; Table 2.4-2) according to the Saskatchewan Conservation Data Centre, which are not discussed in the main EIS document: • Angle-leaved sundew (Drosera anglica) observed in ecosites BS19, BS20, BS22, BS25 • Neat Spike-rush (Eleocharis nitida) observed in ecosite BS25 Table 9.2-12 in section 9.2.6.2.1 of the EIS indicates that there may be indirect disturbance to some of these ecosites (BS19, BS20, BS25). In section 9.2.6.3.1 it is discussed that listed plant species are not likely to return once lost from a specific location. **Rationale:** Given that not all areas in the revised Project footprint were surveyed for listed plant species in baseline studies, there is uncertainty as to whether any species were missed, in particular those that have been observed in ecosites present in the LSA/RSA (e.g., Drosera anglica and Eleocharis nitida, see also Appendix 2 Table of Appendix 9-B). It should also be noted that rare plant surveys were completed in summer 2017 only (section 2.4.2 of Appendix 9-B), which may underestimate annual rare species that may be dormant in the seed bank in some years due to specific seed emergence requirements. It is acknowledged that the Proponent committed to pre-construction listed plant surveys targeted on ecosites encountered in the Project Area but not previously surveyed, as well as ecosites within the Project Area with high potential to support listed plants. More information is requested on the potential indirect effects on rare plant species as well as the planned pre-construction surveys.	1. Please provide a discussion on the potential risks from indirect effects on ecosites with observed rare plant species 2. Please provide additional information on the ecosites included in the planned pre-construction listed plant surveys **Suggestions for mitigation and follow-up measures:** CNSC recommends focusing monitoring on ecosites that have known observations of listed plant species outside of the Project Area (e.g., BS19, BS20, BS22, BS25).		Accepted	n/a
IR-176	-	CNSC	Human Health with respect to radiation exposure	Section 10.1.4.2.1 Section 10.1.6.1.4 Appendix 10-A (ERA)	**Context:** In section 10.1.4.2.1, the Proponent provides an evaluation of air quality constituents of potential concern to human health. It states: "A screening value for radon gas of 200 becquerels per cubic metre (Bq/m3) was available from Health Canada, which applies to total radon including background sources (Health Canada 2009). The radon concentrations which were predicted are incremental concentrations (i.e., above background) and were therefore compared to the applicable incremental screening value of 60 Bq/m3 for indoor air established by the Canadian Nuclear Safety Commission (CNSC) (Health Canada 2010a; Radiation Protection Regulations. SOR/2000-203)." The 60 Bq/m3 radon concentration value also appears in section 7.1.2 of Appendix	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit. 2. Reporting the assessment results as the total dose, from all radionuclides combined including radon progeny, and by comparing this annual effective dose to the effective dose limit. Provide a summary of the conservative assumptions that have been included in the dose calculations.		Accepted	n/a

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					10-A (ERA). Further in section 10.1.6.1.4, it is stated: "Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 Bq/m3." The Radiation Protection Regulations do not stipulate a limit for radon above background for sites Licensed by the CNSC. The effective dose limits for Nuclear Energy Workers (NEWs) and persons that are not NEWs are listed in section 13 of these regulations, and in subsection 1(3) of these regulations for the general public. The annual effective dose from all sources associated with the Licensed activities and within the scope of the Nuclear Safety Control Act and Regulations must be compared to the applicable effective dose limit. For members of the public this limit is 1 mSv per calendar year. In Section 4.2.5.3 of Appendix 10-A (ERA), there appears to be no reference mentioned for the radon equilibrium factors. These factors are a significant input into the dose calculations for radon. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations.	Provide a reference that shows how the radon equilibrium factors were determined.			
IR-177	-	HC	Change to an environmental component due to radiological contaminants	Section 10.1.4.2.1 (p. 10-22) Appendix 10-A (ERA) : Appendix B Table B.9, Ref. 19-2638 Section 6, Table 6.1-1 (p. 6-7)	**Context:** Section 10.1.4.2.1 states that, "Screening values for radionuclide concentrations in ambient air were not available. All relevant radionuclides were assessed in the HHRA in terms of their contribution to the total radiological dose to human and ecological receptors" (p. 10-22). Section 10 Appendix 10-A (ERA) states that, "No formal screening was conducted for radionuclides. However, since radiation dose to human receptors is of public and regulatory interest, the radionuclides in the uranium-238 decay series are carried forward as COPCs for further assessment" (Appendix 10-A (ERA): Appendix B Ref. 19-2638). Table 6.1-1 lists radionuclides as a key indicator for air quality, but only uranium and radon are considered in Section 6, and Section 10 Table B.9 does not include doses from uranium progeny in air. **Rationale:** Health Canada recommends using screening values that are available for radionuclides if they are appropriate for the dose and if the screening values have listed assumptions (such as particulate size and worker exposure time that can be adapted to in Denison's models). Two examples are ICRP 96, which CNSC uses in their regulatory reports to derive reference air quality values for Pb-210, Ra-226, and Th-230 (CNSC: Regulatory Oversight Report for Uranium Mines and Mills in Canada 2019); and Health Canada's Guidelines for Management of NORM (Health	1. Assess predicted radionuclides in Section 10 Appendix 10-A (ERA) using appropriate available screening values. Alternatively, provide a justification for why a screening wasn't conducted for radionuclides despite the availability of screening values (e.g., ICRP 96 and NORM Guidelines, 2011). 2. Clarify if uranium progenies in air are considered in the atmospheric transport and air quality modelling and are simply not reported, or if they are not included in the models because no screening criteria are available.	Response is accepted, but also see AD-55 in the Advice to Proponent table.	Accepted	n/a

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					Canada: Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials, 2011).				
IR-178	-	HC	Change to an environmental component due to hazardous contaminants	Section 10.1.4.2.1 (p. 10-22) Section 6.1.4.2, Potential Project Related Effects (p. 6-31)	The Baseline + Project scenario was not provided for radon levels. **Context:** Section 6.1.4.2 states that the predicted levels for radon were not added to the respective baseline air quality levels (p. 6-31), and further explains that “In all modelled phases of the Project, annual average radon concentrations at receptors beyond the Property Boundary are expected to be indiscernible from background levels.” In Section 10.1.6.1.4, a different approach to evaluating predicted radon levels is mentioned: “the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3“(p. 10-44). **Rationale:** Without a rationale as to why baseline levels of radon were not included in the assessment, HC cannot fully evaluate the appropriateness of the air quality assessment. While Health Canada is of the opinion that using background radon levels as a screening value is appropriate in this case from a health perspective, different approaches to screening predicted radon levels in different sections appear to be used (i.e., background radon levels vs. CNSC incremental concentration).	1. Provide further information on whether and how baseline radon concentrations in air were determined. 2. Include baseline radon concentrations in the predicted total concentrations when comparing to existing guidelines; alternatively, provide a rationale for why baseline concentrations of radon were not included. 3. Discuss the potential health implications of the project-only increment-over-baseline radon levels		Accepted	n/a
IR-179	-	CNSC	Groundwater quality decommissioning objectives.	Section 10.1.4.2.2, Release of Treated Effluent to Whitefish Lake During Decommissioning	**Context:** It is stated that “This process would continue until the recovered water meets acceptable groundwater quality decommissioning objectives”. **Rationale:** The information provided does not include groundwater quality decommissioning objectives nor a reference to these objectives.	Please provide groundwater quality decommissioning objectives or a reference to the information.		Accepted	n/a
IR-180	-	CNSC	Human health with respect to hazardous contaminants	Section 10.1.6.1.1, Human Receptors Selection and Characterization	**Context:** Within the Human Health assessment, offsite receptors during the operation period are only considered downstream of Whitefish Lake. The only identified concern was for Se to the Fisher/Trapper located at Russel Lake. This section cites Indigenous Knowledge as informing the receptor selection and location. **Rationale:** While the assessment is fairly conservative in the assumptions made on intake and receptor habits, it stands to reason that if the trapper receptor was located closer to the operation, such as at McGowan or Whitefish Lakes, this exceedance of Se could be more pronounced. In terms of maintaining a conservative assessment, if the most vulnerable receptor can be shown to be protected at the point of highest expected COPC concentration, it can be concluded that this receptor would be protected further away from the Project. Considering this, why was the hunter/trapper receptor not also assessed at Whitefish or McGowan Lake? Was Indigenous Knowledge specific in mentioning Whitefish or McGowan Lakes were not used for the activities carried out by identified receptors?	Please provide justification for excluding a receptor from occupancy at lakes closer to the Project during operation (McGowan, Whitefish). Alternatively, conduct a risk assessment to a receptor at these lakes during operation to determine if there is a predicted risk that may require monitoring or mitigation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Assessment of a receptor located closer to the point of effluent release may need to be considered to ensure there are negligible risks • If Se is expected to exceed hazard quotients further upstream, selenium removal technology may be required as part of the effluent treatment process as a mitigation measure. Other COPC’s exceeding an HQ of 1 may also be identified under this process that could require specific monitoring or mitigation measures.	Response is accepted, but also see AD-59 in the Advice to Proponent table.	Accepted	n/a

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IR-181	-	CNSC	Human Health with respect to radiation exposure	Section 10.1.6.1.4	**Context:** In section 10.1.6.1.4, it is stated: "The maximum incremental radon concentration at the camp worker site during Operation was predicted to be 12.4 Bq/m3, which is below the CNSC limit of 60 Bq/m3 for incremental radon." As per IR-176, there is no such CNSC limit for incremental radon. The camp worker would be considered a person who is not a nuclear energy worker (NEW) and subject to the dose limits of section 13 and 14 of the Radiation Protection Regulations, not the dose limit for the general public as per subsection 1(3) of the Radiation Protection Regulations. The CNSC has regulatory requirements for the ascertainment and recording of doses of radiation as per section 5 of the Radiation Protection Regulations. Every Licensee must ascertain and record the magnitude of exposure to radon progeny, the effective dose and equivalent dose received by and committed to a person who performs duties in connection with any activity that is authorized by the Nuclear Safety and Control Act or is present at a place where that activity is carried on. The camp worker performs duties in connection with the Licensed activity and is present at the location where the activity is carried out. Hence, they are not considered to be a member of the general public (who has no connection with the activity) Further, the Proponent indicates that the maximum incremental radon dose to the camp worker was estimated to be 0.13 mSv/year during Operation. The assessment assumes that the camp worker spends 100% of the time indoors. Table 10.1-11 shows the maximum total incremental dose for the camp worker to be 0.02 mSv/year. This appears to be a discrepancy. Table 5.2 in Appendix 10-C provides internal annual dose from radon inhalation. The radon doses to some NEW workers (9.44E-02 mSv/a Driller 1 and 1.03E-01 mSv/a Wellfield Operator 1, 2) here appear less than the radon dose (0.13 mSv/year from section 10.1.6.1.4) to the camp worker, who is a non-nuclear energy worker. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations and the environmental impact statement.	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit for incremental radon. 2. Revising all references to the 'public dose limit' applied to camp workers (non-NEWs) to align with section 13 and 14 of the Radiation Protection Regulations. The Proponent should explain why the radon dose for the camp worker appears as 0.13 mSv/year in one instance and 0.02 mSv/year in another. The Proponent is also asked to provide the rationale as to why a non-NEW has a higher radon dose than a NEW.		Accepted	n/a
IR-182	-	HC	Change to an environmental component due to radiological contaminants	Section 10.1.6.1.4, (p. 10-44)	**Context:** Section 10.1.6.1.4 states, "The limit is incremental and is exclusive of natural background, such as natural levels of radon and medical exposures. A dose constraint of 0.3mSv/yr was established for the public from all radionuclides and all pathways for the Project, as recommended by Health Canada (2010a). The dose constraint represents a dose lower than the public dose limit that ensures the combined dose from multiple sources does not result in exceedance of the public dose limit. Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3" (p. 10-44).	1. Provide clarification on how combined doses from all sources would be accounted for in respecting the public dose limit of 0.3 mSV/yr if radon concentrations are being calculated separately.	Response is accepted, but also see AD-65 in the Advice to Proponent table.	Accepted	n/a

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					Rationale: Calculating radon separately from all radionuclides may underestimate the health risks by not considering combined doses from multiple sources when comparing to the public dose limit constraint of 0.3 mSv/yr recommended by Health Canada (2010a).				
IR-183	-	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C	**Context:** Exposure scenarios for workers have been identified and high-level summaries of the assumptions and resultant dose estimates have been provided. However, the detailed dose calculations have not been provided. **Rationale:** The method used to estimate effective, equivalent and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data, for at least the most dose significant scenarios.	Provide the dose calculations for deriving the dose estimates for workers in all exposure scenarios, for at least the most dose significant scenarios.		Accepted	n/a
IR-184	-	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C, 2.0	**Context:** It is stated in Appendix 10-C, section 2.0 that: "In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers." As per section 14 of the Radiation Protection Regulations, the equivalent dose limit for the lens of an eye for nuclear energy workers (NEWs), effective January 1, 2021, is 50 mSv in a one-year dosimetry period. **Rationale:** The reason of the requested change is to ensure consistency with the Radiation Protection Regulations.	The EIS and Appendix 10-C should be aligned with the Radiation Protection Regulations regarding the equivalent dose limit for the lens of an eye for NEWs.		Accepted	n/a
IR-185	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2 Appendix 10-C Table 3.10-3.12	**Context:** The Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in various locations were provided in tables 3.10-3.12 in appendix 10-C. The doses from those scenarios were omitted. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	The Proponent is asked to provide all the necessary information and assumptions required to perform the MicroShield calculations independently and to list the resulting calculated values from the listed scenarios.		Accepted	n/a
IR-186	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Section 10.2.4 Appendix 10-C, Section 3.2	**Context:** In sections 10.2.3.2.4 and 10.2.3.2.6, as well as section 3.2 of Appendix 10-C, the Proponent has stated that workers in the drying and packaging areas of the processing plant will be required to wear powered air purifying respirators (PAPR) to reduce/eliminate inhalation exposure. Further in section 10.2.4, which elaborates mitigation measures, it is stated: "For the drying and packaging/loading areas of the ISR plant, use of PAPR has been assumed. It will be needed in these areas, and it has been planned in these areas to substantially reduce doses from inhalation of uranium dust. Dust levels in these areas will be monitored and kept ALARA." The use of respirators appears to be in contradiction of the requirements of section 13 of the Uranium Mines and Mills Regulations, which states: *No Licensee shall rely*	Provide the rationale for mandating the use of respirators by workers in the drying and packaging areas of the processing plant. Include the demonstration of the application of the hierarchy of control for radiological protection within the design of these areas of the processing plant. Justify that this approach complies with section 13 of the Uranium Mines and Mills Regulations.		Accepted	n/a

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					on the use of a respirator to comply with the Radiation Protection Regulations unless the use of the respirator (a) is for a temporary or unforeseen situation; and (b) is permitted by the code of practice referred to in the licence. The Proponent is also reminded that respirators should not be the first choice for dose reduction in workplaces. They should only be used when the hierarchy of control (elimination, substitution, engineering, or administrative controls) is not possible. **Rationale:** At this stage of the Project, the Proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*				
IR-187	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Appendix 10-C, Section 3.3, 6.0	**Context:** The exposure scenarios and assumptions for the workers in the drying area and the packaging/loading area of the processing plant include the wearing of PAPRs, which is assumed to provide a 1000-fold reduction in dust exposure. Further to reference IR-186, the use of a respirator as well as in worker dose predictions for the Project, appears to contravene section 13 of the Uranium Mines and Mills Regulations, and does not follow the hierarchy of controls for radiological protection of workers as described in REGDOC-2.7.1, Radiation Protection. **Rationale:** At this stage of the Project, the Proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*	Modify the exposure scenarios and assumptions (i.e., remove the use of a respirator) for the workers in the drying area and the packaging/loading area of the processing facility. Assess the resultant exposures against CNSC regulatory dose limits and the ALARA principle. Identify mitigation measures as per the hierarchy of control for radiological protection.		Accepted	n/a
IR-188	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.4	**Context:** The following is stated in section 10.2.4: "Dust inhalation is also a potentially substantial component of worker dose at the core shack. At this location, PAPR will not be required; however, N95 masks will be used, and dust levels will be monitored here…It may be possible to increase air exchange in the core shack, above the planned six exchanges per hour, should this be necessary. This would also reduce radon exposure in the core shack." If it is possible to increase air exchanges in the core shack, it is not clear why this was not assessed and incorporated in the design of the core shack. **Rationale:** It appears that a control measure (e.g., air exchange protocols in the core shack) to reduce the exposure to workers has been identified. However, it is not certain if it has been formally documented to ensure that it is incorporated in the engineered design of the core shack.	Provide details on how the control measures to reduce the exposure to both workers through the air exchange protocols in the core shack have been formally documented to ensure that it is incorporated in the engineered design of the core shack.		Accepted	n/a
IR-189	-	CNSC	Woodland Caribou Ecological Model	Appendix 10-A (ERA)	**Context:** In the ERA (p. C.12, section 2.3.6 Woodland Caribou) it is stated: "For the ecological model a diet comprised of 50% browse, 20% lichen and 30% macrophytes is assumed for the woodland caribou."	Please provide additional evidence to support that those Woodland Caribou who may have higher consumption rates of lichen as part of their diet, will remain protected. This can be provided through including a second model that assumes 70%		Accepted	n/a

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					In the EIS, section 9.3.3.3.1, it is stated: "Research has shown that up to 70% of the year-round diet of caribou may consist of ground and arboreal lichens." **Rationale:** It is unclear whether the assumptions in the ecological model in the ERA regarding Woodland caribou diet are conservative, given only 20% lichen intake in the model. Lichen is known to accumulate COPC such as metals and dust from the atmosphere.	lichen in the diet. See also related: IR-138.			
IR-190	-	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-8 (p. 3.31) and Table 3-9 (p. 3.36) Appendix 6, Table 5 (p. 16)	NO2 criteria is not being consistently compared. **Context**: Provincial and federal air quality criteria/screening values for NO2 have been used inconsistently. Table 3-9 in Appendix 10-A (ERA) uses the 2015 Saskatchewan Ambient Air Quality Standards (SAAQS) value of 300 µg/m3 to compare the maximum concentrations of NO2 at receptor locations for the 1-hour average period, while Table 5 of Appendix 6 uses the 2025 Canadian Ambient Air Quality Standards (CAAQS) of 79µg/m3 for the same average period time. **Rationale**: By utilizing the SAAQS screening value for NO2, the maximum concentrations at receptor locations exceed the 1-hour threshold solely during the decommissioning stage (Table 3-9). However, if the 2025 CAAQS are applied, the screening values would be exceeded at receptor locations for all project phases. It is best practice to use the more protective air quality standards to evaluate potential human health risks associated with project activities.	1. Compare the predicted maximum concentrations to the most protective applicable air quality standards available. Alternatively, provide a rationale as to why the SAAQS for NO2 were used rather than the more protective 2025 CAAQS to determine potential exceedances and screen for the need for additional mitigation measures. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the standards from the 2025 CAAQS for NO2 in future mitigation and follow-up plans.	Following the supplementary submission by Denison on July 5th, 2024, one minor correction remains outstanding. There is an error in Section 3.2.1.3.1 Nitrogen Dioxide (updated text in the ERA in Appendix 10-A): The results reported in the paragraph under the Summary of Exceedances at Human/Ecological Locations sub-heading (0.3% of the year for approximately 28 hours per year) is associated with the <u>operation phase</u> and not the decommissioning phase. This editorial error must be corrected in the final EIS submission package. This IR is accepted for the purposes of the EA review. *The following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1) In their documents to support their licence application, the proponent will have to describe mitigation measures to minimize releases of NO2. If this information is not described, CNSC staff will request the proponent to provide the information. 2) 1-hour threshold for NO2: Denison should not rely on a single study (Hesterberg et al., 2009) to support a 1-hour threshold for NO2. Denison is expected to consult more than one study. Denison will be required in their environmental risk assessment submitted as part of licensing to demonstrate that there will be no unreasonable to the environment and to the health of people as a result of NO2. --- World Health Organization (WHO), 2021. WHO global air quality guidelines. Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. 273 p. Available online at: <u>https://apps.who.int/iris/handle/10665/345329</u>	Accepted	n/a
IR-190	IR-190-R1	HC	Change to an environmental component due to hazardous contaminants	Section 6.1.3.2.2 (p. 6-21) Table 6.1-8 (p. 6-22); and, Table 6.1-9 (p. 6-22)	Limitations with the proposed use of passive NO_2 monitoring would not allow comparison of measurement results to the 2025 CAAQS for 1-hour NO_2. **Context:** In response to IR-190, there was agreement to using the 2025 CAAQS for NO_2 in future mitigation and follow-up plans, which Health Canada supports. However, the proposed air quality monitoring and follow-up plans (Chapter 6.1.8)	1.Provide additional details on proposed air quality monitoring for NO_2 that will allow for comparisons to both the 1-hour and annual 2025 CAAQS and how that will be used to support mitigation and follow-up plans. Distinguish between comparisons with measured and modelled monitoring data, as well as use of passive and active samplers.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Please provide the following information:	Accepted	n/a

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				Section 6.1.8 (p.6-44) IR-190 Response from Denison	anticipate continued use passive NO_2 samplers, which do not measure hourly (1-hour) concentrations. Section 6.1.3.2.2 indicates that the assessment makes use of passive samplers to measure NO_2 at two sampling locations. The results from those samplers are presented in tables 6.1-8 and 6.1-9, for a ~30-day sampling period (i.e., a total concentrations for NO_2 in ambient air over ~30 days). While passive samplers provide measurement data for comparison to the annual 2025 CAAQS for NO_2, measurement data for the 1-hour NO_2 standard commonly requires use of an active sampler. **Rationale:** Health Canada encourages the monitoring of air contaminants when exceedances or near-exceedances of air quality criteria, standards and/or guidance values are predicted or reported, to: • determine the accuracy of predictions; • help verify whether standards are being met; and, • assist with implementing or modifying mitigation measures.	2. If multiple approaches will be used to monitor NO_2 (e.g., use of passive and/or active samplers, modifications due to differences between project phases, etc.), describe their intended contribution to the monitoring objectives and outcomes (e.g., determine the accuracy of predictions; assist with implementing or modifying mitigation measures).	1. Clarify the conditions under which a switch from passive to continuous monitoring would be warranted (e.g., if the 30-d measured NO_2 concentration, after conversion to a 1-h concentration, approaches or exceeds the 1-h CAAQS value).		
IR-191	-	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-9 (p. 3.36) and Table 3-10 (p. 3.46) Section 6.1.8 (p. 6-44)	Non-threshold substances are not included in screening and monitoring plans. **Context:** Fine particulate matter (PM2.5) is not being considered further in secondary air quality screening for short and long-term exposure at human and ecological receptors because it is not predicted to exceed the screening values of the Ontario Ambient Air Quality Criteria (OAAQC) or the Canadian Ambient Air Quality Standards (CAAQS) for both annual and 24-hour average periods (Tables 3-9 and 3-10). Furthermore, it is not compared against the baseline for analysis. Table 3-9 indicates that coarse PM (PM10) is predicted to exceed the 24-hour CAAQS during all phases of the Project. However, Appendix 10-A p. 3.46 states that, “There were no exceedances of PM2.5 which is generally considered to be a more reliable indicator of potential health effects. However, health effects would be infrequent and reversible, subsiding after exposure; therefore, PM10 was not considered for further quantitative assessment in the ERA.” PM10 and PM2.5 were not included in the air quality monitoring plan (Section 6.1.8). **Rationale:** Particulate matter and NO2 are considered non- threshold pollutants, meaning that health effects can occur at any level of exposure, The CAAQS for PM2.5 PM.10, and NO2 recognize that there is no population health threshold for human health effects; therefore, any increase in exposure will result in an incremental population risk (Environment Canada and Health Canada, 2012; CCME, 2000). The CAAQS values should not be construed as limits to which polluting up to is allowed. In addition, based on the principles of keeping clean areas clean and continuous improvement, proposed mitigation measures should not be confined to meeting the standards but should also be targeted towards reducing population	1. Include PM2.5 and PM10 in the secondary air quality screening for short and long- term exposure at human receptors. 2. Include PM10 and PM2.5 in the air quality monitoring plan as they are non- threshold substances. 3. Provide a discussion of the significance of predicted exceedances of health- based standards. 4. Identify additional mitigation measures to reduce concentrations of non- threshold air contaminants associated with the Project. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the 2025 CAAQS Management Levels to develop mitigation measures that reduce project contributions of non-threshold pollutants (e.g., PM2.5, NO2).		Accepted	n/a

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					exposure to CACs associated with the proposed project. Furthermore, although health risks associated with PM2.5 are higher than those associated with PM10, both fractions are considered non- threshold pollutants and identified by IARC (2013) as causes of cancer. **Reference**: [1] International Agency for Research on Cancer (IARC). 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. Lyon: International Agency for Research on Cancer.				
IR-192	-	CNSC	Human Health with respect to radiation exposure	Appendix 10-A (ERA), Section 3.1.1.2, including Tables 3-1 and 3-2	**Context:** Section 3.1.1.2 in Appendix 10-A (ERA) provides the method of how select constituents including cadmium, chromium, selenium and lead-210 were determined. This section does not mention how the other constituents as listed in Tables 3-1 and 3-2 are determined. The values for Th-230 and U-238 in Table 3-1 are unexpected. Typically, these values should be at equilibrium. **Rationale:** The technical basis for the selection of constituents of concern is required as part of the environmental and human health risk assessments.	1. Provide the methodology of how all listed constituents are determined. 2. Provide the rationale as to why Th-230 and U-238 are not in equilibrium.		Accepted	n/a
IR-193	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.1.2 Section 8.2.4.2.3	**Context:** Appendix 10-A (ERA) Table 3-1 'Screening of Effluent Quality against Surface Water Quality Guidelines for the Wheeler River ERA' does not include acute water quality thresholds for all COPCs compared against predicted effluent quality. For example, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the CCME water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. All water quality thresholds should be derived from receiving environment parameters, and there are discrepancies between the values used in Appendix 10-A (ERA) Table 3-1 and the values presented in Tables 8.2-8 and 8.2-10 in Section 8.2.4.2.3 of the draft EIS. No selected screening value for TSS has been calculated from baseline conditions. Un-ionized ammonia, which is a regulated Schedule 4 substance under the MDMER, has not been included. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment.	1. Provide acute and chronic water quality thresholds for all required COPCs with monitoring required under the MDMER. 2. Ensure all water quality thresholds are derived from receiving environment baseline parameters and that these thresholds are consistently applied throughout the draft EIS.	In Denison's July 2nd, 2024, supplementary submission, it is unclear what value Denison is applying as the screening criteria for un-ionized ammonia. The screening value provided in other tables (ex. Tables 8.2-2, 8.2-8, 8.2-10, 8.2-13, 8.2-14) all list the SEQG/CCME water quality guideline of 0.019 mg/L as the screening criteria. The recommendations for phosphorus and inclusion of the HC values in Table 3-1 are editorial and have no influence on the assessment results, therefore can be addressed in licensing. This IR is accepted for the purposes of the EA review, but Denison are expected to correct the remaining errors in Table 3-1 of the ERA in the final EIS submission package: 1. Un-ionized ammonia - The screening value of 0.0156 mg/L for un-ionized ammonia provided in Table 3-1 differs from what has been provided in other tables (ex. 0.019 mg/L in Tables 8.2-2 8.2-8, 8.2-10, 8.2-13, 8.2-14). Denison should confirm what screening criteria is used for un-ionized ammonia and which source it is referenced from. 2. Zinc – The screening value of 0.007 mg/L for zinc provided in Table 3-1 differs from what has been provided in other tables (ex. 0.013 mg/L in Tables 8.2-8, 8.2-10, 8.2-13, 8.2-14). Denison should confirm what screening criteria is used for zinc and which source it is referenced from. 3. Manganese – The CCME value of 0.26 mg/L for zinc provided in Table 3-1 differs from what has been provided in other tables (ex. 0.21 mg/L in Tables	Accepted	n/a

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							8.2-8, 8.2-10, 8.2-13, 8.2-14). While a minor difference, the 0.21 mg/L value appears to be the correct value calculated using site-specific hardness and pH. Denison should verify which value is correct. 4. Molybdenum – the screening criteria used for the EcoRA is the SEQG of 31 mg/L. This is significantly higher the CCME guideline of 0.073 mg/L. The CCME guideline is outdated, however the SEQG guideline does not have a safety factor applied to it, and is significantly higher than other guidelines for Molybdenum. The BC WQG of 7.6 mg/L is both up-to-date and has a safety factor applied. Use of this guideline aligns with the principles of the Precautionary Approach and does not lead to any changes in risk conclusions in ERA (i.e. Molybdenum is still not screened into EcoRA assessment as the predicted effluent concentration is 2.5 mg/L and does not exceed screening criteria). It is recommended that in alignment with CSA N288.6 and the Precautionary Approach that Denison update the screening criteria for molybdenum for the EcoRa to utilize the BC WQG of 7.6 mg/L.		
IR-194	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.1.1.2 and Section 3.1.2.3	**Context:** In the ERA, COPCs should be selected for further assessment based upon the following factors: 1. COPC concentrations in effluent that exceed selected water quality guidelines for the protection of aquatic biota, and 2. Baseline COPC concentrations in the LSA that exceed selected surface water and sediment quality guidelines for the protection of aquatic biota. However, only COPCs that had concentrations in effluent that exceeded guidelines were assessed further. Baseline concentrations of COPCs in sediment were not considered. In addition to this, not all COPCs that require monitoring under the MDMER had predicted effluent concentrations. From Section 8.2.3.3 Table 8.2-2 of the Aquatic Environment Report, it appears Aluminum in McGowan Lake and Whitefish Lake South and North, and pH in Whitefish Lake North exceed water quality guidelines. Predicted effluent concentrations or near-field surface water concentrations for Aluminum and pH are not provided. **Rationale:** It is not possible to determine if there is risk from effluent to the receiving environment and aquatic receptors based on the current information provided.	1. As noted in IR-114, provide the information on predicted effluent quality for COPCs with required monitoring under the MDMER. 2. Provide the information on predicted maximum receiving environment surface water concentrations for COPCs with required monitoring under the MDMER in IR-114. 3. Update the ERA to assess the risk of any additional MDMER COPC concentrations in effluent that exceed water quality guidelines. 4. Update the ERA to assess the risk of COPCs that had elevated baseline water and sediment quality concentrations in the receiving environment.	There are multiple elements of this IR outstanding. This IR is being conditionally accepted, but these issues will need to be resolved during the licensing process. It is expected that a fully revised ERA that both incorporates revisions following closure of EA related IRs and addresses outstanding issues that will be further assessed during the licensing review. *This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Item one of the IR has been met. However additional information is required for items two, three, and four. Similar to ECCC's rationale provided for IR-124, "the ERA primarily relies on modelling results to identify the maximum predicted levels of COPCs in the receiving environment." However, due to the upper bound discharge rates being the only model input evaluated, it is unclear whether the model considered scenarios where maximum COPCs might occur as the exclusion of other environmental variables may have resulted in inaccurate maximum environmental concentrations of the COPCs. The Proponent's responses regarding baseline exceedances of COPC thresholds in the receiving waterbodies requires additional information. The modeling of surface water and sediment COPC's described in Appendix 10-A, Figures 6-1 and 6-2 respectively, show results for the receiving waterbodies. However, it is unclear if these modeled values are based on the worst-case scenarios that account for environmental variables such as seasonal changes in hydrology and chemistry, or if they have only accounted for changes in operational effluent discharge scenarios to consider the upper bound discharge rates. Including the upper bounds of operational effluent discharges regardless of the variability of the receiving environmental conditions is important factor for determining whether the baseline data and risk assessment fully considered the effects of the	Accepted	n/a

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							operations of the proposed mine, including environmental concentrations of the COPCs, on water quality. The Proponent should provide baseline data and a risk assessment that includes consideration of maximum COPC scenarios for the receiving water bodies, including seasonal variability and sediment depositional areas. The Proponent should provide supplemental information to identify if the environmental model has considered environmental variability such as seasonal changes in water levels, flows and sedimentation. The Proponent should also demonstrate that the model has considered a reasonable expected worst case scenario, such as a 100 year return.		
IR-195	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.1	**Context:** Figure 3-2 depicts modelled concentrations of COPCs in the receiving environment surface water during all Project phases. Effluent discharge rates during Operations and Decommissioning are not anticipated to differ significantly. However, COPC concentrations seem to decrease rapidly after the end of the operations period despite effluent releases continuing into the decommissioning phase. **Rationale:** There has been no information provided on predicted changes in effluent COPC concentrations and discharge rates during the decommissioning phase. It remains unclear how COPC concentrations would decrease so quickly following the end of operations.	1. Provide further information on modelled maximum COPC concentrations for each individual Project phase with estimated timing for peak concentrations to appear in the receiving environment. 2. Provide further information on predicted effluent quality during the Project decommissioning phase. 3. Update ERA figures and conclusions as needed.	Following Denison's July 2nd, 2024 supplementary submission, this IR is Accepted.	Accepted	n/a
IR-196	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.3	**Context:** Table 3-6 provides predicted maximum sediment concentrations of COPCs compared to sediment quality guidelines. Several selected sediment screening values are not the most stringent sediment quality guidelines, with no justification provided. Additionally, copper and lead appear to be missing guidelines that are available from the Burnett-Seidel and Liber (2013) study. **Rationale:** The most stringent guidelines should be used for the sediment quality risk assessment in the ERA. Use of the most stringent guidelines will allow the most protective assessment to analyze risks to the receiving environment, aquatic and terrestrial biota.	1. Provide further information and justification for the selection of less stringent thresholds. 2. Update the ERA as needed.		Accepted	n/a
IR-197	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.2	**Context:** It remains unclear if atmospheric deposition from Project related emissions has been incorporated into modelling for the ERA and surface water and sediment quality assessments. **Rationale:** While expected Project air emissions are unlikely to have direct impacts on the aquatic receiving environment and aquatic biota, this Project effect pathway may have indirect effects through accumulation of COPCs over time or deposition of contaminants that are not expected in effluent, which should be evaluated with predicted emissions data incorporated into water quality modelling predictions.	Incorporate atmospheric deposition from Project-related emissions into water quality modelling and assess any Project related effects to aquatic receptors from this pathway.	In Denison's July 5th, 2024 supplementary submission, items one, two, and three were addressed. However, the sample calculation was not added to Section 2.2 of Appendix A, which would support the February 2024 statement that atmospheric deposition is negligible. This IR is accepted for the purposes of the EA review, but Denison is expected to add this sample calculation in the final EIS Submission package.	Accepted	n/a

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IR-198	-	HC	Change to an environmental component due to radiological contaminants	Appendix 10-A (ERA) Appendix B, Tables B.7 and B.8 Ref. 19-2638 Appendix 10-A (ERA), Table 4-3 Ref. 19-2638 (p. 4.17)	**Context:** Section 10 Appendix 10-A (ERA) contains Table 4-3 (p. 4.17), which lists ingestion rates for traditional foods and includes the category "organs" for Mammals. Tables B.7 and Table B.8 in Section 10 Appendix 10-A (ERA) Ref. 19-2638 provide the predicted concentrations of radionuclides for ecological receptors during the Project phases and during future centuries, respectively. They list the concentrations of radionuclides in moose and in moose organs, which is presented as a single cumulative organ value. Other terrestrial and aquatic animals (such as the black bear and woodland caribou) that are a part of the traditional diet of nearby Indigenous communities have higher concentrations of radionuclides than moose, yet concentrations are not provided for organs of these species. **Rationale:** While Health Canada is not aware of transfer factors to individual organs, or to organs in animals that are not ruminants, it would be beneficial to have a better understanding of radionuclide concentrations in the organs of other animals that may be consumed by local Indigenous communities.	1. Provide more clarification on how the mammalian organ ingestion rates are calculated (which animals and relative contribution percentages). 2. Provide a rationale for why concentrations of radionuclides were not assessed in organs of animals (other than moose) that are consumed as country foods by Indigenous people harvesting in the area.	*This IR is accepted for the purpose of the EA review, but the following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1. It is stated that the transfer factor (TF) for moose organs was scaled based on the beef organs transfer factor. What was this scaling value and was it similarly done for the caribou organs? (TF's for beef, moose, and caribou are presented in Table 2). 2. In Table 2, Denison used the feed-to-animal TFs for "Beef-liver" provided in Table G.3 of N288.1-20 for each of their listed RNs. Nowhere in Table G.3 is a TF for Lead-210 provided. Denison is requested to provide the reference for this TF value for Lead-210. 3. CNSC staff are interested in the worked calculations for one of the estimated tissue concentrations presented in Table 3.	Accepted	n/a
IR-198	IR-198-R1	HC	Change to an environmental component due to radiological contaminants	Annex 1 Response to Information Requests (Denison Mining) – August 18, 2023 IR-198 Response from Denison – COPC Concentrations in Organs (*Pages 74, and 354-357 of 419*) Appendix 10-A (ERA)	*Environmental Risk Assessment for Wheeler River* (September 9, 2022) does not include an assessment of radionuclides based on their mass concentrations in country foods (the assessment is only based on radionuclide concentrations). **Context:** As part of the response to IR-198 estimated Pb-210 concentrations in moose organ and caribou organ of 7.15 and 49.4 mg/kg (ww) are reported, respectively. However, Appendix 10-A: *Environmental Risk Assessment for Wheeler River* (September 9, 2022) does not include an assessment of lead among the non-radionuclide COPCs. Using the organ meat consumption figure from the Patuanak community (16.2 g/day), exposure to Pb-210 from caribou organ meat is estimated at over 11 ug/kg bw per day (based on the response to IR-198) which would be close to 10 times greater than the 95th percentile dietary lead exposure estimates for the general Canadian population consuming retail foods. **Rationale:** While the abundance of radionuclides may pose a health risk with respect to radioactivity, their presence as chemical contaminants may also have an impact on health. This is demonstrated by the case of Pb-210 described above. Due to their potential toxicological significance to human health, Health Canada recommends assessing arsenic, cadmium, lead and mercury as part of country food assessment, regardless of the method employed to determine COPCs.	1. Provide a rationale on why radionuclide mass concentrations were not assessed for their impact to human health. 2. Provide an assessment of Lead (Pb) as a chemical contaminant (non-radionuclide) COPC to better understand potential health risks and inform management, mitigation, monitoring and/or follow-up planning.	Version 2 of the Commitment Register (July 17, 2024) included a commitment (ID 8-44) related to monitoring mercury in country foods. The wording of this commitment is specific to methylmercury. It was identified that the draft text provided to Denison by CNSC in the May version of the IR review that the request for commitment was missing the following details: "…monitoring lead and mercury in country foods, as well as including **arsenic, cadmium,** lead, and mercury in any further assessment conducted to determine their potential risk to human health from consumption of country foods". The wording for Commitment 8-44 should be revised to fully capture these other COPCs. As well, CNSC staff noted that in their responses to IR-212-R2 and IR-100-R3, Denison has proposed a conceptual trigger-response mechanism framework. It is unclear to CNSC staff if this is referring to the monitoring detailed under Commitment 8-44, or if it is separate. If the latter, this conceptual trigger-response framework should be submitted to CNSC for review before it is finalized for implementation, for review as part of the licensing process. This IR is accepted for the purposes of the EA review, and the following must be corrected in the final EIS submission package: 1. Revise the wording for Commitment 8-44 to fully capture the other COPCs that Denison intends to include in their country foods monitoring. 2. Clarify if Commitment 8-44 will also include Denison's proposed conceptual trigger-response framework. *The following elements of this commitment will be further assessed as part of*	Accepted	n/a

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							licensing technical reviews, prior to the granting of a licence: 1. Establishing/confirming baseline concentrations of Hg in water, sediment, and fish tissues before construction; 2. Regular monitoring during construction, operation and post-closure; and, 3. Undertaking an HHRA should monitoring results exceed established/confirmed baseline levels, to inform decisions on adaptive management and mitigation measures		
IR-199	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Sections 3.2.1 and 3.3.1, Wheeler River Project IMPACT Model	**Context:** Model calibrated concentrations of selenium, uranium, and lead- 210 are under-predicted compared to measured baseline concentrations for water quality in the IMPACT modelling based on Figure 3-2. Calibrated concentrations of cobalt are under-predicted and there is poor agreement between model calibrated and measured concentrations of arsenic, lead-210, polonium-210, and radium-226 for sediment quality in Figure 3-3. **Rationale:** It is unclear how poor agreement between model calibrated and measured baseline concentrations of COPCs impacts the near-field and far-field modelling predictions of COPCs during all Project phases. It is also unclear why measured concentrations of COPCS could not be used directly as model inputs when there was poor agreement.	1. Provide justification as to why model calibrated concentration inputs of COPCs were preferable for use in predictive modelling of water and sediment quality over measured baseline concentrations. 2. Provide a rationale detailing how under- or over-predicted model calibrated COPC concentration inputs influence IMPACT model predictions and uncertainty for water and sediment quality. Provide specific details on how this may impact the risk analysis for parameters that have been highlighted as having poor agreement between calibrated and measured concentrations (i.e., arsenic, selenium, uranium, lead-210, polonium-210, and radium-226).	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent has not fully responded to either item for this IR. In the response for item one, the table provided in the response supports the statement added to Section 3.2.1 of Appendix A from Appendix 10-A, that there is little difference between the geometric and arithmetic means for parameter concentrations in water. It is important to clarify if this is also the case for sediment. Apart from arsenic and radionuclides, all modelled sediment concentrations are at or below geometric mean for sediment. Given that geometric means are typically lower than arithmetic means (and at most equal) this might indicate a consistent underestimation by the model for parameter concentrations in sediment. The proponent indicates that the geometric mean is more representative of the central value of the data distribution. ECCC does not support this view because a median or mode would be used to find a central value, depending on what was meant. The geometric mean may have been used because it is less influenced by outlier values, but these should be analyzed and removed if necessary before calculating the mean, as described in Section 6.3.3.6 of CSA N288.6:22. The only reference to geometric means in CSA N288.6:22 is for calculating means of literature values. Otherwise, when considering field data, an arithmetic mean is referred to. Typically, parameter concentration statistics are calculated individually for each site to highlight differences and help identify more sensitive sites. Differences between sites are expected because of differences in lake size, catchment area and other environmental factors. Pooling data from all sites smooths out high and low values, which compounds the smoothing done by using a geometric mean. This reduction in precision causes unreliability when evaluating model predictions, since the range of parameter concentrations at baseline is not well characterized. To address the lack of clarity, the Proponent should provide a table comparing arithmetic and geometric means for parameter concentrations in sediment, as they have done for water concentrations. If differences are significant, then modify graphs in Figure 3-3 of Appendix A from Appendix 10-A to compare arithmetic means of baseline data with modelled results. For parameters with sufficient data to calculate meaningful statistics, the Proponent should demonstrate that concentrations in Russell Lake are not significantly different	Accepted	n/a

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							than those in McGowan and Whitefish Lakes. If water quality is significantly different between lakes, then the Proponent should modify graphs in Figure 3-2 of Appendix A from Appendix 10-A to compare lake-specific baseline and modelled concentrations. In the response to item two, the statement "*it is not appropriate to calibrate the model to baseline conditions as we are most interested in impacted conditions*" is incorrect, because the point of calibration is to demonstrate the model correctly simulates site conditions to predict concentrations. Inaccurate model predictions during baseline indicate the site and its system of interactions is not well understood, and the model would not be able to produce accurate predictions during operations either. Section 7.3.6 of CSA N288.6:22 states "*The models may be calibrated to give the best possible agreement with available monitoring data so that risk assessors can have confidence in model-predicted concentrations for areas and media that are poorly represented in monitoring programs.*" The monitoring data is insufficient to characterize baseline concentrations for most of the parameters in water since there are often less than 50% of samples with concentrations above the detection limits. This limits the parameters that can be used to evaluate the model to concentrations in water of chloride, sulphate and arsenic, as well as concentrations in sediment. The Proponent should demonstrate the accuracy of the model by comparing model outputs with measured concentrations for those parameters where there is sufficient data to calculate meaningful averages, quantify model uncertainty, and discuss the influence of uncertainty on risk assessment conclusions. Denison is expected to: 1. Calculate the model to baseline conditions, compare arithmetic and geometric means for parameter concentrations in sediment; 2. Calibrate model to baseline conditions; 3. Calculate parameter concentration statistics individually for each site; and 4. Modify graphs as needed if significant differences are observed.		
IR-200	-	HC	Indigenous Peoples' health / Socio- economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19)	Indigenous consultation should be included in the Country Foods analysis. **Context**: The Proponent obtained country food consumption data through engagement with a single local fisher/trapper and from a dietary survey administered by CanNorth to the English River First Nations (ERFN) in 2017. However, the potential health risks to consumers of traditional food were only assessed using the data obtained from the CanNorth dietary survey. Section 10 of the EIS *states the following: "*The diet assumptions for the fisher/trapper are conservative and are based on engagement with a local fisher/trapper. The diet of the fisher/trapper is representative of one person, who consumes a unique composition and quantity of traditional foods (e.g., ingestion rate of 175 kg/yr of caribou, equivalent to approximately 2 to 3 servings per day). Most people fishing, hunting, and trapping in the Local Study Area and Regional Study Area would consume traditional foods more consistent with the average traditional foods consumer diet which was developed from the ERFN country foods study. In	1. Evaluate the suitability of using the 2017 EFRN survey results and consider surveying additional community members (such as local hunters/trappers) to obtain more representative country food consumption rates for use in the traditional foods risk assessment, and for communicating the results to the communities. 2. Additionally, consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately.		Accepted	n/a

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					comparison, the ERFN country foods study in Section 10 Appendix 10-A (ERA) Table 4- 4 indicates a caribou ingestion rate of 2.6 kg/yr (1 to 2 servings per month) and a total game ingestion rate of 21.3 kg/yr**”** *(p. 4.10).* **Rationale:** Health Canada is in general agreement that the dietary habits of the local fisher/trapper may be an outlier and not necessarily representative of most of the local population. However, a rationale has not been provided to demonstrate whether and how the 2017 ERFN dietary survey results are representative of consumption patterns of local Indigenous communities. Also, it is unclear whether or how the ERFN dietary survey results account for the consumption patterns of vulnerable or more sensitive subgroups (e.g., heavy consumers, children and women of child-bearing age)	**Suggestions for mitigation and follow-up measures:** Health Canada recommends providing the community with the opportunity to validate the ERFN 2017 survey results.			
IR-200	IR-200-R1	HC	Indigenous People'' health / Socio- economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19) IR-200 Response from Denison	The traditional foods risk assessment should be updated to include an “Intense Land User” scenario and consider all relevant sub-groups. **Context:** See ‘Rationale for Status’ in IR-200 **Rationale:** Health Canada notes that the response to IR-1 confirms that the use, diet and consumption rates used to assess the “Trapper” receptor are representative of “intensive land users” from the ERFN and possibly others. This change in the assumption is significant and should be integrated into the traditional foods risk assessment. Suggestions and follow-up measures have been provided to assist in responding to this information request, which benefits from the clarity provided in response to IR-1. Health Canada also notes that the response to IR-200 did not consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately.	1. Update assumptions used in the risk assessment to reflect the new information provided in response to IR-1. (e.g., the *ERFN Trapper’s use of the area as* ***representative*** *of current and future land users*). 2. Update the risk assessment in the EIS and ERA for the “Trapper” receptor (i.e., Intensive Land Users) to account for the **representative** nature of their described diet (i.e., consumption rates and composition). 3. Update the rationale and decisions related to management, mitigation, monitoring and follow-up. Include a specific discussion for those COPCs that contribute to elevated health risks among “intensive land users” and those raised by Indigenous communities (i.e., selenium, mercury & cadmium). 4. Revise receptor’s descriptor/title from “Trapper” to “Intensive land users” throughout the EIS and ERA to be consistent with proposed revisions made in response to IR-1. Consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately. Alternatively, provide a fulsome rationale to justify their exclusion.		Accepted	n/a
IR-201	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 5.0	**Context:** For the ERA methodology the Proponent followed CSA N288.6-12 for the assessment of risk to aquatic biota from radionuclide and non-radionuclide COPCs. This is the 2012 version, and a more recent 2022 version was publicly released. **Rationale:** The Proponent should review the most up-to-date version of the standard to ensure no changes to the methodology of the COPC exposure assessment are required for the ERA.	Update the COPC exposure assessment methodology in the ERA using the most recent CSA N288.6-22 standard, as needed.		Accepted	n/a

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IR-202	-	CNSC	QA/QC	Appendix 10-A (ERA), Section 6.0-Quality Assurance	**Context:** This section provides only Quality Assurance (QA) of the ERA, including planning and preparation of the ERA. **Rational:** The Quality Control (QC) aspects are not included. Both QA and QC aspects provide confidence that ERA results are defensible and fit for use in decision-making. The N288.6 (Clause 10.2) requires that “Appropriate QA/QC requirements shall exist for all aspects of the ERA and should be specified prior to conducting the ERA”.	Please include appropriate QC aspects, as per a Clause 10.2 of the N288.6.		Accepted	n/a
IR-203	-	CNSC	Sediment Quality and Benthic Invertebrates	Appendix 10-A (ERA), Section 6.2 Future Centuries Sensitivity Analysis	**Context:** This section of the ERA states “If treated effluent was released at the maximum upper bound discharge rate, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines.” It appears from Figure 6-2: “Comparison of maximum concentrations of COPCs in sediment at expected and upper bound discharge rate” that cadmium and vanadium would be over their sediment quality guidelines indicated if maximum upper bound discharge rates are used. **Rationale:** It is not clear which is correct; the statement that no exceedances of sediment quality guidelines when considering the maximum upper limit effluent release, or the figures indicating there could be exceedances for cadmium and vanadium. This discrepancy in the ERA should be explained and corrected.	Please provide clarity on if cadmium and vanadium are expected to be over the sediment quality guidelines for the maximum upper bound discharge rate scenario.		Accepted	n/a
IR-204	-	CNSC	Human health with respect to hazardous contaminants	Appendix 10-A (ERA), 7.1.1, Non-radiological Human Health Risk Assessment	**Context:** In the human health risk assessment of the non-radiological COPCs, it was determined that the Project incremental HQ was predicted to remain below 0.2 for all non-carcinogens and all pathways during all phases of the Project, except for selenium for the fisher/trapper at Russell Lake from the fish ingestion pathway. **Rationale:** Given that the fisher/trapper receptor will likely be exposed to higher concentrations of selenium from the consumption of fish at Russell Lake, there is an elevated risk of selenosis in exposed individuals. This potential for selenosis would be further exacerbated in individuals who consume fish taken from other lakes closer to the mining operation. There is, however, no discussion of mitigation of these risks to exposed individuals.	Please provide a discussion of measures that could be applied to mitigate the risk of selenosis in exposed individuals who consume fish from Russell Lake and other waterbodies closer to the mining operation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Selenium abatement technologies may be considered to eliminate or reduce selenium in effluent entering the lake system. • If HQs continue to exceed 0.2, then it may be necessary to post fish consumption advisories, in consultation with the Medical Officer of Health for the jurisdiction where the Project is located.		Accepted	n/a
IR-205	-	CNSC	Geology and Groundwater	Section 7, appendix H	**Context:** In this appendix the analytical concentration of various groundwater samples taken from monitoring wells is reported. **Rationale:** There is one sample labeled as “Tracer Tank” with no definition available in the current report. It is difficult to judge whether the results presented are relevant to the EIS and how it may impact the findings therein.	Please clarify the definition of “tracer tank”.		Accepted	n/a
IR-206	-	CNSC	Current use of lands and resources for	Section 11 Section 12 Section 15	**Context:** Impacts to Lands and Resources Use have been identified by Indigenous Nations and communities.	Please describe any outstanding or residual issues or concerns raised by Indigenous Nations and communities that Denison was unable to address. In addition, outline any plans to find		Accepted	n/a

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			traditional purposes	Section 16	**Rationale:** Additional information is required to demonstrate whether Indigenous Nations and communities were engaged directly by Denison regarding the cumulative effects assessment, significance determination and residual effects, and thus the overall conclusions on potential adverse impacts of the Project on the potential or established Indigenous and/or treaty rights and effects of changes to the environment on Indigenous peoples, pursuant to paragraph 5(1)(c) of the CEAA 2012.	solutions or continue discussions with the potentially impacted Indigenous Nations and communities.			
IR-207	-	CNSC	Current use of lands and resources for traditional purposes	Section 11, Perceived Risks to Lands and Resources	**Context:** The EIS states: "Resource users may also experience changes in their perception of the quality of resources for consumption such as the palatability of fish or wildlife or have apprehensions about the safety of resources for consumption. These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning. The ERFN refer to this indicator as a "psycho-social' effect, meaning that even if people know their fears are "*perceived fears, the fear … is real and has real impacts on ERFN members' perception of their overall health and well-being*" (ERFN and SVS 2022a)." (p. 11-11) Resource harvesters may experience Project-related disturbances and, depending on how these changes are perceived, it may cause some resource harvesters to avoid the Project Area. Reductions in harvests may occur based on fear or uncertainty about the ongoing quality of country foods. For example, "*People stopped picking berries in this area when Key Lake mine was established because of concerns about health impacts*" (ERFN and SVS 2022b). **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS will document specific suggestions raised by Indigenous groups for mitigating the effects of changes to the environment on Indigenous peoples (section 5(1)(c) of CEAA 2012). For the mitigation measures intended to address the effects of changes to the environment for Indigenous peoples, the Proponent must discuss the residual effects with the Indigenous groups prior to submitting the EIS." These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning.	How does Denison plan to work directly with Indigenous Nations and communities who currently use the potentially impacted areas, including the RSA, to mitigate and monitor the perceived risks and/changes to the RSA? Has Denison had discussions with the potential impacted Indigenous Nations and communities on how fear and avoidance behaviors and related impacts on traditional land use will be mitigated, especially within the RSA? Additional information is needed to determine if Denison has engaged directly with the Indigenous Nations and communities to develop potential mitigation measures to address fear and avoidance impacts, such as a community monitoring program, which could help to reduce the perceived risk to lands and resource use through education, collaboration, and long-term monitoring with Indigenous Nations, in order to build trust. **Suggestions for mitigation and follow-up measures:** It is recommended that Denison consider engaging with potentially impacted Indigenous Nations and communities on the collaborative development and implementation of a monitoring program to help address concerns about potential impacts on lands and resources as a result of the Project. The program(s) could help to monitor changes over time related the potential perceived risk of contamination of the land from Project activities and subsequent effects on the quality of fish, vegetation, and wildlife resources, which in turn could affect the safety of traditional foods and human health, and impacts on culture practices, and overall community well-being that travel to region yearly.	Response is accepted, but also see AD-60 in the Advice to Proponent table.	Accepted	n/a
IR-208	-	CNSC	Indigenous physical and cultural heritage	Tables 11.1-3, 11.1-4 and 11.1-5 Section 11.1.3.2.6	**Context:** Black bear is listed as a species hunted by several Indigenous nations, including Pinehouse residents. CNSC participated in an in-person engagement with Pinehouse residents in October 2022 and bears eating waste was identified as a concern for hunting and consumption.	Please specify measures that Denison will take to ensure bears and other animals do not scavenge from waste facilities.		Accepted	n/a

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					Rationale: Perceived risk of eating animals that are contaminated by hazardous or radiological wastes could deter community members from harvesting animals that are normally part of their traditional diet. Fencing for waste was specified as a deterrent for human trespassers, not animals.				
IR-209	-	CNSC	Indigenous Peoples' health / Socio-economic conditions	Section 12.1.4.2.1 (p. 12-22) Section 12.1.5 Section 12.1.6.2	**Context:** KML indicates that working at a mine camp could inhibit community members from participating in cultural activities and sharing them with family and community members, resulting in a loss of cultural knowledge and language, thus impact knowledge transmission (p. 12-22). **Rationale:** Denison addresses this by briefly identifying culturally sensitive policies which would eliminate residual effects (p. 12-30)	Please provide detailed proposed mitigation measure for KML's concerns related to loss of cultural knowledge and language should they work for Denison.		Accepted	n/a
IR-210	-	CNSC	Current use of lands and resources for traditional purposes	Section 12.1.4.2.2, Potential Effect 2: Change in Traditional Diet, Perceived Suitability of Country Foods (p. 12-26)	**Context:** The EIS states: "Project activities could change the perceived suitability of country foods. An ecological risk assessment (ERA) was conducted to consider both radiological and toxicological risks to ecological receptors such as terrestrial and aquatic invertebrates, terrestrial and aquatic vegetation, fish, and terrestrial and aquatic mammals and birds. Results for the radiological assessment predicted no exceedances of the radiation dose benchmark for the ecological receptors. For non-radiological COPCs, no exceedances were predicted except for selenium in fish from Russell Lake, based on a conversative dietary assumption for one resource user. The traditional foods diet for the fisher/trapper is conservative as it assumes that their annual fish consumption (183 kg of fish per year) would be obtained from Russell Lake, meaning the exceedance of the benchmark for selenium from fish would only occur if fish were only sourced from this one lake. This one exceedance could potentially change the perceived safety of country foods for community members and make country foods a less desirable part of a traditional diet. <u>Experience from other uranium operations in northern Saskatchewan suggests that resource use will continue despite the potential selenium exceedance. An examination of members of the Hatchet Lake Denesųłiné First Nation who live in Wollaston Lake near the Rabbit Lake operation found that over years of being active on the landscape both with and without the presence of the uranium industry, members had developed their own culturally appropriate practice of risk assessment and management based on their relationship with the land. Hatchet Lake Denesųłiné First Nation members appear to be more concerned with the direct effects of uranium mining on the local environment and less concerned about uranium mining's effects on their health through consumption of plants and animals. This is likely due to their high level of confidence in recognizing affected plants and wildlife and avoiding them (Elias et al. 1997).</u> The usage patterns of the ERFN Trapper have similarly allowed for continued use and access to areas proximal to other uranium operations. The ERFN Trapper had a positive relationship with other uranium operations in the ILRU LSA. He also continued to trap (i.e., used his trapline in Fur Block N-18), fish, and opportunistically pick berries, and consumed those resources during operations (KPI Program 2021). Good relationships between Denison and a	Given concerns with psycho-social impacts and the influence of perception discussed by ERFN earlier on in the EIS, does Denison have information on the perspectives from Indigenous Nations and communities to validate this conclusion is applicable?		Accepted	n/a

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					new trapper who eventually takes over the trapline from the ERFN Trapper would promote continued use." (p. 12-26) **Rationale**: The underlined reference suggests that negative perceptions may not prevent traditional resource users from continuing to consume, due to adaptation to potential risks in the environment.				
IR-211	-	CNSC	Accidents and Malfunctions	Section 14.6.1, Bounding Scenario 1, Vehicle Accident and Aquatic Release of Radioactivity	**Context:** Scenario 1 describes a spill of uranium concentrate into the lake. It's not clear how the ecological risk assessment was performed. It is stated that sediment concentrations in post-remediation conditions are expected to exceed the benthic invertebrate benchmark and that these results indicate that a spill of uranium concentrate could potentially affect benthic invertebrate populations following a spill, but the spatial extent would be limited. For water, it is stated that when evaluating the potential effect, a comparison was made between the results of the estimated short-term water quality 1,892 µg/L (1.892 mg/kg) and the guideline (33 µg/L). This indicates that there may be some aquatic species that could be affected, but the effects are expected to be transient as the water concertation quickly drops to a long-term level of 0.19 µg/L. However, when looking at dose to other receptors, the results of the ecological risk assessment indicated short-term ingestion of contaminated water resulting from an accident would not result in potential risks to grouse, vole, or deer, however rationale for how these receptors were chosen is not provided. **Rationale:** It's not clear from the EIS, why the receptors grouse, vole, and deer were chosen to evaluate ecological effects from a potential spill, and why they differ from receptors in the ERA. It is also not clear if the pathway from sediment ingestion/contact was considered for semi-aquatic receptors as they could be exposed to the increased concentrations post-spill. It is also not clear if SARA species exposure to sediment and water post-spill was considered.	Please clarify why grouse, vole, and deer were chosen as receptors for the ecological risk assessment performed for accidents and malfunctions scenario 1 and clarify if the sediment pathway to receptors post-spill was considered, as well as if SARA species were considered.		Accepted	n/a
IR-212	-	HC	Human health with respect to hazardous contaminants	Section 14 (p. 14-3) Appendix 16-C (p. 14 & 15)	The follow-up plan does not sufficiently describe how various parties will be engaged in the design, implementation, and review of monitoring programs. **Context:** Section 14 of the EIS states that "The overarching fear of contamination from the mine is woven in to almost every other concern noted by participants in the TK study. It is worth acknowledging this concern separately given the potential for mental health impacts related to people's experiences of fear and anxiety" (p. 14- 3). The commitment regarding monitoring and follow-up activities appears limited to *"shar[ing] information in a transparent manner with the General Public, and specifically those Communities of Interest and Nearby Land Users with whom Denison is regularly engaging about the Project. Such an information-sharing program would consider the involvement of the Regulators to make sure the information available addresses the issues identified as concerns"* (p. 14). **Rationale:** Country food safety is not regulated federally unless foods are sold	1. Provide details of how local, provincial and federal authorities, and Indigenous Nations and communities will be engaged in developing the follow-up and monitoring program, including the information-sharing program. 2. Describe the steps that will be taken if there are any exceedances of established benchmarks or deviation from predictions. **Suggestions for mitigation and follow-up measures**: Health Canada recommends that the Proponent's plan for communicating follow-up results (environmental and country foods) aims at, among other things, responding to community concerns regarding country foods to minimize avoidance of this resource. This goes beyond a passive dissemination of information and developing a strategy based on dialogue and		Accepted	n/a

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					commercially. Certain aspects of country food safety and availability may be covered by provincial regulators. It is unclear whether and how various levels of government and potentially affected communities would be involved in the development of the follow-up and monitoring program. It is also unclear what the information sharing program entails and how it would inform any adaptive management if monitoring results deviated from the prediction	the direct involvement of communities in monitoring, surveillance, and risk communication activities.			
IR-213	-	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A	**Context:** The Proponent states that the assessment of accidents and malfunctions began with the initial identification of hazard scenarios. Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. The hazard identification was conducted to identify a comprehensive list of potential project-related accident and malfunction scenarios associated with the key project components and activities with further details provided in Appendix 14-A. The initial hazards were then screened qualitatively based on likelihood and consequence to determine overall risk level using a risk matrix approach. Bounding scenarios were then selected from this initial list of hazard scenarios. The results of numerical analyses (RESPEC, 2021) of detailed strip model suggest that the deformation imposed on the cemented steel casing from downward movement of the rock mass may exceed the assumed casing-strain yield limits and the failure limit locally after extracting the uranium ore. However, this potential hazard is not identified in the hazard identification. **Rationale:** Exceedance of steel casing yield limits and failure limit would either compromise the steel casing integrity or damage the steel casing and result in the leakage of injected solution, which could impact on mine operation and contaminate the surrounding groundwater.	Please include the hazard of steel casing yield or damage in the table of hazard identification evaluation and conduct an initial risk screening and further detailed assessment as required.		Accepted	n/a
IR-214	-	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A, section 3.2.3	**Context:** Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. Details for how each of these project components and activities are considered in the initial hazard scenario identification process are provided in the accidents and malfunctions TSD (see Appendix 14-A; Ecometrix 2022). However, in Table 3-1 to Table 3-14 in Appendix A of Appendix 14-A, the following inconsistencies were identified: i. consequences for the hazards ID# 1.1, 1.5, 1.7, 14.2 include occupational major injuries; however, the severity (S) is denoted as number 2 that appears to be inconsistent with consequence rating number in Figure 14.5-2 ii. Hazard ID# 1.5 has a L=2, but it is described as a highly unlikely event, which is inconsistent with the term in Figure 14.5-2 iii. Hazards ID# 3.6 and 3.7 have a L=1, but they are described as low probability event that is inconsistent with the term in Figure 14.5-2	Please clarify or correct all inconsistent and/or inaccurate information in Tables 3-1 to 3-14 in Appendix A of Appendix 14-A.		Accepted	n/a

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					iv. Hazards ID# 8.2, 8.3, 9.1, 10.1 to 10.5, 11.1, 11.5 have a L=1, but they are described as unlikely events, which are inconsistent with the term in Figure 14.5-2. Rationale needs to be provided how stockpile erosion is considered to have a L=1 v. Hazard ID# 12.1 has a L=2 and S=3, but it's risk ranking is moderate, which is inconsistent with the term in Figure 14.5-2 vi. Hazard ID# 13.3 has a L=2. Based on the operation experience in the similar projects in the northern Saskatchewan, ponds lining failure and leakage is a very likely event. Rationale needs to be provided to support L=2 or change the number for L. **Rationale:** Inconsistent or inaccurate/incorrect information was included in Accidents and Malfunctions assessment.				
IR-215	-	CNSC	Human health with respect to hazardous contaminants	Section 14.6	**Context:** One of the potential risks of a uranium mine and mill is a spill of untreated effluent. **Rationale:** In the EIS, it doesn't appear that the scenario of a spill of untreated effluent to the environment has been considered. A failure of the piping containing the untreated effluent could result in an uncontrolled release to the environment and could affect the groundwater, soil quality, and terrestrial biota.	Please evaluate and provide the results for a bounding scenario of a spill of untreated effluent or provide justification for its exclusion.		Accepted	n/a
IR-216	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.1 Section 14.6.7 Appendix 14-A	**Context:** Radiological doses to human receptors, including workers (i.e., driver(s) of the vehicles), from the Bounding Scenarios 1 (Vehicle Accident Including Rollover, Collision, Run Off Road) and 7 (Vehicle Accident Including Rollover, Collision, Run Off Road) have not been assessed. **Rationale:** An estimate of the effective doses to human receptors, including workers, are required to determine whether the expected doses meet the dose limits set out in the Radiation Protection Regulations.	Provide estimates (including calculations) of the potential radiological doses to human receptors, including workers, resulting from Bounding Scenarios 1 and 7.		Accepted	n/a
IR-217	-	CNSC	Accidents and Malfunctions	Sections 14.6.1 and 14.6.2	**Context:** Highway 914 crosses the Wheeler River 10 km southwest of the access road junction. A vehicle accident, including a rollover, collision, or run off road, at or near the bridge could potentially result in a release of uranium concentrate and release of fuels and chemicals into the surface water at this location. Denison believes that a release of uranium concentrate and a release of fuels and chemicals at this location would bound the releases at any other water crossing along the transportation corridor. However, no information on what other water crossings along the transportation corridor exist and how bounding scenarios 1 and 2 would bound the risk of releasing uranium concentrate and fuels and chemicals at other crossings. **Rationale:** The release of uranium concentrate and fuels and chemicals at water crossings would contaminate the water body at the crossings and pose a risk to the environment and public health.	Please provide information on all water crossings along the transportation corridor and justification why bounding scenarios 1 and 2 would bound the effects of the accidental releases of uranium concentrate and fuels and chemicals at these crossings.		Accepted	n/a

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IR-218	-	CNSC	Accidents and Malfunctions	Sections 14.6.1.1 and 14.6.1.4	**Context:** Table 14.6-1 indicates that the average flow of Wheeler River south of Russel Lake is 17,340 L/s or 17.34 m3/s. This rate is used for uranium dissolution rate calculation. However, in section 14.6.1.4, it states that the average annual flow is 24.3 m3/s. In Table 14.6-3, the last two rows appear to be added wrongly. It also states that sediment quality results are shown in Table 14.6-5 for post-remediation conditions. During minimum flow conditions, the affected volume is expected to be smaller, resulting in a higher sediment concentration. In comparison, higher flow conditions are expected to result in a greater footprint and lower concentrations. However, in Table 14.6-5, the average sediments concentration and porewater concentration appear to be incorrect and switched between average flow and maximum flow. **Rationale:** Inconsistent/inaccurate information provided in the EIS.	Please clarify and correct the inconsistent information on average flow rate of Wheeler River at the crossing and incorrect information in Table 14.6-3, and average sediment concentration and porewater concentration under average and maximum flow conditions in Table 14.6-5.		Accepted	n/a
IR-219	-	CNSC	Accidents and Malfunctions	Sections 14.6.1.1.1 and 14.6.1.4.1; Sections 5.1.1 and 8.1 of Appendix 14-A	**Context:** When assessing the release characterization of Bounding Scenario 1, the Proponent assumed that 95% of the released uranium concentrate can be recovered from the release location without sufficient justification, and that different water column depths, i.e., 10 cm and 5 cm, and average water depth of 1.2 m at the release location were used without explanation. **Rationale:** As the recovery rate of the uranium concentrate would have an impact on the assessment of its potential effects, it is necessary to understand how the recovery rate and water level were selected for assessing this bounding scenario.	Provide further rationale for assuming 95% recovery rate and for using different water column depths for uranium concentrate release characterization.		Accepted	n/a
IR-220	-	CNSC	Accidents and Malfunctions	Section 14.6.1.1.1 Appendix 14-A, Section 5.1.1	**Context:** The Proponent states that based on drum deformations performed in a previous analysis (McSweeney et al. 2004), if a drum experienced a crush force of 100,000 lbs., then the deformation of the drum would cause the lid to detach from the drum. Using this drum failure mechanism, and assuming the drums weigh 450 kg and are arranged four across in the truck, at a speed of 48 km/h, the front 25% of the drums would fail, at 60 km/h to 97 km/h 55% would fail, at 145 km/h 75% would fail, and at ≥193 km/h all would fail. Given that the speed of the truck is likely between 60 km/h to 97 km/h, it was concluded that less than 55% of the drums would fail upon a traffic accident scenario. It is assumed to be 40 drums per shipment, so some stacking or rows of drums should be expected in this scenario. The drums stacked above could be at greater risk of deformation in a traffic accident. It is not clear whether drums stacking was considered in the previous study cited by the Proponent and whether less than 55% fail is still an adequate percentage of drum failures in such traffic accident scenarios if drums stacking is needed. **Rationale:** Drum failure percentage will impact the release quantity of uranium in such an accident scenario and then impact the consequence assessment. Therefore, the drum failure should be adequately assessed and supported with sufficient information and justification.	Please provide information and/or rationale as to whether drum stacking would impact drum failure at different speeds and confirm whether 55% drum fail for such an accident is still valid.		Accepted	n/a

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IR-221	-	CNSC	Accidents and Malfunctions	Section 14.6.1.3, Appendix 14-A, Section 7.1	**Context:** It is projected that there would be about 100 drums packaged per mill operating day. One trip per day for 330 days per year is assumed for the probability evaluation. This means 100 drums per trip, which is inconsistent with description in section 14.6.1.1.1 where assuming 40 drums in one shipment per day. **Rationale:** Shipments per day will impact the probability evaluation, and number of drums per trip will impact the release of uranium during an accident.	Please clarify the number of shipments per day and number of drums per shipment that are expected and re-calculate the probability as necessary.		Accepted	n/a
IR-222	-	CNSC	Accidents and Malfunctions	Section 14.6.2.4	**Context:** Bounding Scenario 2 consists of the aquatic release of fuel and hazardous chemicals due to traffic accidents. The EIS states that amongst the fuels considered for this scenario, the consequences of the release of gasoline and solvents are bounded by the consequences associated with the release of diesel. Both gasoline and solvents are lighter with higher vapour pressure; therefore, they have a shorter half-life in the aquatic environment and a lesser tendency for adsorption to sediments and suspended solids in the water column. There is no other justification provided to show that the release of diesel can bound other chemicals such as sulfuric acid and sodium hydroxide that are heavier than diesel. **Rationale:** The release of either sulfuric acid or sodium hydroxide during accident could change the water PH significantly at the releasing location, which would post a negative impact on the local environment.	Please provide further justification that the consequences of the release of sulfuric acid and sodium hydroxide can be bounded by the consequences associated with the release of diesel.		Accepted	n/a
IR-223	-	CNSC	Accidents and Malfunctions	Section 14.6.4.1 Appendix 7-A, Appendix K	**Context:** The EIS states that the 3D strip numerical model predicted that stresses and displacements did not show instability in the altered sandstone or basement rock at the location where a freeze wall would be placed around the Phoenix Deposit boundary (RESPEC 2021). The potential damage to the freeze wall due to mine-induced stresses and displacements under this scenario is excluded. **Rationale:** One outer section of the freeze wall (i.e., north-east freeze wall of the phase 4 mining area) and some internal cross walls are located in the desilicified zone. The RESPEC 2021 report (i.e., Appendix K of Appendix 7-A) appears not to have included the desilicified zone in the geomechnical modeling, nor is provided the stresses and the displacements/deformation of the area northeast of the phase 4 ore body where a significant extent of the desilicified zone exists.	Please provide information on the stresses and displacements/deformation of the area northeast of the phase 4 ore body from the geomechanical studies to demonstrate the resulted stresses and displacements will not impact on the freeze wall integrity after IRs for geomechanical studies for ore extraction are addressed. **Technical Discussion Required**: Yes		Accepted	n/a
IR-224	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** For the Bounding Scenario 5 (Process System and Piping Failure), doses to receptors at distances of 100 and 500 metres (0.25 and 0.01 mSv respectively) are predicted. The assessment also indicated that the dose to the unprotected worker staying inside the processing plant during the spill could exceed the 50 mSv dose limit specified by CNSC if workers did not leave the area quickly after the spill. The Proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 5 (Process System and Piping Failure).		Accepted	n/a

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					is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.				
IR-225	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** With the Bounding Scenario 5 (Process System and Piping Failure), the Proponent states that Denison ensures that the process is designed to include control measures to reduce the exposure to both workers and members of the public as low as achievable. The measures would ensure that the processing plant is adequately ventilated, and that spills or leaks are detected by loss of system pressure, observation, or flow imbalance. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 5, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 5, have been formally documented and incorporated in the engineered design of the processing facility.		Accepted	n/a
IR-226	-	CNSC	Accidents and Malfunctions	Sections 14.6.6.1 and 14.6.6.4	**Context:** It is stated that in the case of the accident and for a release amount of 1 kg inside the processing plant, the dose to offsite receptors at 200 m from the Project site was calculated to be less than the CNSC public dose limit of 1 mSv. The analysis also indicated that the dose to a worker in a full-face-piece powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. **Rationale:** Section 14.6.6.1 indicates that 2 kg of uranium concentrate could be released in case of the accident. No rationale is provided why 1 kg rather than 2 kg uranium concentrate is used for dose calculation. If 2 kg is used as the source term, the dose to offsite receptors at 200m and workers in the area would be higher.	Please provide the rationale for using a source term of 1 kg rather than 2 kg of uranium concentrate for the dose calculation to offsite receptors and workers. If sufficient rationale cannot be provided, the doses to offsite receptors and workers should be recalculated using 2 kg uranium concentrate, and the results provide.		Accepted	n/a
IR-227	-	CNSC	Accidents and Malfunctions	Section 14.6.6.1.1	**Context:** Bounding Scenario 6 involves a fire and/or explosion within the processing plant, resulting in the release of a large amount uranium to the atmosphere. The airborne source term for this scenario is estimated with equation developed by the United States Department of Energy (USDOE), where the respirable faction is assumed to only include particles of 10 mm and smaller. **Rationale:** No rationale was provided to support the consideration of only 10 mm and smaller particles. As provided in Table 14.6-3, the particle size of uranium <15 mm is less than 20%. Majority of the uranium particle size is larger than 10 mm. The airborne source term is an important factor for the effects assessment and should be calculated with transparent and justified information/data.	Provide rationale for only considering 10 mm and smaller particles for the respirable fraction.		Accepted	n/a
IR-228	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** For the Bounding Scenario 6 (Facility Fire and/or Explosion), the predicted dose is less than 1 mSv to a member of the public 200 metres away from the Project site. The analysis also indicated that the dose to a worker in a full-face powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv.	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 6 (Facility Fire and/or Explosion).		Accepted	n/a

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					The Proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.				
IR-229	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** With the Bounding Scenario 6 (Facility Fire and/or Explosion), the Proponent states that Denison would ensure that the design of the plant includes control measures to reduce the exposure to both workers and members of the public to levels that are as low as achievable. The measures would ensure that the processing plant is adequately ventilated. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 6, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 6, have been formally documented and incorporated in the engineered design of the processing facility.		Accepted	n/a
IR-230	-	CNSC	Accidents and Malfunctions	Section 14.6.7.4	**Context:** It is stated that a conservative penetration time of 15 min was applied in the assessment. Based on this assumption, the maximum depth of contamination could be 90 cm (for penetration rate of 0.1 cm/s). It is not clear why the penetration time of 15 minutes is considered conservative as the penetration time would depend on the time needed for the emergency response team to respond. It is also stated that the wide range of the calculated velocities is a result of variation of soil conditions and the slope of the surface. The distance that the groundwater can travel under these extreme (i.e., conservative) conditions ranges from 0.15 m to 100 m. It is not clear how the groundwater travel distance of 0.15m and 100m is calculated. **Rationale:** The penetration time will influence the penetration depth of the released materials, which in turn, considering the groundwater travel distance, will impact the potential areas and volumes of contaminated soils and shallow groundwater.	Please provide justification for applying 15 minutes of penetration time, and why it is considered conservative. In addition, please provide information on how the groundwater travel distance of 0.15 m and 100 m was obtained.		Accepted	n/a
IR-231	-	CNSC	Accidents and Malfunctions	Sections 14.6.6.4 and 14.6.6.5	**Context:** The EIS states that in the unlikely event of an unmitigated accidental release of uranium due to a dryer explosion, doses to the workers are expected to have a moderate effect, while doses to members of the public are expected to have a minor effect. Based on this evaluation, the severity of the consequences of this accident and malfunction scenario is predicted to be moderate. In consideration of both probability and consequences, the overall risk related to Bounding Scenario 6 is predicted to be low. **Rationale:** When there is an explosion within the process plant, it is likely there will	Please re-evaluate the consequence and the risk of Bounding Scenario 6 by considering the potential worker fatality resulted from an explosion.		Accepted	n/a

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					have worker fatality. The severity of the consequences of an explosion would be catastrophic and the risk of Bounding Scenario 6 would be higher.				
IR-232	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 14-A, Table 3-7, ID# 7.1 Appendix 14-A, Table 5-5	**Context:** The Proponent indicates in Appendix 14-A, Table 3-7 that a release of sulfuric acid is a low consequence event therefore would not require further assessment. However, according to a Safety Datasheet on high concentrated sulfuric acid (ICSC–0362 - SULFURIC ACID, concentrated (> 51% and < 100%) (ilo.org)), the substance is incompatible with certain materials and can give off toxic fumes. Furthermore, it reacts with various metals to produce hydrogen gas, which is explosive. The Proponent provides estimates of chemicals, including sulfuric acid, to be transported to site in Appendix 14-A, Table 5-5. The annual consumption of sulfuric acid is estimated at 15,417 m3, in 617 trucks per year, but the concentration is not stated. **Rationale**: Given the high reactivity and inherent corrosive nature of sulfuric acid combined with the volume and concentration that may be stored on site, ECCC requests that the Proponent provide a detailed risk assessment related to a terrestrial spill of sulfuric acid, specifically at the processing plant.	1. Provide the volume and the concentration of sulfuric acid that will be stored on site. 2. Provide a detailed risk assessment of the fate and behavior of sulfuric acid during a release into the environment.		Accepted	n/a
IR-233	-	HC	Human health with respect to hazardous contaminants	Appendix 14-A, Section 8.7 (p. 8.10)	An effects assessment for a transportation accident scenario involving radioactive materials was not included. **Context:** The Proponent provided an effects assessment relating to a diesel spill on the ground (Section 14 Appendix 14-A, Section 8.7). However, no information was provided regarding the potential human health effects of a uranium concentrate release at the two locations considered (Section 14 Appendix 14-A p. 8.10). **Rationale:** An accident involving radioactive material may have an impact on human receptors, based on the proximity of receptors and the proposed response protocols.	1. Assess and describe the potential health effects (chemical and radiological) of a transportation accident involving a uranium concentrate spill at the following locations: a) km 160 of Hwy 914, which is the location of a cultural camp that has been established by the ERFN. b) km 67 of Hwy 914, which is a gathering location for the Kineepik Métis Local associated with the Northern Village of Pinehouse. c) All other potential sites of importance for the public and Indigenous peoples.		Accepted	n/a
IR-234		CNSC	Effect of Environment	Section 15.2.2	**Context:** Effects of seismic events on the uranium extraction and post decommissioning are not assessed. **Rationale:** Seismic events could further exacerbate the stability of the voids induced by the uranium extraction, which will result in extra stresses and displacements/deformation in the overlying rock formations. These extra stresses and displacements/deformation could impact on the mine operation and post decommissioning groundwater flow and contaminant transport.	Please provide an assessment of seismic events on the mine-induced voids stability and the resulted effects on the mine operation and post decommissioning. **Technical Discussion Required**: Yes		Accepted	n/a
IR-235	-	ECCC CNSC	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** In this section it is stated that: "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit, following the RPC4.5 and RCP8.5 scenarios, respectively, as indicated by the Climate Atlas (PCC 2019)." RCP4.5 represents predicted climate conditions of a moderate carbon future.	1. Provide the source of the data displayed in Max 1-Day Precipitation (mm) category in Tables 15.5.1 and 15.5-2. 2. Provide detailed calculations for the following average values:		Accepted	n/a

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					RCP8.5 represents predicted climate conditions under a high carbon future. The values shown in Tables 15.5-1 and 15.5-2 show averages of 25.9 and 26.7 mm for RCP4.5 and 25.9/27.5 mm for RCP8.5. These values do not correspond to the source indicated by the Proponent. **Rationale:** Based on the Proponent's description we would expect to find the same values for "Max 1-Day Precipitation (mm)"in the Climate Atlas for RCP4.5 and RCP8.5 scenarios. ECCC was unable to duplicate the results. ECCC queried the Climate Atlas for Tomblin Lake and returned a result of "Region Geikie River." https://climateatlas.ca/find-local-data ECCC then queried the Climate Atlas for Max 1 Day Precipitation (mm). https://climateatlas.ca/data/grid/782/maxdaypr_2030_85/line https://climateatlas.ca/data/grid/782/maxdaypr_2030_45/line The results displayed an array of values ranging from 83.6 mm (2050) to 87.3mm (2092) for a Regional Concentration Pathway RCP8.5 scenario and values ranging from 48.9mm (2050) to 89.5 mm (2083) for an RCP4.5 scenario. These values do not match the averages shown in Tables 15.5-1 and 15.5-2.	• 25.9 mm 26.7 mm in Table 15.5-1: Predicted Climate Conditions of a RCP4.5 Moderate Carbon Future • 25.9 mm 27.5 mm in Table 15.5-2: Predicted Climate Conditions of a RCP8.5 High Carbon Future 3. Explain how the data shown in Tables 15.5.1 and 15.5.2 were used in the precipitation risk assessment. 4. Denote the differences between "mean", "value/max value", and "fluctuation", in the calculation of extreme event risk. 5. Compare model derived data against: 1. Natural variability of the observed data. 2. Variability in the statistics generated via observation based time series. **Technical Discussion Required**: Yes			
IR 236	-	ECCC ERAD	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** It is stated that, "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit…" As per the Proponent's description, Tomblin Lake was chosen as representative location for Wheeler when Climate Atlas was used as data source. **Rationale:** In those two tables, for the "Max 1-Day Precipitation (mm)" the historical average is given as 24.1mm. Local time series analysis for the climatic region in which Wheeler Project is located provide averages (for 1-day max precipitation) of approximately 30+ mm. It is the Proponent's responsibility to keep the required database current and up to date, because the length of the time series influences all derived statistics. Statistical analysis of extreme events is highly dependent of the mean with extreme values reaching values 3 to 4 times higher than the mean.	1. Provide a clear explanation on how the historical mean for 1-Day Max Precipitation was calculated. 2. Compare the values obtained via various means (ex: copied from the internet, modeled via some online algorithm, derived from specialty literature), against time series analysis based on observations. **Technical Discussion Required**: Yes		Accepted	n/a

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IR-237		CNSC	EA follow-up and monitoring program	Appendix 16-C throughout, including Table 1.5-1: Wheeler River Monitoring and Follow-up Program Summary (p. 8-15)	**Context:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS should provide discussion on the follow-up program's requirements, and include:
					• objectives and structure of the follow-up program and the VCs targeted by the program
					• tabular summary and explanatory text of the main components of the program including:
					  ○ a description of each monitoring activity under that component
					  ○ which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures)
					  ○ the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects)
					  ○ the specific monitoring objective for that activity
					  ○ planned schedule
					• roles and responsibilities to be played by the Proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the program results
					• possible involvement of independent researchers
					• program funding sources
					• information management and reporting (reporting frequency, methods and format)
					• possible opportunities for the Proponent to include the participation of the public and Indigenous groups, during the development and implementation of the program
					
					The follow-up program plan should be sufficiently described in the EIS to allow independent judgment as to the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures." (Section 11)
					
					Rationale: The Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information, and while some of the aspects detailed in the Generic EIS Guidelines are included, the aspects underlined are missing or appear incomplete.
					
					Further, all information from throughout the EIS should be incorporated into this Summary. For example, the EIS notes that: "Groundwater samples will be collected at least monthly and semi-annually in the wells within the freeze wall and on the freeze wall perimeter, respectively" (p. 7-109) and that "At least five to seven multi-well clusters are proposed across the mined area (Figure 7.8-2). Sampling will include KI parameters or the full suite of COPC at different times in the remediation process" (p. 7-111).
					
					These details (only examples) are not included in Appendix 16-C.
						It is recognized that this document will evolve over the planning process and be finalized prior to the EA Decision; however, as plans are developed and revised, CNSC staff expect that updates will be made to this document and provided with any future versions of the EIS.
						
						Appendix 16-C Summary of Monitoring and Follow-up Programs must include sufficient details to allow CNSC staff to determine the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures. This includes concrete monitoring plans (sampling locations, frequency, etc.).
						
						Additionally, please incorporate any relevant information included in the EIS into this Summary.
								Accepted	n/a

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IR-238	-	CNSC	Current use of lands and resources for traditional purposes	Various sections of the EIS, including: Section 8 Section 9 Section 10 Section 11 Section 12 Section 15 Section 16 Appendix 16-C (p. 3)	**Context:** The EIS indicates that "further detailed [follow-up and monitoring programs] will be developed as Project designs are finalized that may influence the nature, frequency, and locations of monitoring. In addition, input from regulatory agencies, the public and Indigenous Peoples will be considered." (Appendix 16-C, p.3) It is not clear in several section(s) of the EIS and the Indigenous Engagement Report, whether Denison has provided the interested Indigenous Nations and communities with the opportunity to participate in the development, implementation, and review of monitoring and mitigation measures, as per the guidance of REGDOC-3.2.2 and CNSC's Generic EIS Guidelines. **Rational:** As outlined in Section 11 of CNSC's Generic Guidelines for the Preparation of an EIS, please include roles and responsibilities to be played by the Proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the monitoring program results as well as possible opportunities for the Proponent to include the participation of the public and Indigenous Nations and communities, during the development and implementation of the program.	Please provide additional information to demonstrate whether Indigenous Nations and communities were engaged directly on the potential mitigation and monitoring measures to address the concerns raised regarding potential impacts of the Project on the potential or established Indigenous and/or treaty rights. Provide a rationale if this engagement has not been completed. As the Project develops, please provide concrete actions Denison will take in the follow-up and monitoring programs to engage Indigenous Peoples to alleviate concerns and incorporate their interests, and when this engagement is planned to take place.		Accepted	n/a

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[i]**Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation**
Health Canada, Water and Air Quality Bureau, October 2022

Health Canada (2022) provides a quantitative estimate of the risk of lung cancer associated with exposure to PM2.5 in Canada. The pooled hazard ratio (HR) for lung cancer mortality in the Canadian population is 1.127 (95% CI: 1.085, 1.170) per 10 µg/m3 increase in long-term exposure to ambient PM2.5. The slope coefficient (β) for this relationship is 0.01196, as derived below:

$$e^{(\beta\times 10\ \mu g/m^3)} = pooled\ hazard\ ratio\ per\ 10\ \mu g/m^3$$

$$e^{(\beta\times 10\ \mu g/m^3)} = 1.127$$

$$\beta \times 10\ \mu g/m^3 = \ln 1.127$$

$$\beta = (\ln 1.127)/(10\ \mu g/m^3)$$

$$\beta = 0.01196$$

The additional lung cancer mortality (over the baseline rate) from PM2.5 derived from a given source can be determined using the equation below, based on the attributable fraction or (HR-1)/HR (Greco et al. 2020):

$$ALCM = \left[\left(e^{\beta\cdot Exposure} - 1\right)\Big/_{e^{\beta\cdot Exposure}}\right]\cdot Baseline\ rate\cdot Years$$

ALCM = additional lung cancer mortality cases per 100,000 population

β = 0.01196 (slope coefficient from meta-analysis in Health Canada (2022))

Exposure = estimated PM2.5 exposure concentration from the relevant source(s) (µg/m3) (does not include baseline PM2.5 exposure)
Baseline rate = 45.5 per 100,000 (current Canadian Age Standardized Mortality Rate (ASMR) for lung cancer from Canadian Cancer Statistics Advisory Committee 2021); the Canadian baseline rate is appropriate as the slope coefficient was derived from Canada-wide studies and an updated ASMR of Canada (if available) would be appropriate for use in the calculation

Years = years of project or project phase

Sample calculation:

Project estimates an exposure from relevant source(s) of 0.067 µg/m3 over 50 years of operation

$$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) / e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$$

$$ALCM = \left[\left(e^{0.01196 \cdot 0.067} - 1\right) / e^{0.01196 \cdot 0.067} \right] \cdot 45.5 \cdot 50$$

ALCM = 1.8 additional lung cancer mortality cases per 100,000

References:

[1] Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian Cancer Statistics 2021. Toronto, ON: Canadian Cancer Society; 2021. Available at: cancer.ca/Canadian-Cancer-Statistics-2021-EN

[2] Greco, S.L., MacIntyre, E., Young, S. et al. An approach to estimating the environmental burden of cancer from known and probable carcinogens: application to Ontario, Canada. BMC Public Health 20, 1017 (2020). https://doi.org/10.1186/s12889-020-08771-w

[3] Health Canada. Lung cancer and ambient PM2.5 in Canada: a systematic review and meta-analysis.

[4] Health Canada, 2022. Available online at: https://publications.gc.ca/site/eng/9.907038/publication.html

Updated[1] Annex 6

Federal Indigenous Review Team (FIRT) Review of Denison Responses to Information Requests (IRs) and Supporting Documents Received February 10, 2024

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-01	-	English River First Nation (ERFN)	Current use of lands and resources for traditional purposes	General	**Context:** Denison has not gone far enough in terms of learning from and incorporating information from ERFN provided in the *Traditional Knowledge Study and Health and Socio-Economic Study Report*. It appears Denison put a disproportionate amount of reliance on the views and interests of one ERFN land user. While we applaud the efforts of Denison to seek feedback from ERFN land users directly and to work closely with such land users, ERFN's rights and interests in the region of the Project (and the potential of the Project to adversely impact such rights and interests) extend well beyond that of just one land user. **Rationale**: It is important for the Proponent and regulators to understand that while the rights and interests of individual ERFN members are important to consider, the Elders and elected leaders of ERFN represent the collective rights and interests of ERFN as a Nation. The results of the scoping study indicated that ERFN holds firmly established rights to the area where the planned project is located. Numerous studies conducted over several decades have examined ERFN's relationship and connection to land use and occupancy of the region where the proposed mine is located from traditional land use, subsistence harvesting, ecological, and sociocultural and economic perspective.	The draft EIS should be revised to reflect the totality of ERFN TK and land use information. Denison and CNSC must continue to work with ERFN to ensure that impacts on ERFN rights are appropriately and fully considered, mitigated, and accommodated.		Accepted
IR-02	-	Canadian Nuclear Safety Commission (CNSC)	Mitigation Measures	General Appendix 16-C	**Context:** Denison's 2019 Wheeler River Terms of Reference states: "The EIA will also discuss the monitoring programs required to demonstrate regulatory compliance and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders." The CNSC's Generic Guidelines for the Preparation of an Environmental Impact Statement (EIS), also state: "The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the Proponent intends to implement them and the environmental outcome the mitigation is designed to address. **Rationale:** The EIS and the Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information. It is not clear which monitoring programs will be employed to demonstrate regulatory compliance, and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders.	CNSC staff expect Denison to provide a comprehensive list of commitments along with the next version of the EIS, including any commitments made to Indigenous Nations and communities and other stakeholders (As committed in the Wheeler River Terms of reference, and as noted in the November 28th, 2022 email from CNSC staff to Denison: *Future Submission of a Commitments Table for Wheeler River EIS*).		Accepted
IR-03	-	CNSC	Site preparation	Section 1.3.2 Temporal Boundaries Appendix 10-A (ERA)	**Context:** The EIS and TSD-ERA provide assessment on the Project timeframe, including construction, operation, and decommissioning phases. **Rational**: The site preparation phase is not included in the timeframe (EIS and TSD-ERA). As per REGDOC 2.9.1, the sub-section 4.1.1 Complexity of the environmental risk assessment requirements states that "The applicant or Licensee shall identify facility characteristics and activities that may interact with the environment during the relevant	Please provide an assessment of those facility characteristics and activities that may interact with the environment during the site preparation phase, along with an assessment of their potential effects, in order to reflect the entire lifecycle or provide a rationale for its exclusion.		Accepted

[1] Updated November 20th, as the accepted responses by CNSC were based on draft responses that were not initially posted on the Canadian Impact Assessment Registry.

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					phase of the facility or activity's lifecycle (for example, site preparation, construction, operation, and decommissioning."			
IR-04	-	Environment and Climate Change Canada (ECCC)	Fish and fish habitat	Section 2, Project Description Section: Glossary	**Context:** The Proponent defines 'clean waste rock' as "Waste rock generated as sandstone cuttings and core from drilling activities associated with well and freeze hole development that does not have uranium containing materials". ECCC notes that the use of the term "Clean Waste Rock" could be misunderstood to mean that the waste rock is devoid of any contaminant. Even when the waste rock referred to as "clean waste rock" does not contain uranium materials, it could contain other metals or contaminants that could have adverse environmental effects. It is also not clear whether the "clean waste rock" is characterized for Acid Rock Drainage/Metal Leaching (ARD/ML) given that some portion of the basement rock is to be drilled out to anchor the freeze walls and may have ARD/ML potential. **Rationale:** The current definition of 'clean waste rock' in the draft EIS could lead to inappropriate handling and disposal if it is assumed to be devoid of any metals or other contaminants that might negatively affect the environment.	Provide a clear and more detailed definition of the term 'clean waste rock'.		Accepted
IR-05	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 2.2.1.2	**Context:** Water volumes for mud/diamond drilling is listed as minimal as the mud will be re-used. The mud is identified as a mixture of water, clay, and environmentally friendly polymers that clean out the cuttings and help to keep the drilling bit cool. **Rationale:** Although the mud for drilling will be re-used, there could be environmental impacts should there be an accident while drilling.	Please identify the components of the environmentally friendly polymers for the drilling mud and potential environmental impacts should the mud not be recovered.		Accepted
IR-06	-	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for Proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow", And that "The applicant or Licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems".	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.).		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.	3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.		
IR-06	IR-06-R1	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for Proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow", And that "The applicant or Licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems". Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.			
IR-07	-	ECCC	Fish and fish habitat	Section 2.2.1.4.2, Wellfield Operation Section 2.2.1.4.2.2, Secondary Containment of Mining Solution – Pumping	**Context:** The description in Sections 2.2.1.4.2 and 2.2.1.4.2.2 refer to the differential rates of injection and withdrawal, which implies that more solution will be withdrawn through the recovery well than volume of mining solution injected. According to the description of the site, a freeze wall will create a barrier between the uranium deposit to be mined and outside the isolated area to prevent inflow of groundwater from the sandstone outside the freeze wall. Secondly, it was indicated that the basement rock below the uranium deposit will prevent infusion of groundwater from below. The Proponent stated that inward hydraulic gradient will be created by recovering more solution than is being injected. In general, the wellfield will operate to draw a minimum of 1% more solution out of the wellfield compared to solutions injected in. This will help avoid increased subsurface pressures from injection pressure build up within the deposit. **Rationale:** It is not clear where the extra groundwater will come from that will sustain this differential rate of injection and withdrawals as the freeze wall and bedrock basement will isolate the injection well from groundwater. If it is assumed that there is limited amount of groundwater present in the sandstone layer above the uranium deposit, that amount of groundwater in the sandstone layer is finite and will be exhausted at some point. Therefore, it is not clear where the extra groundwater will come from. If the extra volume of water is not accounted for in the modelling, that would ultimately affect the volume of water that ends up in the receiving environment and likewise the amount of contaminants contained.	Clarify where the extra groundwater will come from to sustain this differential rate of injection and withdrawals during operation and if this extra water has been accounted for in the model and the amount of water that ends up in the receiving environment.		Accepted
IR-08	-	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.1.4.2.2 Project Description	**Context:** This section describes how an inward hydraulic gradient will be created within the mining area as a secondary containment method for control of mining solution. While the process is described, there is no information on contingency measures in place for pump failure or system maintenance solutions. There is also no information on how quickly the hydraulic gradient, and therefore secondary containment, would be compromised if any pumps stopped working. It is also unclear how primary containment (i.e., well design) failure, such as physical/mechanical issues compromising casings, would affect the creation of the hydraulic gradient and secondary containment as well. **Rationale:** It is important to have contingency planning in place in the event that there are any issues with the hydraulic gradient and secondary containment system for control of the acidic mining solution. There is no information in this section on how the hydraulic gradient (i.e., secondary containment) would be maintained if a well or pump (i.e., Primary containment) experienced problems.	Provide further information regarding how the inward hydraulic gradient system functions, with particular focus on how the hydraulic gradient and secondary containment will be maintained if any wells or pumps were compromised.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-09	-	CNSC	Geology and Groundwater	Section 2.2.1.4.2.2	**Context:** This section indicates that mining solution within the mining area can primarily be controlled by maintaining an inward hydraulic gradient. The inward hydraulic gradient will be created by recovering more solution than is being injected. **Rationale**: If, for some reason, the recovered solution is much more than that being injected, an excessive drawdown could be created. If, by accident, mining solution is leaking into the upper sandstone aquifer through crack in injection/recovery well casing at the same time, it would be challenging to remediate the upper sandstone aquifer in dry conditions (due to excessive drawdown).	Please clarify if any measure will be implemented to avoid excessive drawdown and develop contingency measures to address such accident.		Accepted
IR-10	-	ECCC	Fish and fish habitat	Section 2.2.1.4.2.3, Tertiary Containment of Mining Solution - Freeze Wall	**Context:** The Proponent stated that as a tertiary means of containment for the mining area, the uranium deposit is proposed to be surrounded by a freeze wall that extends from the surface to the basement rock, isolating the mining area from regional groundwater. Current plans are for the freeze wall to be a minimum of 10 m thick, be installed 25 m away from the uranium deposit, and extend 30 m into the basement rock (Figure 2.2-6). As explained in Section 2.2.1.4.2.2, mining solution will be injected into the ore zone under pressure and will likely react, not just with the uranium in the ore zone, but also the binding or cementing material in the sandstone. This means that some portion of the sandstone above the uranium layer and perhaps some portions of the freeze wall will dissolve, thereby creating more void than just the thickness of the uranium layer or horizon. The void may affect the integrity of the freeze wall as containment. **Rationale:** It is not clear how the Proponent will monitor the freeze wall to verify whether portions of the freeze wall are being dissolved in the mining process and how it plans to verify the integrity of the freeze wall as a containment for the mining solution. In addition, if the dissolution reaction of the uranium ore is exothermic, then the heat generated may also affect the integrity of the freeze wall.	1. Explain how the integrity of the freeze wall will be maintained as a means of containment that prevents migration of the mining solution out of the ore zone into the receiving environment. 2. Demonstrate that the mining solution injected under pressure will not compromise the integrity of the freeze wall as a containment. 3. Demonstrate how both exothermic and chemical reactions of the mining solution used to dissolve the uranium ore will not compromise the integrity of the freeze wall as a containment. **Technical Discussion Required**: Yes. ECCC would like to better understand the chemical constituents that compose the mining solution and the chemical reactions that it will cause.	The Proponent's response is accepted. Please also see AD-50 in the Advice to Proponent table.	Accepted
IR-11	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3 Project Description	**Context:** It is unclear how much contact water may be produced during the drilling of the mine well field during the construction phase of the proposed Project. Figure 2.2-14 indicates that no water will be produced during the drilling process in the construction phase. In Section 2.2.1.2 both mud rotary drilling and diamond drilling are proposed for the creation of wells. Both processes require water, however only mud rotary drilling produces liquid mud that is then reused in the drilling process. **Rationale:** It is unclear if the liquid mud produced during drilling can be reused indefinitely with further water additions, or if this eventually becomes the clean sand grain cutting and how it will be disposed of (i.e., liquid or solid waste). If the mud produced from drilling is classified as liquid waste and disposed of as contact water, it is not clear if this is accounted for in the site water management plan and water balance during the construction phase. Contact water from well drilling during the construction phase has not been quantified or accounted for in Figure 2.2-1, and therefore it is unclear if proposed infrastructure during the construction phase has the capacity to	Provide further information on potential wastewater produced during the construction phase from drilling processes, and if proposed infrastructure can contain any water produced.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					contain this waste stream in addition to the waste streams currently outlined in Figure 2.2-1.			
IR-12	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description	**Context:** There is not enough information provided within the draft EIS and site water infrastructure designs to determine if the infrastructure will sufficiently contain mine site contact and non-contact water runoff. It is unclear how water management will occur during all proposed Project stages at the Project airstrip, which is located away from the main Project site. No information has been provided regarding water that may come into contact with fuels and oils from machinery on the air strip, how and where that contaminated water will be treated, and how surface runoff around the airstrip will be managed. Additionally, it is unclear if contaminants from heavy machinery on roads have been considered during runoff collection plans throughout the mine Project site. Water management at the airstrip and roads can have impacts on surface water quality and sediment quality and contaminants (e.g., Hydrocarbons) from these sources should be considered in overall site water management plans. In Section 2.2.3.1 a site drainage plan for contact and non-contact water has been provided in Figure 2.2-17, and water balances have been provided for the different Project phases in Figures 2.2-14 to 2.2-16. In Section 2.2.3.4 a volume of 30,000m3 for the process water pond is provided, and it is stated that the process water pond has the capacity to contain Probable Maximum Precipitation (PMP) event estimated to be 483.3mm while allowing for 1.0m of freeboard. However, there are no estimates on the total volume of water that may be drained from the overall site infrastructure (i.e., the well field, processing areas, etc.) during a 24-hr PMP event. Additionally, in Figure 2.2.17 culvert locations are provided, however there is no further information on culvert designs, flow ratings and capacity for PMP events. **Rationale:** In order to be able to understand site water management and flood risk potential, more information needs to be provided regarding the site water infrastructure designs and capture volumes during PMP events. This information will aid ECCC in understanding how contact and non-contact water will be conveyed throughout the site. Runoff from roads and the site airstrip will contain contaminants from vehicles, heavy machinery, aircrafts and de-icing practices. Additional information on the runoff collection systems and expected contaminant concentrations for the site airstrip and roads is needed to determine if the receiving environment and aquatic and terrestrial receptors are protected.	1. Provide information on how contact and non-contact water from the site airstrip will be managed. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 2. Provide further information on how potential contaminants in runoff from roads have been considered in the site water management. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 3. Provide estimated volumes of water to be drained from overall site infrastructure (such as the mine terrace, airstrip, camp area etc.), during a 24-hr PMP event. 4. Provide additional information on culvert designs and conveyance capacity for PMP events.	In a supplementary submission provided by Denison on July 9th, 2024, much of the information requested has been provided. Table 1 of round 3 attachment IR-12 is a screening of constituents of potential concern (COPCs) in water catchments. For the "Camp" catchment, risks to the aquatic environment from nutrients is described as "*None expected.*" However, sewage spills occur occasionally at camps and would release nutrients which could reach the aquatic environment. Also in Table 1, a management/mitigation often referred to is, "*A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.*" No further details were found on how wash bay water will be handled such that it does not pose a risk to the aquatic environment. The Proponent is relying on its spill response plan to handle any spills from the freeze plant and substation as well as the camp. Section 14 of the EIS, Accidents and Malfunctions, does not discuss these hazards. Given the stated reliance on the spill response plan for brine and sewage spills on site, it will be important that the plan explicitly address brine and sewage spills. <u>In order to resolve this IR, Denison are expected to:</u> • Include nutrients from sewage as a contaminant of potential concern for the Camp Watershed in Table 1 of round 3 attachment IR-12 or provide justification why there are no risks to the aquatic environment from nutrients from the camp. • Clarify how wash bay water will be handled, given that it may potentially contain contaminants. *The following outstanding issue will be further assessed as part of licensing technical reviews, prior to the granting of a Licence*: • Denison will be expected to incorporate information provided in this supplementary submission in the Spill Response Plan. See also AD-75 in the Advice to Proponent table.	Not Accepted
IR-12	IR-12-R1A	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description Proponent response to IR-12	**Context**: Runoff water from site infrastructure such as the airstrip and roads may be categorized as non-contact water because it does not come into contact with contaminants of potential concern (COPCs) directly from mining operations infrastructure. However, it still has the potential to contain deleterious substances from mine-related activities such as operation of vehicles, including heavy machinery and aircraft, spills, fire management practices, and snow removal practices. The *Metal and Diamond Mining Effluent Regulations* (MDMER) pursuant to the *Fisheries Act* requires all mine effluent and seepage from the mine site that contains deleterious substances be discharged through a final discharge point. This includes deleterious substances in non-contact water from all site infrastructure including the airstrip, roads, and camp area.	1. Update site water management plans to include management of potentially deleterious substances contained in non-contact water from all site infrastructure. 2. Provide updated estimates of water volumes to be drained and managed from overall site infrastructure (including runoff from roads, airstrip, camp area, etc.) during the different Project phases. Include updated information on water treatment flows, capacity and effluent discharge during	To be resolved as part of IR-12.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: All mine effluent and seepage that contains deleterious substances must be discharged through a final discharge point. This includes site non-contact water which has the potential to contain deleterious substances such as those released from vehicles, machinery, aircrafts, spills, and de-icing practices. The Proponent has not included how non-contact water runoff from site infrastructure will be captured within site water management planning. To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the capture of non-contact water.	normal operations, and a 24-hr Probable Maximum Precipitation (PMP) Event.		
IR-12	IR-12-R1B	ECCC	Water Quality - Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description Proponent response to IR-12	**Context:** The Proponent has clarified that there is no infrastructure in place for management of non-contact water from site infrastructure that may contain COPCs, including but not limited to roads, the airstrip, and the campground. **Rationale:** To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the type of infrastructure and its location for the capture of non-contact water.	Provide a map marking the locations of proposed surface drainage structures for runoff collection including collection ditches, culverts, diversion ditches, perimeter berms, collection ponds and other similar structures.	See also AD-73 in the Advice to Proponent table.	Accepted
IR-13	-	ECCC CNSC	Fish and fish habitat	Section 2.2.4, Waste Management Section 2.2.7.7, Borrow Area Section 2.3.1.3 Site Preparation and Earthworks	**Context:** The Proponent indicates that a borrow area is planned for an area northeast of the processing plant. The borrow material or overburden will be used during construction for roads, airstrip, pads, and in the batch plant for concrete production needs, during Operation for ongoing maintenance of various Project components and during decommissioning for fill and cover material. Suitable construction fill material will be sourced from the proposed borrow area and any suitable clean sandstone generated during freeze wall and well drilling (Section 2.2.7.7). It was also noted in Sections 2.2.1.3 and 2.2.14 that the freeze wall will be established by drilling over 300 vertical holes from surface to the basement rock. The freeze holes will extend 30 m into the basement rock and will produce waste rock from basement rock (Figure 2.2-6). However, there is no information whether the waste rock from basement rock would potentially be acid generating and/or metal leaching. This means that all the extra 30 m of basement rock should also be characterized for potential ARD/ML to determine use or appropriate disposal. **Rationale:** ECCC notes that the Proponent did not indicate whether the borrow material and the drill out part of the sandstone layers and basement rock will be tested for Acid rock drainage/metal leaching (ARD/ML) potential before they will be used during construction, operation and decommissioning. ARD/ML is an environmental hazard that will have an adverse effect on waterbodies frequented by fish. Potential acid generating and metal leaching waste rock could pose negative impacts on the environment if they are not managed adequately.	Please provide: 1. Information on whether the waste rock from the basement rock is potentially acid generating and metal leaching; a. Confirm that any borrow material to be used for construction will be characterized for potential ARD/ML. b. Confirm that the part of waste rock recovered from the basement rock, will also be tested for potential ARD/ML. 2. Criteria for segregating the potential acid generating and metal leaching waste rock, if it exists, from clean waste rock; and, 3. A plan to manage the potential acid generating and metal leaching waste rock, if it exists.	Denison has captured their commitment to develop the waste rock segregation criteria and to develop appropriate mitigations and management for potentially acid generation (PAG) material in version 2 of the Commitments Register (ID 2-33), so this IR has been accepted.	Accepted
IR-14	-	CNSC	Wastes and Decommissioning	Section 2.3.3.1.3 Decontamination,	**Context:** The EIS states "Concrete foundations will be left in place. Any portions of concrete foundations remaining above grade will be levelled and rebar will be cut-off at	How has the proposal to leave these foundations in place been received by the Indigenous Nations and communities during engagement sessions? Have engagement activities influenced	Denison has captured their commitment related to addressing concerns from Indigenous Nations and communities on their decommissioning approach within the Preliminary	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Demolition, and Disposal (p. 2-82) Table 4.3-2: Key Issues and Concerns from English River First Nation (p. 4-33)	grade. Large slabs will be perforated on a 2-m grid to permit drainage. Concrete slabs will be covered with 0.5 m of development rock or locally stockpiled till." (p. 2-82) Further, Denison notes that "Concern about responsible authority for restoring the environment, including contaminants when mining concludes. How long will it take to have the environment fully restored and, if Denison is no longer the operator, how will this be completed?" (p. 4-33). This comment status is noted as *Complete*. **Rationale:** Permanent structures will remain following decommissioning, according to the excerpt above. It's unclear how engagement activities influenced Denison's planned decommissioning approach, or how the comment above has been addressed or received.	Denison's planned decommissioning approach? Describe in additional detail how the comment from p. 4-33 has been addressed and how this has been received by those who expressed this concern?	Decommissioning Plans in version 2 of the Commitments Register (ID 4-5), so this IR has been accepted.	
IR-15	-	ECCC	Fish and fish habitat	Section 2.2.3.4 Project Description Section 8.1.3.4.2, Aquatic Environnent	**Context:** In Section 2.2.3.4 it is stated that the estimated PMP event for Project infrastructure planning is 483.3mm. In Section 8.1.3.4.2 it is stated that the PMP is 489.3 mm. **Rationale:** It is unclear which value is the correct PMP value and if Project infrastructure has been planned correctly.	Provide the correct PMP value and verify that Project infrastructure has been designed utilizing the correct value.		Accepted
IR-16	-	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** The EIS and technical supporting documents do not provide sufficient justification for the selection of the proposed wastewater treatment systems for the industrial wastewater treatment plant or the domestic wastewater treatment plant. In addition, it is not clear how the upper bound of the industrial wastewater treatment plant effluent quality was obtained. **Rationale:** Draft REGDOC-2.9.2 formally documents the CNSC's expectations to Licensees for controlling releases to the environment. For proposed new facilities, these expectations include conducting a best available technology and techniques, economically achievable (BATEA) Assessment, and determining key parameters necessary to support the EIS. These include identifying: • environmental release targets to inform the design of wastewater treatment systems to constrain the quantity and concentration of contaminants and physical stressors released into the environment, • the best available technology and techniques through an options analysis; and • the anticipated influent characteristics, overall treatment efficiencies, and maximum predicted design release as the output of the assessment. Consideration of the principle of pollution prevention and BATEA is also a requirement of REGDOC-2.9.1. CNSC staff have met with Denison to discuss the expectations in draft REGDOC-2.9.2.	Please provide a summary of the BATEA assessment to justify the selection of the wastewater treatment plant system. As part of the summary, please identify the anticipated environmental release targets used to inform the design, as well as the maximum predicted design release concentrations and loadings to the receiving environment. The maximum predicted design releases should be used in the ERA to demonstrate protection of people and the environment.		Accepted
IR-17	-	CNSC	Human health with respect to	Section 2.2.3.8	**Context:** It is also acknowledged that Denison stated in meetings with CNSC staff that Denison intends to propose final release targets to the CNSC as part of the licence application submission.	Denison should harmonize their proposed Effluent Release Targets with the technology-based performance standards that exist in the Metal and Diamond Mining Effluent		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			hazardous contaminants		**Rationale:** It is not clear in the submission whether Denison has considered whether any applicable technology-based performance standards exist in Canada or internationally, and would be relevant as effluent discharge targets, in order to ensure principles of pollution prevention are applied. Consideration of this would help ensure that the proposed effluent discharge targets harmonize with existing federal, provincial/territorial, and/or municipal requirements. For example, there are release limits for radium-226, TSS, and pH outlined in the federal Metal and Diamond Mining Effluent Regulations, which have been demonstrated to be achievable in the uranium mine and mill industry. In addition, countries like the United States, where in-situ recovery has been conducted in the past, have specific technology-based limits. These are known as New Source Performance Standards and are identified in US Code of Federal Regulations (US CFR) 40, Chapter 1, Subchapter N, Part 440 – Ore Mining and Dressing Point Source Category. It is not clear whether these have been considered in Denison's assessment. These should be considered when identifying suitable achievable technologies.	Regulations where applicable, or other suitable international regulations.		
IR-18	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3.9, Project Description Appendix 8-E	**Context:** In Table 2.2-1 the upper bound Industrial Wastewater Treatment Plant (IWWTP) effluent quality final discharge targets for Constituents of Potential Concern (COPCs) are provided. General parameters (e.g., temperature, pH, etc.), and several Schedule 4 Substances with maximum authorized concentrations (lead, nickel, suspended solids, and un-ionized ammonia) under the Metal and Diamond Mining Effluent Regulations (MDMER) have not been provided in this table. There are several COPCs (aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese) for effluent characterization under Schedule 5 Section 4 of the MDMER that have not been provided in this table. Additionally, no information on water quality guidelines has been provided in this table. Furthermore, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. **Rationale:** ECCC requests the Proponent include the general water quality parameters that influence water quality thresholds, parameters in Schedule 4 and Schedule 5 Section 4 of the MDMER, and their respective water quality guidelines for consideration and transparency. Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non- acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.	1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 4 Substances under the MDMER with maximum authorized concentrations: lead, nickel, suspended solids, and un-ionized ammonia. 3. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 5 Section 4 parameters required for effluent characterization under the MDMER: aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese. 4. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. 5. Describe additional mitigation measures that can be considered to minimize impacts to aquatic biota from uranium concentrations in effluent.	In a supplementary submission provided on July 5th, 2024, Denison provided responses to the following outstanding requests: 1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include the following missing Schedule 5 Section 4 parameters required for effluent characterization: aluminum, iron, nitrate, thallium, and manganese. Provide further explanation if this information is not available. 3. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. Include information on the concentrations of modifying environmental factors (i.e. pH, hardness, etc.) used to calculate these guidelines as footnotes. 4. Provide a clear commitment to ECCC for continued consultation on developing effluent discharge targets including a review of final_predicted effluent discharge targets once available. *This IR is resolved for the purposes of the EA process. The outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a licence.* For item one, the effluent conductivity and TDS presented are not plausible, as explained in the FIRT's May 31st draft comments. As the conclusions of significance for the EA are not influenced by this error, the correct effluent conductivity and TDS will be assessed during the BATEA assessment required for licencing, and predictions will be updated by Denison as needed. It is recommended that conductivity not be used as a surrogate for TDS while monitoring, until the conductivity-TDS relationship is corrected. Follow up for item three is addressed in IR-108 and IR-115.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							To address item four, the Proponent will have to follow the guidance and requirements in REGDOC-2.9.2 to develop effluent discharge targets. The CNSC will engage with ECCC during this process as necessary.	
IR-19	-	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.4 Project Description	**Context:** In this section, it is proposed that the IWWTP precipitate pond will have a single geosynthetic composite liner system, which is used for ponds/pads that only store non-radioactive materials. However, from Section 2.2.3.9 on industrial wastewater treatment, it is unclear if the precipitates from the stage three neutralization process that are pumped to the IWWTP precipitates pond will have any residual radioactivity. **Rationale:** For the protection of the surrounding environment, it is important that any ponds/pads that are expected to store radiological contaminants be designed to have proper controls (i.e., liners with monitoring systems) in place.	1. Confirm the characterization of the precipitates that are to be stored in the IWWTP precipitate pond. 2. If radiological constituents are expected within those precipitates, update the draft EIS to ensure the proposed geosynthetic liner system for the IWWTP precipitate pond will be adequate to ensure the protection of the surrounding environment.		Accepted
IR-20	-	NRCan	Fish and fish habitat	Section 2.3.3.1.1 Appendix 7-C	**Context**: The Proponent's objective for mining area remediation is to restore the groundwater within the confines of the freeze wall to an acceptable remediation target (EIS, sec. 2.3.3.1.1). The Proponent's acceptable decommissioning objectives for groundwater quality are provided in EIS Table 2.3-3 and in Table 3-5 of Appendix 7-C. These objectives were based on laboratory core flood tests performed by flushing samples of ore with groundwater and groundwater amended with sodium hydroxide or sodium bicarbonate. The composition of the remediated groundwater observed in the core flood tests serves as the source term for the post-decommissioning reactive transport modeling presented in section 4 of Appendix 7-C. **Rationale**: In NRCan's opinion, it is important for reviewers to be able to assess the level of remediation achieved in order to reach the Proponent's decommissioning groundwater quality objectives. Therefore, the Proponent should provide complete water quality data for the pregnant lixiviant that remains in the ore zone after the end of mining and prior to any remediation.	NRCan requests that the Proponent revise Table 3-5 of Appendix 7-C to show the water quality in lixiviant remaining in the ore zone at the end of mining, prior to remediation activities.		Accepted
IR-21	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.3.3.1.3, Project Description	**Context:** The decommissioning process for the wellfield and associated infrastructure is discussed, however there is no information provided on the potential risk for subsidence of the ground above the depleted uranium deposit. After the uranium has been dissolved and pumped to the surface, a cavity will be formed in the area where the uranium used to exist. This could destabilize the overlying substrates, causing the ground at the surface to sink in the future. There is currently no information regarding this risk, and how it may alter the overlying environment, surface water features, runoff, or existing nearby waterbodies. **Rationale:** From a surface water and sediment quality perspective, it is important to understand how potential subsidence in the future post-decommissioning may affect the existing environment. It is currently unclear if there is any risk to the aquatic environment if subsidence were to occur and alter existing waterbodies, create new surface water features, or if there will be any risk to the decommissioned onsite industrial landfill and industrial wastewater treatment plant precipitate pond.	Provide further information on the potential risks from subsidence including the probability of occurrence, how it may affect surface water features, and if there exists any risk to the planned decommissioning of waste management infrastructure.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-22	-	NRCan	Fish and fish habitat	Section 2.10 Appendix 2-C, section 1.1.1.4	**Context**: With respect to the choice of In-Situ Recovery (ISR) mining solution, two alternatives were assessed: alkaline and acidic lixiviants (Appendix 2-C, sec. 1.1.1.4). In the consideration of technical and economic feasibility of the alternatives (Table 2, Appendix 2-C), the Proponent concludes that: Option 1 (alkaline) is not technically feasible based on the uranium deposit geochemistry. Option 2 (acidic) is technically and economically feasible based on the uranium deposit geochemistry and ability to dissolve uranium. Accordingly, the alkaline alternative was not carried forward into the Environmental Assessment (EIS, Table 2.10-1; Appendix 2-C, Table 3). While acidic ISR solutions are widely used internationally (e.g., Kazakhstan), in the United States, where the environmental regulatory regime is more strict, alkaline solutions have been used exclusively since 1970. **Rationale**: In NRCan's opinion, the Proponent should provide a more thorough technical justification for adopting an acidic ISR lixiviant.	In the Alternative Means Assessment (Appendix 2-C), NRCan requests that the Proponent provides a more thorough technical justification for selecting an acidic ISR lixiviant rather than a less environmentally problematic alkaline leach used exclusively in the USA.		Accepted
IR-23	-	CNSC	Alternative Means	Section 2.10.2 Alternative Means Appendix 2-A PD Engagement Tables Appendix 2-C Alternative Means Assessment (p. 3)	**Context:** There are multiple rows in the Indigenous Tables for Appendix 2-A where comments and concerns raised by Indigenous Nations and communities and other members of the public were taken into consideration in the Alternative Means Assessment. However, it is unclear how these were considered. A few examples: • 16-EN-DesNd-101.1: Interested in any future business opportunities that may be available as Denison advances their Wheeler River Project. • 16-EN-ERFN-100.15: In that territory near the Wheeler River there are a lot of spawning and calving areas for moose, caribou; those creeks are for whitefish spawning. There's lots of heavy muskeg there. A lot of us have been there, and we'd like to know there'll still be access to the area. • 6-EN-ERFN-100.17: Today because of climate change, things are starting to happen that normally didn't happen. Even the permafrost is now further down. In the Wheeler River area, where there's some permafrost, have your environment guys seen a change? Will there be a change? These are some of the questions that need to be answered in order to come out with a positive spin. **Rationale**: Appendix 2-C, Alternative Means assessment, states (p.3): "Engagement with Interested Parties naturally included alternatives means and the engagement input was included in the evaluation of alternative means. Refer to the references list below and *Appendix 2-A Engagement Database Summary – Project Description* for details of engagement information referenced in this alternative means assessment." It is unclear in section 2.10.2 of the EIS, Appendix 2-A or Appendix 2C how the comments documented by Denison have been considered or influenced the alternative means assessment.	Please explain how comments and concerns collected during Denison's engagement sessions were considered or influenced the alternative means assessment. Please include this information in the EIS and/or it's appendices.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-24	-	CNSC	Alternative Means	Section 2.10.2 Alternative Means	**Context:** While Appendix 2-C (Alternative Means Assessment) is detailed and includes all aspects of the Alternative means assessment that are required, the summary of the analysis and conclusions in Section 2.10.2 of the EIS lacks the level of detail required to understand the methodology used, and how Denison arrived at these conclusions. **Rationale**: As noted in the Agency's Operational Policy Statement on Addressing "Purpose of" and "Alternative Means" under the CEAA 2012: "If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the Proponent, and be documented in the EIS in sufficient detail to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the choice."	Please summarize the analysis of the alternative means assessment within the body of the EIS, in sufficient detail that a reader of the EIS has adequate information to understand the methodology used, and how Denison arrived at these conclusions. *Note: In addition to the adding text to summarize, Table 6 in Appendix 2-C could be useful to understanding table 2.10.1 in the EIS.		Accepted
IR-25	-	CNSC	Current use of lands and resources for traditional purposes	Section 3, Sections 4, Section 5, Section 11 (and all other applicable once Métis Knowledge Use Study is completed)	**Context:** The EIS states that Denison is currently negotiating an agreement with MN-S and no traditional land use information is included throughout the EIS given no agreement was signed or Traditional land use information was shared at the time the EIS was being drafted. As noted in the EIS Denison has committed that: "As information becomes available from the agreed-upon process between the Métis Nation – Saskatchewan and Denison, it will be incorporated into the final EIS." (p. 11-36) **Rationale:** More information is required to better understand the issues and concerns, valued components, and current use of lands and resources for traditional purposes by MN-S near the Project area. Requirements are detailed in CNSC's Generic EIS Guidelines, section 8.9: Indigenous land and resource use.	Please update the revised Draft EIS to reflect the integration of the Métis Use and Knowledge Study in the Draft EIS where applicable, when this study is completed and provided to Denison. In addition, please include an updated Issues and Concerns table that includes relevant information from the MN-S as a result of engagement activities and relevant MN-S studies in the next version of the EIS, as appropriate. Should this information not be made available to Denison at the time of revising the draft EIS, the next version of the EIS and the response to this IR should provide a status update on discussions and engagement with MN-S and next steps.		Accepted
IR-26	-	CNSC	Precautionary principle and approach	Section 3.4.8 Lands Taken Up from an Indigenous Perspective (p. 3-14)	**Context**: Denison states: "Discrepancies among IK and western scientific information provide an opportunity for Denison to take a precautionary approach. Examples of concrete actions to address uncertainty in cases where IK and LK have differing conclusions on predicted Project effects include addressing uncertainty through monitoring and follow-up programs and communicating results of those monitoring and follow-up programs to demonstrate they have been responsive to the IK shared." (p. 3-14) **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "In documenting the analyses included in the EIS, the Proponent will demonstrate that all aspects of the Project have been examined and planned in a careful and precautionary manner in order to avoid significant adverse environmental effects. A document by Canada's Privy Council Office, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making*." (Section 2.5)	Please clarify how the precautionary principle, and the Privy Council Office's, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making* has been considered and incorporated into the EA described in the EIS.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-27	-	CNSC	Cumulative Effects Analysis	Section 3.4.8	**Context:** During an outreach and engagement trip by CNSC in October 2022, an abandoned exploration camp adjacent to the proposed Wheeler River site was observed. This site has not been identified within the EIS as part of the cumulative effects assessment. As noted in section 3.4.8, KML has also raised concerns with Denison related to abandoned camps and industrial waste left with no programs for clean-up. **Rationale:** Section 9.4.3 of CNSC's Generic Guidelines for the Preparation of an EIS states that "The applicant shall assess any residual adverse environmental effects of the Project in combination with other past, present or reasonably foreseeable projects and/or activities within the study area."	Please specify why abandoned exploration camps and industrial waste aren't taken into consideration when completing cumulative effects assessment.		Accepted
IR-28	-	CNSC	Current use of lands and resources for traditional purposes	Section 4, IER and engagement appendices, including: Appendix 2-A Appendix 6-B Appendix 7-B Appendix 8-A Appendix 9-A Appendix 10-B Appendix 11-A Appendix 12-A Appendix 13-A Appendix 14-B	**Context:** The summary of issues tables do not appear to include all of the key issues identified by the Indigenous Nations and communities. For example, some Indigenous Nations and communities have shared concerns with respect to accident prevention and overall safety on the Key Lake road (Highway 914) due to increased traffic, impacts on treaty rights and section 35 rights due to cumulative impacts, and decommissioning, that were not captured in the issues and concerns and summary tables in Section 4.3.2 and in the IER. The tables in the engagement appendices include a column titled "Response (From Denison)". The "Response" column does not include responses, but instead points the reader to where this comment or concern was considered. When navigating to the sections referenced, it is often unclear how this information was considered or influenced the assessment. **Rationale:** Additional detail is required in order to ensure the key issues are all identified and to understand the status of validation for each issue raised and the response provided.	1. Update the summary of issues and concerns tables to include all relevant issues and concerns raised by each of the Indigenous Nations and communities to date, including concerns raised in the Indigenous Knowledge studies provided, additional engagement, and Draft EIS comments. 2. Please include a column in the issues and concerns tables to clearly articulate the specific mitigation/monitoring measures that Denison have committed to, or any other measures, in order to address the concerns raised by each Indigenous Nation and community during the engagement process to date. 3. Denison must demonstrate that each Indigenous Nation and community has validated that the summary of issues and concerns table reflects their understanding or agreement, and/or a path forward to complete the validation throughout the EIS and the updated IER. Validation must be complete by the time the technical review is complete, prior to submission of a final EIS. Should Denison not be able to fully address issues, concerns or feedback raised by any Indigenous Nation or community, through mitigation and monitoring measures, this should be documented, and a rationale provided. 4. Update the response column of the Engagement tables to describe how these were considered in the sections referenced. Consider renaming this column to reflect the nature of the content (i.e., how the information was considered).	This response has been accepted. Denison has provided fully updated information as of January 2024. It will be expected that a fully updated IER and issues and concerns tables for each Nation as per the original IR, be provided in future submissions, for CNSC staff awareness of progress on this work. This includes updates on the validation from all Nations and communities, or updated paths forward to validation, if applicable. Note: In the IER Denison provides this information in charts categorized by Nation and in the Appendix 4-B of the EIS, Denison instead includes one large chart with the concerns categorized by key topic. CNSC would recommend using only one method for both the IER and EIS, preferring the format used in the IER by Indigenous Nation and/or community.	Accepted
IR-29	-	CNSC	Current use of lands and resources for	Section 4.3.2 and IER	**Context:** In this section, Denison includes the engagement with BNDN and includes a summary of issues and concerns table for the Nation. Within the history of interactions (Section 4.3.3.2.1).	Please ensure updated information of any additional engagement activities that Denison has completed with BNDN related to understanding their current and traditional land use and potential interests near the proposed project is provided.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			traditional purposes		**Rationale**: Denison states that they have been providing information on the Project to BNDN in 2019, 2021 and again in 2022 and that Denison and BNDN have not responded to date in order to advance further engagement and dialogue.			
IR-30	-	CNSC	Indigenous physical and cultural heritage	Section 4.3.2.1.3, Table 4.3.2	**Context:** Concerns were raised during engagement sessions that "Elders are not being consulted as most of the engagement has been through online means and without a translator". **Rationale:** There's no indication that a translator has been employed to engage with Elders since 2021 in the engagement Table 4.3.2.	How has Denison adapted engagement with Elders from the ERFN since receiving this comment on March 31, 2021?		Accepted
IR-31	-	CNSC	Indigenous Engagement	Section 4.4.2.1.3, Key Engagement Activities (p. 4-88)	**Context and Rationale:** Regarding the following: "An open house for the general public was planned to be hosted in 2022 on preliminary effects and mitigation, but due to concerns identified by MN-S about hosting a public open house in a community with a significant Métis population, this meeting was postponed by Denison. Denison looks forward to rescheduling the meeting in collaboration with the MN-S." (p. 4-88)	Please provide an update on the evolution or progress of this engagement with local communities, following collaboration with MN-S (or otherwise).		Accepted
IR-32	-	CNSC	Current use of lands and resources for traditional purposes	Section 5.3 Section 9.0 Terrestrial Environment	**Context:** Some sections of the EIS (such as Fish and Fish Habitat, Indigenous Lands and resource use) indicate that Indigenous and/or local knowledge was considered when defining the spatial boundaries. However, this is not included in other sections, such as Terrestrial Environment. **Rationale:** Section 5.2.2 of CNSC's Generic EIS Guidelines require that spatial boundaries be defined by considering, but not limited to, the following criteria: Community and Indigenous traditional knowledge, ecological and technical considerations.	Please provide any additional details about how any comments or concerns raised were considered in defining the spatial boundaries with Indigenous Nations and communities with respect to spatial boundaries, for the Terrestrial Section and which specific Indigenous Nations and communities were engaged on these topics and how their input and knowledge was incorporated into the EIS. If already presented in the EIS text body, please indicate where this information can be found or link to Section 4 of the EIS or in the IER.		Accepted
IR-33	-	CNSC	Residual Effect Characterization	Section 5.8.1, Definitions for Residual Effects Characterization and Significance Section 5.8.1.1, Residual Effects Characteristics Section 8, Table 8.3-9: Fish and Fish Habitat - Surface Water Quality	**Context:** Denison uses specific criteria (Residual Effect Characteristics: Direction, magnitude, geographic extent, duration, frequency, reversibility, context and likelihood) and associated ratings (e.g., adverse/positive, low/moderate/high) for the predicted effects assessment. However, it is unclear whether an aggregation method was used in order to determine whether impacts will be significant or not significant, depending on the combination of rating categories (i.e., weightings that were calculated, use of decision rules). For example, medium term and long term are both used to represent the same time category: "Effects are expected to last between 3 to 38 years (i.e., effects expected during Construction through to the end of post-Decommissioning)." (See table 8.4-13 on p. 8-200 compared to table 8.4-12 on p. 8-199 and table 8.5-9 on p. 8-246). **Rationale:** The Generic Guidelines state: "The method used to describe the level of the adverse effect should be transparent and reproducible." In Table 8.3-11, duration was moderate, but again uses same rationale. There is no 'moderate' in Table 8.3-8, and by the same rationale, this should be medium-term to be	If an aggregation method was used and ratings (e.g., High, medium, low) were weighted, what weightings were used, how were these calculated? Please also describe any decision rules that informed the determination of significance. If no aggregation was used, how did Denison ensure that results were consistent, given the varying rankings for each of the key criteria, and varying combination? Regarding inconsistencies in ratings, please use consistent terminology for same rating.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					consistent with definitions provided and summary Table 8.3-12. It was noted that all three tables should be deemed medium-term based on definitions of ratings outlined in Table 8.3-8. Frequency was also showing up as "continuous" and "continuously" in these tables.			
IR-34	-	CNSC	Cumulative Effects Analysis	Section 5.9.2.2 (p. 5-41)	**Context:** Denison identifies the Gryphon deposit as a project that is not reasonably foreseeable. The direct quote from the EIS indicates that the "Development of the Gryphon deposit as an underground mine was evaluated at the prefeasibility level in 2018 but has not advanced to feasibility study or EA. Denison has not announced an intent to proceed with the development of the Gryphon deposit." (p. 5-41) **Rationale:** The guidance Assessing Cumulative Environmental Effects under the CEAA, 2012 defines *Reasonably Foreseeable* as a "physical activity [that] is expected to proceed, e.g. the Proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed." In a press release by Denison Mines (2018: Denison announces decision to advance Wheeler River Project following positive PFS results), Denison publicly disclosed intention to seek the necessary EA for Gryphon to proceed: "After careful consideration of the risks and opportunities associated with permitting and concurrent advancement of project engineering activities, the Company has decided to submit a PD and initiate the EA process in early 2019 for the Phoenix ISR operation, and to bring the Gryphon operation forward, at a later date, as required to achieve the PFS plan of Gryphon first production by 2030." Further, Denison's Wheeler River Webpage references a "start of pre-production activities for the Gryphon operation in 2026"	Please update the cumulative effects assessment in the EIS to include the Gryphon deposit as a Present or Reasonably Foreseeable Project.		Accepted
IR-35	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 6, Chemicals of Potential Concern	**Context:** The use of petroleum products (e.g., propane, gasoline, and diesel) at the Denison Mines Wheeler River site is associated with vehicles and periodic operational testing of emergency generators as well as stationary pumps for emergency power or fire water systems. Thus, the air emissions will contain acrolein. **Rationale:** This chemical of potential concern (COPC) poses potential risks to human health via inhalation, but acrolein appears to have been missed or deemed insignificant. However, its consideration in the assessment will provide information on the significance of the associated risk.	Please consider acrolein in the assessment or provide a rationale for its exclusion.		Accepted
IR-35	IR-35-R1	Health Canada (HC)	Change to an environmental component due to hazardous contaminants IR-35 Response from Denison	Section 6, Chemicals of Potential Concern	**Context**: Potential health risks from long-term exposure to acrolein were not considered in the Proponent's response to IR-35. **Rationale**: No annual predicted concentrations for acrolein were provided in the draft EIS or in the response to IR-35. Concentrations were modelled for short-term exposure (1h and 24h) only in the draft EIS and compared to the 1-hour and 24-hour Ontario Ambient Air Quality Criteria for acrolein. It is Health Canada (HC) guidance to assess both potential short and long-term health effects. The predicted annual concentrations for	Use predicted annual concentrations and available chronic reference concentrations to account for potential health risks from long-term exposure to acrolein to support the decision to screen out acrolein as a COPC from further assessment.	This IR has been accepted. In a June 27th, 2024 supplementary submission, updates were made to Table 3-10 in the Revised DRAFT EIS (January 2024; Appendix 10-A - Environmental Risk Assessment) to include the predicted maximum annual concentration for acrolein at the fence line, as noted in Denison's Response to IR-35.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					acrolein should be compared against chronic reference concentrations (e.g., the USEPA Reference Concentration (RfC)[2] (0.02 µg/m^3) and the Tolerable Concentration (TC) from Environment and Climate Change Canada and Health Canada's Priority Substances List Assessment Report[3] (0.4 µg/m^3)).			
IR-36	-	CNSC	Other	Section 6, Table 6.1-11 Baseline External Gamma Monitoring	**Context:** For one of the exposures in the summary table for baseline external gamma monitoring (Table 6.1-11), the cell states "Destroyed in Field". **Rationale:** No rationale or indication as to why or how it was destroyed is provided.	Please provide any additional info available as to how equipment was destroyed.		Accepted
IR-37	-	CNSC	Air Quality	Section 6.1.1.1, CALPUFF model	**Context:** "The Saskatchewan Ministry of Environment (SK MOE) has developed the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) to assist Proponents in conducting air dispersion modelling assessments in a consistent manner. The guideline defines the recommended approach for dispersion modelling assessments in Saskatchewan, including model selection, emission source characterization, and the determination of compliance criteria to apply." **Rationale:** Saskatchewan air quality guideline requires consultation on use of CALPUFF model, where it states" The ministry acknowledges that there will be situations where specialized air dispersion models such as CALPUFF, CALQ3HCR and others may be applicable. The use of specialized models requires consultation with the ministry" OR "Pre-consultation with the ministry must be undertaken prior to the facility conducting specialized modelling (p. 3)." It is not clear if Denison Mines consulted with Saskatchewan MOE on use of CALPUFF model. Noted that Section 6.1.4.2 is again referring to Saskatchewan MOE guidance for justification, but no indication that they consulted with them (a requirement).	Please confirm and provide a summary of the consultation with the Saskatchewan MOE on the use of CALPUFF model for the Wheeler River EIS as per provincial air quality guidelines.		Accepted
IR-38	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.1, Potential Interactions Between the Project and Valued Component / Key Indicators	**Context:** In this section, the Proponent identifies primary interactions between Project activities and air quality valued components and their associated key indicators. These primary interactions may result in an adverse effect on the valued component. Among the primary interactions are the use of emergency generators in a backup role should there be an interruption of the provincial electrical grid. However, it is not evident what is the anticipated frequency and duration of interruption to grid power. **Rationale:** The Proponent states in the conservative operation scenario that while the site will be powered from the provincial grid at the operations stage, the back-up power generators were assumed to be operating under emergency conditions as a worst-case scenario. ECCC acknowledges the positive impact of extending the electrical grid to the Project site with resultant reduction in generator emissions. The impact of an interruption in grid power would be greatest during the winter months when energy use	Provide an evaluation of a worst-case scenario of grid power interruptions (i.e., average aggregate length of power outages) during the winter months for this section of the electrical power grid.		Accepted

[2] https://iris.epa.gov/static/pdfs/0364_summary.pdf
[3] https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/psl2-lsp2/acrolein/acrolein-eng.pdf

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					would be greatest and surface-based temperature inversions, which vertically trap emissions, would be strongest.			
IR-39	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.2, Potential Project-Related Effects	**Context:** In this section, the Proponent discusses the approach taken for air dispersion numerical modelling. Using their CALMET data set, the Proponent's CALPUFF model runs indicated exceedances for 24- hour total suspended particulates, 24-hour particulate matter (PM10), 1-hour nitrogen dioxide, and 24-hour uranium concentrations. However, there is no mention of possible diurnal and seasonal occurrences of the exceedances. **Rationale:** Adequate assessment of the modelling results requires knowledge of the temporal characteristics for the exceedances. For example, wintertime exceedances may be due to strong temperature inversions, especially during the overnight to morning hours. These strong inversions are challenging for numerical models to capture. Exceedances during warmer months may be due to specific wind directions, which transport emissions directly to downwind receptors.	Provide additional information on any diurnal and seasonal influences of the modelled exceedances.		Accepted
IR-40	-	CNSC	Air Quality	Section 6.1.6.2.1, Air quality significance determination	**Context:** Significance determination was not conducted for air quality due to interconnectedness with other assessment endpoints. **Rationale**: It is not clear where and how these air quality assessment endpoints were factored into the assessment.	Please provide additional information to demonstrate where and how these air quality assessment endpoints were factored in.		Accepted
IR-41	-	CNSC	Air Quality	Section 6.1.6.2.2, Background concentrations	**Context:** The EIS states that "Conservative regional background concentrations from the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) and based on the La Loche monitoring station were used for particulate matter, NO2, SO2, and CO. The La Loche monitoring station is located near anthropogenic sources, while the Project is in a remote area removed from anthropogenic sources." **Rationale:** If La Loche monitoring station is located near anthropogenic sources and the Project is not, use of this data is not a conservative or realistic representation of background. For a realistic approach, background data considered should be upper 95th percentile (or max if n<10) from an area representative of project location For a conservative approach, background data from an area located even further from anthropogenic sources (if this exists) should be used, or an upper limit of background less than upper 95th should be applied as the background. Upper limit of background is used to screen out COPCs or often subtracted from total to ascertain relative contribution / impact from source, so using a higher upper limit may result in COPCs screening out or appear to have a lower relative contribution. If background was added to source, then approach used would be conservative. If this is the case, confirmation and reference to where this is discussed in methodology should be provided.	Please provide additional rationale to justify the appropriateness of La Loche monitoring station concentrations as background for project location.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-42	-	HC	Physical stressors (noise and vibration)	Section 6.2.4.2.2, (p. 6-66) Section 6, Section 6.2.9, (p. 6-72)	Nighttime noise impacts are not adequately considered for human receptors. **Context:** The EIS states in Section 6.2.9 that, "While the predicted sound levels were less than the guideline values, the increase from baseline was predicted to be noticeable" (p. 6-72). No information is provided on individual noise events occurring during the nighttime period. **Rationale:** While the increase from baseline is predicted to be noticeable, it is important to also consider that changes to the characteristics of the sound from baseline (e.g., a change in frequency, changes in sound modulation, increased impulsiveness or tonality, or a shift in noise from the daytime to being more at night) may cause noise to be even more noticeable. Consult ANSI S12.9-2005/Part 4, clause A.1.3 for further information. In particular, consideration should be given to potential impacts on sleep, where adverse impacts are reported to begin when sound levels inside bedrooms exceed 30 dBA for continuous noise sources and 45 dBA LAmax for discrete noise events (WHO, 1999).	1. Provide a description of the project- related nighttime noise sources that may impact human receptors as well as a qualitative discussion of the resulting potential impacts on perception considering not only changes in sound levels but also sound characteristics (e.g., tonality, impulsivity). 2. Confirm whether individual nighttime noise events exceeding 45 dBA LAMax outdoors (or 30 dBA indoors) are expected to occur more than 15 times over the nighttime period at any nearby potentially noise-sensitive human receptor location(s). This may be of particular concern if some construction and/or operations activities occur during sleeping hours.		Accepted
IR-43	-	HC	Physical stressors (noise and vibration)	Section 6.2.5, (p. 6-66) Section 6.2.5, (p. 6-71)	Mitigation measures for project-related noise were not identified for the Construction phase. **Context:** The mitigation measures provided in Section 6.2.5, including a complaint management system is also to be implemented as part of the EMS, are only proposed for the operations phase. However, construction activities are predicted to last more than one year. Construction noise will involve the use of equipment operating at the site, construction of surface facilities, drilling, and partial operation of the freeze plant. It will also include regular truck trips and air traffic for personnel changes. **Rationale:** It is unclear if listed mitigation measures also apply to the construction phase (or only to the operations phase).	1. Clarify whether mitigation measures and the proposed EMS apply to the Construction phase. If not, identify mitigation measures for noise impacts related to Construction phase activities, and consider applying the EMS to the Construction phase and implementing the community complaints and response procedure from the beginning of construction activities. 2. Health Canada suggests that construction noise lasting longer than 1 year be assessed as operational noise, and that noise mitigation measures be applied also to the construction phase. Special consideration should be given to mitigation measures for construction noise that occurs at night, in order to minimize impacts on sleep (i.e., avoiding tonal or impulsive noise sources at night). **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of Appendix H of Health Canada (2017), which identifies additional construction noise mitigation measures that could also be considered to reduce project- related noise.		Accepted
IR-44	-	HC	Physical stressors (noise and vibration)	Section 6.2.8, (p. 6-71)	The noise complaints resolution and response procedure is not sufficiently described in the EIS. **Context:** Section 6.2.8 discusses Monitoring and Follow- up. The Proponent indicates: "The EMS will also include a community complaints and response procedure" (p. 6-71). **Rationale:** Details have not been provided regarding how the complaints would be received, addressed or what the timelines will be for providing a response or resolution.	1. Provide the details of the noise complaints resolution and response procedure as per Health Canada (2017). 2. Consider conducting community consultations and/or implementing an advanced community notification system to pro-actively reduce the probability noise-related impacts and complaints.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					It is important to provide information to potentially affected communities in advance of particularly noisy activities. Community consultation and advanced notification of noisy activities has been shown to reduce complaints (see Health Canada, 2017).			
IR-45	-	HC	Change to an environmental component due to hazardous contaminants	Section 6 Air Quality Technical Supporting Document Section 6.3.1	The carcinogenic risks of diesel exhaust from the Project should be assessed. **Context:** Section 6.3.1 discusses modelled predictions of exceedances for Particulate Matter (PM). TSD p. 22 states: "concentrations of 24-hour PM2.5 are also elevated around the standby generators at the freeze plant, which emit fine particulate matter from combustion of diesel fuel". However, diesel particulate matter is not evaluated for the whole project in the air quality model or the air quality assessment. **Rationale:** Health Canada has determined that diesel exhaust is carcinogenic in humans which is consistent with the conclusion of the International Agency for Research on Cancer (IARC), and that diesel exhaust is associated with significant population health impacts in Canada. To characterize the carcinogenic risk of diesel exhaust from a project, HC has published a report (2022)1 which provides a quantitative assessment of the relationship between ambient PM2.5 exposure and lung cancer risk. Specifically, this report quantifies the increase in risk of lung cancer mortality (over the baseline rate in the Canadian population) due to PM2.5 exposure. This quantitative assessment is considered appropriate to characterize risks from diesel PM given the contribution of diesel exhaust to ambient PM2.5 in Canada, and that the carcinogenicity of diesel exhaust has generally been evaluated based on the respirable PM fraction1,2,3. **References:** [1] HC. 2022. Lung Cancer and Ambient PM2.5 in Canada: A Systematic Review and Meta-analysis. Available at: https://publications.gc.ca/site/eng/9.907038/publication.html [2] HC. 2016. Human Health Risk Assessment for Diesel Exhaust. Available at: http://publications.gc.ca/collections/collection_2016/sc-hc/H129-60-2016-eng.pdf [3] IARC. 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. https://publications.iarc.fr/Book-And-Report Series/Iarc-Monographs-On-The-IdentificationOf-Carcinogenic-Hazards-To-Humans/Outdoor Air-Pollution-2015	1. Evaluate the carcinogenic risk of all potential diesel exhaust from the Project based on the approach proposed by Health Canada (2022). Additional guidance (Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation") is provided as an appendix to this comment table.[i]		Accepted
IR-46	-	HC	Physical stressors (noise and vibration)	Appendix 6-A Table A-1	Low-frequency noise and associated potential human health effects were not assessed. **Context:** Some equipment that may emit low-frequency noise (LFN) have been listed in Table A-1: Assessment Scenarios and Sound Level Data (Section 6 Appendix A); however, no information describing potential impacts of this type of sound on nearby human receptors are presented.	1. Clarify whether any project-related activities (construction, operation and/or decommissioning) may produce LFN that could impact off-site human receptors. Evaluate LFN in the noise assessment, if and where applicable. See Appendix C of Health Canada (2017) for a discussion of LFN.		Accepted

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					Rationale: Low frequency noise can be associated with the introduction of noticeable vibrations and rattles in nearby structures. Research indicates that annoyance related to noise is greater when low-frequency noise is present (ISO 1996-1:2003). As sound environments are usually characterized using A-weighted decibel levels (dBA) that reflect the frequencies most audible to the human ear, the impacts of low- frequency noise may need to be assessed separately.			
IR-47	-	ECCC	Air Quality	Appendix 6-A, A.1	**Context and Rationale:** Verification of the following calculation is required for assessing predicted emissions of dust from general construction. It appears the result of 0.70 ton/acre/month is incorrect and should instead be 0.314 ton/acre/month. Appendix 6-A, Appendix A, A.1 (p. A4) TSP Emission Factor for General Construction: $EF\ (TSP) = 0.11 \frac{\frac{ton}{acre}}{month} \times 1.2 \frac{\frac{ton}{acre}}{month} \div 0.42 \frac{\frac{ton}{acre}}{month} = 0.70 \frac{\frac{ton}{acre}}{month}$	Explain how the emission factor total suspended particulates (EF (TSP)) result was obtained or rectify if it is incorrect and update the draft EIS to reflect the correction.		Accepted
IR-48	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, Figure 6.2.3, p. 6-57	Noise-sensitive receptors are not included on noise contour maps. **Context:** Noise-sensitive receptors are identified in the acoustic model report in Section 6 Appendix 6-E but not presented on any maps in the atmospheric and acoustic sections of the main report (Figure 6.2-3). **Rationale:** The noise assessment typically includes a map illustrating modelled noise levels from the Project at receptor locations in the study area. Certainty regarding the presence of human receptors in the regional study area is also recommended in order to assess cumulative impacts.	1. For more clarity, identify noise-sensitive receptors on Figure 6.2-3: Noise Assessment Study Area as well as on contour maps showing the baseline and predicted noise levels.		Accepted
IR-49	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The Noise Source Characterization is incomplete. **Context:** Section 3.0 of the Draft EIS Section 6 Appendix 6- E discusses Source Characterization. There is no detail regarding potential tonal or impulsive noise sources in Section 3.0. **Rationale:** The draft EIS should include a description of sound source characteristics (e.g., tonal, impulsive, highly impulsive) in order to properly inform the quantitative noise assessment and which assumptions/adjustments need to be applied and to properly evaluate impacts of project noise on health of affected receptors.	1. Identify any tonal, regularly impulsive, highly impulsive, or high-energy impulsive noises likely to be produced during project activities that could be audible at noise sensitive receptors. Furthermore, describe the timing (e.g., hours of night-time activities), frequency and duration of noise events, and their sound characteristics, including frequency spectrum. See Health Canada (2017) for details.		Accepted
IR-50	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The description of noise modelling does not document or justify the use of sound level adjustments**.** **Context:** ISO Standard 9613-2 has been used for the sound level modelling; however, it is unclear if all applicable adjustments have been considered as per ISO 1996-1:2016 (Table A.1).	1. Clarify whether ISO-1996-1:2016 has been considered in the modelling to account for any applicable sound level adjustments. Adjustments should be considered when calculating Ln (night- time sound level) and Ldn (day-night sound level). In addition, if applicable, adjustments can be applied depending on the noise characteristic (impulsive,		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: When modelling techniques are used to estimate present (baseline) or future (construction and operational) sound levels, these techniques and any accompanying assumptions, including the use of sound level adjustments, it is important to provide appropriate documentation and justification. Note that in situations where more than one source characteristic adjustment is applicable (e.g., impulsive or tonal), only the higher of the adjustments is used. However, all time-of-day adjustments and the quiet rural area adjustment are to be added to the highest of the applicable source adjustments.	highly impulsive, etc.), and because the Project location is considered to be in a quiet rural area. See: ISO 1996-1:2016 and Health Canada (2017) for details.		
IR-51	-	CNSC	Geology and Groundwater	Section 7, Figure 7.8-1 Appendix 7-C	**Context:** Figure 7.8-1 (p. 7-107, main EIS report) shows monitoring well cluster outside of the freeze wall. **Rationale**: It is not clear what the targeted hydro-stratigraphic units of each monitoring well cluster are. In addition, it is not clear how the establishment of the freeze wall and any leakage from the brine solution will be monitored. If there is any "window" within the freeze wall (i.e., the freeze wall is not continuous), is there any way to identify that?	Please clarify the targeted hydro-stratigraphic units of each monitoring well cluster in Figure 7.8-1 (p. 7-107, main EIS report). Please clarify how the establishment of a continuous freeze wall will be monitored.		Accepted
IR-52	-	ECCC	Fish and fish habitat	Section 7, Geology and Groundwater Appendix 7	**Context:** According to the Proponent, ''an acidic or low pH mining solution will be used to leach uranium ores from the ground. Mining solution may be a mixture of sulphuric acid, hydrogen peroxide, ferric sulphate, and freshwater (from shallow groundwater well or surface waterbody) or recycled water. Wellfield will consist of a combination of injection and recovery wells, in the general the arrangement of one recovery well in the center surrounded by four injection wells (5-spot pattern) with about 5 to 10 m between wells. The final wellfield is expected to include approximately 300 wells over an area measuring 90 m wide x 750 m long''. As the components/contaminants mentioned in the description of the hydrogeologic contaminant transport processes above may be transported to Whitesfish Lake through groundwater, the injection and recovery wells should be included in the model. **Rationale:** The hydrogeologic contaminant transport processes described above are an important part of the proposed Project and it is not clear why numerical modelling results and a sensitivity analysis for the above processes was not presented.	1. Explain why 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells was not presented. 2. Alternatively, provide simulation results and a sensitivity analysis for the injection and extraction of the acidic solution in the mining area.		Accepted
IR-53	-	CNSC	Geology and Groundwater	Section 7.3, Table 7.3.-2 Appendix 7-C	**Context:** The field-based hydraulic conductivity values (referred to as K values hereafter) in Table 7.3-2 (p. 7-32, main EIS report) indicate that the K value ranges of upper and lower sandstone aquifers have a significant overlap with those of the intermediate sandstone aquitard. However, the calibrated K value in Table 2-2 (p. 2.7, Appendix 7-C)) for the intermediate sandstone aquitard is close to the lower end of the field-based K value range, while the calibrated K values for the upper and lower sandstone aquifers are close to the upper end of the field-based K value range. **Rationale:** It is not clear how representative the calibrated K values are of the field-	Please provide additional information to support the representativeness of the calibrated K values (for example, use graph to present the measured K values and the calibrated K values).	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Please include figure(s) (y axis representing depth below ground, x axis representing K, different length of vertical line segment representing different packer testing intervals, etc.) showing the field measured K values, as well as the calibrated K value for the upper sandstone aquifer, intermediate aquitard, and lower sandstone aquifer. This would help demonstrate the distribution of field measured K values and representativeness of calibrated K values.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					based K values for each hydro-stratigraphic unit, and if the significant difference between the K values for the upper and lower sandstone aquifers and those for the intermediate sandstone aquitard is supported by the geological properties of the corresponding stratigraphy units. It is stated in the report (p. 7-36, main EIS report) that "Vertical fracture or fault zones that hydraulically connect the Local (upper) and Semi-Regional (lower) groundwater flow regimes are present throughout the Athabasca Basin". But fractures and fault zones are not explicitly considered in the model. There is possibility that these features could increase the hydraulic connection between the upper and lower sandstone aquifer.			
IR-54	-	CNSC	Geology and Groundwater	Section 7.3.1	**Context:** EIS states: "The most important associated topographic features in the region are the northwest to southeast trending drumlins and eskers…." This is not the trend shown on the provided maps, nor described elsewhere in the report, e.g., Section 7.3.2.1 **Rationale:** Inaccurate information in the EIS	Please update the EIS where required to accurately describe the topographical features.		Accepted
IR-55	-	NRCan	Fish and fish habitat	Section 7.3.3.1; Appendix 7-A, sections 3.4, 3.5, 3.8, 4.2; Appendix 7-C, section 2.8	**Context**: According to the Proponent's conceptual hydrogeological model (EIS, sec 7.3.3, Figure 7.3-7, Table 7.3-2; Appendix 7-A, sec. 3.4, Table 3-4), the horizontal hydraulic conductivity of the Intermediate Sandstone (Iss) aquitard is 8.4 E-09 m/s based on field measurements. The Proponent further assumes a 10:1 anisotropy ratio for the unit (Appendix 7-A, sec. 3.5.1) such that its estimated vertical conductivity is 8.4 E- 10 m/s. Based on this information, structural geology and groundwater quality data, the Proponent concludes that the connectivity between the Upper sandstone aquifer and the Intermediate Sandstone aquifer (sic) is limited (EIS sec. 7.3.3.3; Appendix 7-A, sec. 4.4). While acknowledging the paucity of conductivity data and the Proponent's attempt to mitigate this by leveraging collateral information on fracture frequency and clay content (Appendix 7-A, sec. 3.3.1), NRCan considers that the hydraulic conductivity assigned to the Iss aquitard is unrealistically low and inconsistent with the following lines of evidence: a) The conductivity value for the Iss is based on the geometric mean of 18 field measurements, 12 of which are from the same borehole (WR-695) located in the Gryphon zone, beyond the domain of the numerical model (Appendix 7-A, Appendix C, Table C-1). If the conductivity data were weighted equally, with one value per borehole, the geometric mean would be approximately 1.5 E-07 m/s, or two orders of magnitude higher; b) The Proponent notes that vertical fracture or fault zones that hydraulically connect Upper and Lower aquifer systems are present throughout the Athabasca Basin including in the Phoenix area (EIS, sec. 7.3.3.2.2; Appendix 7-A, sec.3.8.1); c) The Proponent notes that groundwater chemistry data (major ions) corroborate the presence of structurally controlled vertical hydraulic connections between the Upper and Lower aquifer systems (EIS, sec. 7.3.3.2.2, sec. 7.3.3.3; Appendix 7-A, 4.3.3); d) Groundwater chemistry data (Appendix 7-A, sec. 4.2, Table 4-1) also indicate the presence of detectable levels of "bomb" tritium (indicating recharge waters < 50 years old) in the Lower Sandstone Aquifer (GWR-025, GWR-008, GWR-033) and in the Iss (GWR-009, GWR-034), outside the area of U mineralization. This is also evidence of vertical hydraulic connection through the Iss. In summary, whereas the Proponent conceptualizes the Iss as a very low-permeability unit with localized vertical hydraulic connection (WS Shear), NRCan interprets the Iss as a "leaky" aquitard with pervasive fracture-controlled and much higher vertical hydraulic conductivity.	In the "Parameter Uncertainty Assessment" for the numerical groundwater flow model (Appendix 7-C, sec. 2.8), NRCan requests that the Proponent develop a calibrated numerical model with an alternate conceptualization of the Intermediate sandstone as a "leaky" aquitard with a horizontal hydraulic conductivity on the order of 1 E-07 m/s and a much lower anisotropy ratio. This should involve modifying the model lateral boundary conditions to allow for groundwater inflow/outflow across the entire thickness of the Athabasca Sandstone Group rather than just the Lower Sandstone aquifer.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: The significance of NRCan's alternative interpretation of the Iss hydrostratigraphic unit is that deep groundwaters, including mining-impacted waters, may represent a greater proportion of baseflow discharge to Whitefish Lake than the 1% currently estimated in the Proponent's groundwater flow model (EIS, sec. 7.4.2.1, p.7-51; Appendix 7-C, sec. 2.6.3).			
IR-56	-	CNSC	Geology and Groundwater	Section 7.3.3.2	**Context:** It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." **Rationale:** It is not clear why the exploration boreholes have not been decommissioned.	Please clarify why the exploration boreholes have not been decommissioned and the timeline to decommission the boreholes according to appropriate guidelines/procedures. If it is not decommissioned before the ISR operation, what is the potential impact of the unplugged boreholes on the mining solution migration?		Accepted
IR-57	-	NRCan	Fish and fish habitat	Section 7.3.3.2 Appendix 7-A, sections 3.1.2 and 3.7 Appendix 7-C, section 2.5.2	**Context**: The Proponent's conceptual model of groundwater flow in the Local Study Area (EIS, sec 7.3.3, Figure 7.3-7) involves an unconfined Upper system hosted by overburden and the Upper sandstone aquifer, and a Lower confined system hosted by the Lower Sandstone Aquifer. The Intermediate Sandstone aquitard acts as a confining unit. Vertical heads gradients are directed downwards west of the Phoenix deposit and upwards beneath surface water receptors including Whitefish Lake (EIS, sec. 7.3.3.2). Using head data from nested monitoring wells (Appendix 7-A, sec. 3.1.2, Table 3-1) the Proponent calculates upward gradients in cluster WR-607, between the Lower Sandstone aquifer and the Upper Sandstone aquifer. In cluster LA-5, an upward gradient is calculated between the Upper Sandstone and the overburden unit (Appendix 7-A, Table 3-5). In areas west and south-west of the Phoenix deposit, groundwater is estimated to flow downward under a vertical gradient of approximately 0.015 m/m (Appendix 7-A, p.3-15). **Rationale**: In NRCan's opinion, the Proponent's interpretation of vertical head gradients in the LSA is not fully accurate. For the "Up-Gradient" monitoring well cluster, the tabulated head data (Appendix 7-A, Table 3-1) and data logger hydrographs (Appendix 7-A, Appendix B) indicate a downward gradient (0.014 m/m) from the overburden unit to the Intermediate Sandstone and an upward gradient (0.056 m/m) from the Lower Sandstone to the Intermediate Sandstone. Head data from the "NW" monitoring well cluster indicate a similar pattern of downward (0.016 m/m) and upward (0.014 m/m) gradients converging in the Intermediate Sandstone. In the "Downgradient" and "SE" monitoring well clusters, head observations and data logger hydrographs indicate downward gradients from the shallow aquifer system but essentially equal heads in the Intermediate and Lower Sandstones. This more complex picture of groundwater flow systems in the LSA does not appear to have been captured in the Proponent's conceptual model. Given the importance of the baseline hydrogeological regime for predicting the transport and fate of COPCs in the post-decommissioning period, the	In section 2.5.2 of Appendix 7-C (Calibration Results), the Proponent should demonstrate that the numerical groundwater flow model reproduces quantitatively or at least qualitatively the vertical head gradients calculated from observations in the nested monitoring well clusters (Appendix 7-A, Table 3-1).		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Proponent needs to demonstrate that the numerical groundwater flow model accounts for observed vertical head gradients.			
IR-58	-	ECCC	Fish and fish habitat	Section 7.3.2.4, Ore Deposit	**Context:** The Proponent states that the Phoenix ore bodies are long and narrow (approximately 25 to 50 m wide) and are located within or near a graphitic pelite unit. Hydrothermal alteration associated with the ore zone is a discontinuous envelope of clay alteration and a sulphide-cemented rock zone that extends into the overlying sandstone and the underlying basement (Figure 7.3-3). This black, clay-rich zone is approximately 3 m thick on average and locally hydraulically isolates the ore zone from the overlying sandstones and underlying weathered basement rock. **Rationale:** As indicated by the Proponent, a 3 m black clay rich zone isolates the ore zone from the overlying sandstones and underlying weathered basement rock. It is, however, unclear whether this discontinuous clay layer will prevent downward migration of uranium-bearing solution into the Paleo-weathered basement rock or horizontal flow along the unconformity surface to escape into the environment. Escape of uranium-bearing solution into the environment will have a negative effect on the receiving environment.	1. Verify that there will be no downward migration of mining solution into the paleo- weathered basement rock or that there is no flow along the unconformity surface. 2. If downward migration of the mining solution occurs, explain how it will be mitigated.		Accepted
IR-59	-	CNSC	Fish and fish habitat	Section 7.4 Assessment of Project-related Effects, Figure 7.4-2 (p. 7-56)	**Context:** Figure 7.4-2: Simulated Change in Groundwater Discharge and Flow through Whitefish Lake Over the Life of the Project appears to be missing information. **Rationale:** Legend is included below the image, but the Legend box is blank. The green dotted line is not represented by anything in the legend.	Please update this Figure to ensure it is complete, and that features are properly indicated in the legend.		Accepted
IR-60	-	NRCan	Fish and fish habitat	Section 7.4.2.1 Appendix 7-C, section 5.2.1, Appendix B	**Context:** In the discussion of the limitations of the numerical groundwater flow model (Appendix 7-C, sec. 5.2.1), the Proponent invokes the well known modeling principles of "Occam's razor" and "Parsimony" which guided the parametrization of hydraulic conductivity in model layers. The Proponent states that hydrogeologic property values were applied uniformly for, among other units, the Lower Sandstone aquifer beyond the immediate area of desilicified materials. However, in the layer parametrization for the Lower Sandstone aquifer (Appendix 7-C, Appendix B, Figure B-5), NRCan notes a large zone of enhanced conductivity (1 E-05 m/s) extending south from Kratchkowsky Lake, which contrasts with the value (2 E-07 m/s) assigned elsewhere outside the desilicified zone. NRCan also notes the extremely detailed parametrization of hydraulic conductivity in the clay cap overlying the ore zone where borehole control is dense (Appendix 7-C, Appendix B, Figure B-6). **Rationale**: In NRCan's opinion, these model features appear to violate the principle of "Parsimony" and require greater justification supported by field observations.	NRCan requests that the Proponent provide justification based on field evidence for the multiple hydraulic conductivity zones assigned to the Lower Sandstone aquifer and the clay cap above the ore zone.		Accepted
IR-61	-	CNSC	Geology and Groundwater	Section 7.4.2	**Context:** There is no discussion of potential induced seismicity from mining processes. **Rationale:** Induced seismicity may lead to a loss of process as identified for natural seismicity.	Please provide information on the potential mining-induced seismicity.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-62	-	ECCC	Fish and fish habitat	Section 7.4.2, Potential Project-related Effects	**Context:** The Proponent indicates that the mining area includes: • the 'active mining area', which is the target ore zone; • a zone extending between 11 and 13 m above the active mining area that represents the maximum vertical height over which the injected mining fluids will migrate upwards from the ore zone during active mining; and • a zone extending 50 m vertically upwards from the active mining area (that incorporates the active mining area and the 11 to 13 m zone defined in the previous bullet) that was selected to account for potential upset conditions. **Rationale:** It is not clear to ECCC how the Proponent would be able to limit the mining solution migration within 11 & 13 m above active mining as the maximum vertical height over which the injected mining fluid will migrate. As the mining fluid will be injected under pressure into zones with possible presence of fractures, the pressure may also cause additional fractures and given that the solution is warm/hot will possibly dissolve the other cementing material in the sandstone above, making it difficult to accurately predict where the solution will migrate to.	1. Explain plans to limit the upward migration of mining solution into the overlying layer to 11 and 13m above the ore zone. 2. Explain what impacts will occur if the mining solution migrates beyond the predicted height.		Accepted
IR-63	-	CNSC	Geology and groundwater	Section 7.4.2.1, Potential Effect #1: Groundwater Quantity – Construction to Decommissioning Appendix 7-C, Section 2.7, Groundwater Conditions During Mine Operations	**Context:** The numerical groundwater model described was calibrated to observed water level and stream baseflow data. Table 7.4-3 in the EIS indicates that Denison recognizes the potential for freeze wall operation to impact groundwater quantity. To simulate this impact, the model was adapted to reduce recharge (to 50%) within the freeze wall area, reduce hydraulic conductivity associated with the vertical freeze walls, and simulate pumping within the freeze wall area. Recovery from pumping and effects on discharge to groundwater discharge to Whitefish Lake are discussed in the potential effects section. **Rationale:** Although this assessment considered drawdown of the water table and discharge to Whitefish Lake, the discussion did not address the potential effects of operating the freeze wall on the local and semi-regional groundwater regimes. What would the pathway be for groundwater to pass around the freeze wall? What is the basis for the parameters selected, e.g., 50% recharge and lower hydraulic conductivity for freeze well? These factors need to be considered when evaluating the potential impacts of freeze well operations on groundwater flow conditions and corresponding receptors.	Please provide a more fulsome discussion on the impact of freeze wall operations on local and semi-regional groundwater regimes and potential receptors. Please provide the rationale for assumptions made for key model parameters (e.g., selection of 50% recharge, hydraulic conductivity value used to represent freeze wall). In addition, please discuss the potential pathways for groundwater flow around the freeze wall, complete with figures demonstrating these pathways.		Accepted
IR-64	-	ECCC CNSC	Fish and fish habitat	Section: 7.4.2.2, Potential Effect #2: Terrain Morphology and Stability – Operation Appendix 7-A, Appendix K (p. 12)	**Context:** The Proponent stated that the geological assessment predicted maximum vertical displacement in altered sandstone immediately above the mining area (17.5 cm). A very minor change in elevation at ground surface (of less than 7.5 cm) was predicted within a discrete and localized area overlying the ore body. The modelling work is considered to provide a worst-case bounding scenario. If subsidence were to occur over the lifetime of the Project, or in the years following mining, the extent of vertical displacement is not expected to exceed that predicted in the modelling, which is based on an assumed volume extraction. **Rationale:** ECCC notes that the thickness of the ore zone has an average thickness of 5 m with a range of 2 to 17 m, and is 25-50 m wide and that the overburden rock above the ore zone measures about 400 m. Therefore, it is not clear how the Proponent determined that the surface expression of a subsidence on the surface if it occurs will be limited to 7.5 cm and localized. A subsidence greater than 7.5 cm, implies that the void	Explain: • Will this be revisited with updated data based on extraction feasibility results? • How will the surface expression of a subsidence will be limited to 7.5 cm and localized? **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent consider implementing remediation measures immediately after mining to prevent subsidence from occurring in the first place.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					in the ore zone will be narrower, and will affect the amount of water migrating through the zone. It was the recommendation of the consultant who conducted the work in Appendix K that more accurate material properties should be used for future modelling.			
IR-65	-	CNSC	Geology and Groundwater	Section 7.4.2.2	**Context:** It is stated the maximum subsidence is 7.5cm based on modeling with an assumed volume extraction. Has subsidence from dewatering/pumping and from lack of inflow of groundwater due to freeze wall been considered? **Rationale:** Surface facilities and wells may be impacted if there is unaccounted for subsidence.	Please provide additional details for any dewatering/pumping induced subsidence.		Accepted
IR-66	-	CNSC	Geology and Groundwater	Section 7, Table 7.5-1, Row 1, Column 6	**Context:** Column 6 in Table 7.5-1 indicates the mitigation measures for a valued component. For Row 1, Geology, there is no description of mitigation measures but only that contingency plans will be developed if based on monitoring. **Rationale:** Subsidence may impact wells and surface infrastructure.	Please provide additional details on monitoring and contingency plans related to the geological environment (e.g., subsidence), including triggers for implementing such plans.		Accepted
IR-67	-	CNSC	Geology and groundwater	Section 7.6.2.1 (Remediation Objectives)	**Context:** Metallurgical testing, including batch reaction, coreflood testing and column tests are mentioned frequently throughout Sections 2 and 7 of the EIS. Outside of the composition of restored solutions from coreflood tests #2B and 3C, results from these various tests are not reported in the EIS or any associated Appendices. **Rationale:** The results from metallurgical testing are important to a number of items discussed in the EIS, including (but not limited to): evolution of hydrochemistry during remediation, source of salts in Lower Sandstone Aquifer porewaters, process plans, industrial wastewater treatment, estimating composition and volume of process precipitates, and composition of mining fluids and leachate. In particular, the EIS posits that mining area decommissioning objectives are achievable based on metallurgical testing and provides these objectives in Table 2.3-3. CNSC staff need to understand the specifics of this metallurgical testing, given its importance for the development and justification for mining and remediation activities. Denison must also provide information demonstrating that the proposed restoration actions and remediation targets are As Low As Reasonably Achievable (ALARA).	1. Please provide a summary of the results and the analysis of results of the metallurgical tests within the EIS, or provide the technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. This should include sample information for cores (e.g., mineralogy, location, U content, depth), test conditions (e.g., duration, # of iterations, column length, flow rate, temperature, pressure, sample frequency, influent/effluent composition), as well as results and how they are pertinent to the development of ISR activities. 2. Please provide further clarification/justification on how results from two singular coreflood tests (i.e., Coreflood #2B and Coreflood #3C) can justify large-scale remediation activities and targets following solution mining. 3. Please provide material demonstrating that the proposed restoration actions and remediation targets are ALARA.		Accepted
IR-68	-	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.3, 4.1, 4.4.4 and 4.7	**Context**: Sources terms for the COPCs considered in 3D reactive transport modeling are given by the composition of "Restoration Solution #1", which the Proponent believes is representative of groundwater quality in the ore zone after remediation at decommissioning (Appendix 7-C, sec. 3.3, Table 3-5; sec 4.0). The Proponent considers COPC source terms as "initial conditions" for groundwater quality in the ore zone at the start of the model simulation period. During the simulation, no additional mass of COPCs is transferred to groundwater in the ore zone. **Rationale**: In NRCan's opinion, this representation of COPC sources is not conservative as it fails to account for various long-term slow mass release processes. These processes	NRCan requests that the Proponent's reactive transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) consider extended source release periods for additional COPCs.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					could include redissolution of secondary phases formed during ISR mining (e.g., radium-bearing gypsum or barite, jarosite, alunite) and migration of unrecovered lixiviant or restored solution from low-permeability regions or stagnant zones that were not fully swept during mining or remediation. NRCan notes that scenario #2 in the Proponent's transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) does consider an extended source release period for protons (desorption from chlorite). However, in NRCan's opinion, additional modeling scenarios should consider extended-release periods for other COPCs as well.			
IR-69	-	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.1 and 3.2	**Context**: For hydrogeological and geochemical assessments in support of ISR projects, the Proponent identifies two aspects of primary importance (Appendix 7-C, sec. 3.1). These are a) groundwater remediation (Appendix 7-C, sec. 3.1.1); and b) the assimilative capacity of host rocks downgradient from the ore zone (Appendix 7-C, sec. 3.1.2). According to the Proponent, the objective of groundwater remediation at decommissioning is to achieve water quality in the mined zone that does not pose a risk to receptors at the point of exposure. Assimilative capacity refers to the ability of groundwater-rock reactions to naturally sequester or attenuate COPCs migrating from the ore zone during the post-decommissioning period. **Rationale:** However, in NRCan's opinion, the Proponent has neglected to mention the most fundamental aspect for hydrogeological and geochemical assessments in support of ISR projects. That aspect is the choice of ISR lixiviant and its effects on the mineralogy and hydrogeochemistry of the ore zone during mining operations. The Proponent provides information on the pre-mining mineralogy (Appendix 7-C, sec. 3.2.1) and hydrogeochemistry (Appendix 7-C, sec. 3.2.2) but no information on their expected changes as a result of ISR mining. This Information is important when considering source terms in reactive transport modeling.	NRCan requests that the Proponent provide a detailed description of the expected mineralogical and hydrogeochemical changes occurring within the ore and barrier zones as a result of the injection of acidic lixiviant.		Accepted
IR-70	-	CNSC ECCC	Fish and fish habitat Geology and groundwater	Section 7.6.2.2.3, Evaluation of Geochemical Reactive Transport Appendix 7-C, Section 4.4.2, Sub-Domain Model Hydrogeologic Parameters	**Context:** The EIS indicates that "changes to hydrogeological conditions within the mining area were considered during development of the 3D sub-domain model. Dissolution of ore within the active mining area is expected to enhance … hydraulic conductivity". In Section 4.7 (Prediction Uncertainty Analysis), predictive uncertainty scenarios are provided. For scenario 7, the hydraulic conductivity (K) of the ore zone was increased even further than initial model assumptions. The value used is not indicated in the text. **Rationale:** A hydraulic conductivity (K) value of 5x10-6 m/s, which is a factor of five (5) greater than the value assumed for the ore zone, was applied in the base case numerical model to account for this impact. It is unclear from the information provided in Section 7 of the EIS or associated Appendices what the basis of this five-fold increase in K value for the ore zone, and how this was judged to be conservative, or to adequately represent anticipated conditions. This parameter is important as it impacts the rate at which contaminants flow from the ore zone following mining activities. Due to of the dissolution of uranium, larger voids will likely be created, and the hydraulic conductivity may increase by more than a factor of 5 compared to pre-project material. Therefore, a variation of at least one or two orders of magnitude for hydraulic conductivity should be used in the sensitivity analysis. Having a representative, conservative value for hydraulic	Please provide a more fulsome discussion on the anticipated impacts of mining on permeability of the ore zone due to mining activities in the EIS or in an Appendix. The value used for scenario 7 of the prediction uncertainty analysis should be provided. The scientific rationale for the use of a K value only a factor of five greater than the value assumed for the ore zone in the 3D regional model should be provided, alternatively, provide simulation results for a more conservative scenario. Specifically, this discussion should address the potential effects of mechanical permeability enhancement with tools, dissolution of ore, gas plugging, chemical plugging, plugging due to ion exchange, and mechanical plugging.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					conductivity is essential for understanding groundwater as a pathway of contaminant transport to Whitefish Lake and potential impacts to aquatic life. The K value used in the predictive uncertainty analysis should be reported.			
IR-71	-	CNSC	Geology and groundwater	Section 7.7.1, Climate Change Considerations	**Context:** The report states that in a scenario of increased precipitation and decreased/constant evaporation, climate change may result in greater flows in the Wheeler River drainage system and increased recharge to groundwater, which would correspond to increased groundwater discharge to Whitefish Lake. Additionally, it is also stated that climate change was evaluated qualitatively. **Rationale:** It is not clear why the impacts of increased evapotranspiration associated with higher average temperatures were not considered, even though these are likely outcomes of temperature increases due to climate change in areas such as the Prairies (Climate trends and projections - Canada.ca). It is also not clear why climate change considerations were not assessed quantitatively.	Please provide a discussion on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area. Provide justification for performing qualitative assessment of impacts of climate change rather than a quantitative one.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The effect of climate change on groundwater recharge in Prairies or Canada is generally uncertain due to the large degree of uncertainty in the modelling of future recharge although future changes in temperature and precipitation are expected to alter groundwater recharge (through changes to runoff, evapotranspiration, and snow accumulation). While CNSC staff accepts the response on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area, no justification has been provided on why quantitative analysis was not completed to address the effect of climate change on groundwater recharge.	Accepted
IR-72	-	CNSC	Geology and groundwater	Section 7.8.2, Groundwater Monitoring	**Context:** Monitoring seems to consider COPCs from surface facilities, and excursion of pumped mine fluid in the Lower Sandstone Aquifer. There does not appear any discussion on how the proposed monitoring program considers potential excursions of brine from freeze wells. **Rationale:** It is unclear how potential excursions of brine from freeze wells will be monitored. Would this be through the fiber optic cables installed within the freeze well network? Or would it be achieved in the monitoring well clusters? If this is the case, how would an excursion of brine from a freeze well be differentiated from an excursion of mining solution?	Please provide further information regarding how potential excursions of brine from freeze wells will be monitored as part of the proposed groundwater monitoring program.		Accepted
IR-73	-	CNSC	Geology and groundwater	Section 7.8.2.2, In Situ Recovery Mining Area Appendix 7-A, Appendix C	**Context:** The EIS recommends that a follow-up study be carried out to supplement available data on hydraulic conductivity in the Desilicified Zone (DSZ). **Rationale:** Appendix C (Summary of Hydraulic Testing Data and Conductivity Values) of Appendix 7A indicates that only n = 6 hydraulic conductivity values are available for the DSZ, one of which appears unreliable due to a problem with packer sealing. This is relatively few values compared to the Intermediate and Lower Sandstones. Additionally, limited hydraulic head data from boreholes screened in the DSZ is available (GWR-037, GWR-012 and GWR-014; See Figures 16/17 in Appendix 7-A) – most information appears to originate from open core holes. The information presented in its current form is insufficient considering the importance of this zone as a preferential pathway for contaminants following remediation activities, and the heterogeneity of the unit due to intense hydrothermal alteration and fracturing. Further information regarding hydrogeological properties and groundwater flow would aid greatly in validating and refining the numerical groundwater model.	As per the EIS recommendations, please provide additional information to supplement available data on hydraulic conductivity in the DSZ. Please provide the following information as part of the follow-up study: 1. identification of the vertical conductivity (KV) as there is an upward flow component (isotropy was assumed in DSZ for numerical model, this assumption must be verified) 2. quantification of the horizontal and vertical flow gradients in the DSZ; and 3. identification and mapping of any structures with the potential to influence groundwater flow in the DSZ, such as fracture/fault zones.		Accepted
IR-74	-	CNSC	Geology and Groundwater	Section 7.8.2.3	**Context:** It is stated in Section 7.8.2.3 (p. 7-113, main EIS report) that, at the Post-Decommissioning Stage, “Excursion are signaled by a change in water quality that is outside of that bounded by modelling predictions”, and “The model predictions	Please clarify in which locations the water quality data is used to compare with the model predictions to determine if excursion occurs.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					spatiotemporally bound COPC concentrations in the subsurface that do not pose a risk to the receiving environment. Water quality that is outside of this bounding is defined as representing a material increase over a meaningful period compared to the predicted values either in rate of change or magnitude of change of COPC concentrations." **Rationale**: It is not clear in which locations (e.g., is it in the mining area, or downstream of the mining area, or anywhere else?) the water quality is used to compare with the model predictions to determine if excursion occurs.			
IR-75	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K	**Context:** The geomechanical study showed that the stability of the remnant ore zone and surrounding rock mass is highly sensitive to the magnitude of the material properties. To quantify this risk, the Proponent conducted a sensitivity analysis to assess the influence that material properties have on the stability of key stratigraphic layers. The results of the sensitivity analyses suggest that small variations in the cohesion magnitude and angle of internal friction may significantly influence the stability of the altered sandstone, ore zone, and upper and lower clays. **Rationale:** By considering the potential uncertainties and risks in association with the geomechanical study and the empirically derived rock mass strength parameters and the non-site specific physical parameters of different rock formations used for the modeling, the Proponent's consultant suggests to define a laboratory testing program to address data gaps in the current geotechnical data and increase confidence in the material properties, and use more accurate material properties to model the phased extraction of uranium-enriched rock and assess the associated risks for cavity collapse and failure in the steel casing. CNSC staff concurs with these suggestions.	Please provide a plan to implement recommendations for further detailed geomechanical studies to reduce the uncertainties and risks in association with the stability and deformation analyses of ore zone rock matrix and its overlying rock mass formations and assess their impacts on the mine operation.		Accepted
IR-76	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K (p. 12)	**Context:** Based on the consultant's report, the modeled vertical strain is approaching or exceeding the tensile and compressive yield limits for steel casing. **Rationale:** Failure of steel casing may result in process loss or alter groundwater flow and quality.	Please provide additional details on how casing integrity will be monitored and potential effects mitigated.		Accepted
IR-77	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K Results of a Geomechanical Study Investigating the Influence of Uranium Extraction on Mining-Cavity Stability for the Wheeler River Uranium Project (Revision 1)	**Context:** It is reported in the appendix K report, within Appendix 7-A, that both phase I scoping analysis and phase II detailed strip model were investigated by numerical modelling. The analysis discussed influence on host rock stability as a result of incremental increase in volumetric extraction and graded conservative treatment of material properties. **Rationale:** As critical components of a numerical geomechanical simulation, initial and boundary conditions are crucially important to the confidence and reliability of the modelling results. However, this information is absent from the current report. In-situ principal stresses largely affects the stability of the excavated host rock, and the vertical strain and surface subsidence. This information is also absent in current form.	Please provide details on the boundary and initial conditions applied on stress loading and strain for the numerical analysis. In particular, the in-situ principal stresses, which are critical to correct understanding of the excavation disturbance to the host rock, should be provided and justified as appropriate.		Accepted
IR-78	-	CNSC ECCC	Fish and fish habitat	Appendix 7-A, Section 3.5.2, Porosity	**Context:** This section of the report outlines the estimated/assumed effective porosity values. The only reference provided is for permeameter testing on rock core samples (Scibek, 2019).	1. Please provide the reference for the data substantiating the assumed effective porosity values reported in Appendix 7-A and used in the numerical model in Appendix 7-C.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.*	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			Geology and groundwater	Appendix 7-C, Section 2.3.2.1, Porosity Values	Additionally, the report states that "As tracer test results to estimate effective porosity were unavailable at the time of modelling, effective porosity values for the sandstone bedrock and basement units were sourced from literature values", where literature values are effective porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to justify this value. Additionally,, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". **Rationale:** The source of reported effective porosity values is unclear from Section 3.5.2 in Appendix A (e.g. literature review, field work, laboratory work). In Section 2.3.2.1 of Appendix 7-C, there is a lack of clarity regarding the effective porosity data used in the numerical model. It appears that no site-specific data derived from tracer tests or pumping tests is used in the numerical model. Given that effective porosity directly correlates to seepage velocity and by extension transport time and distribution of COPCs in groundwater, it is an important parameter. Given its relative importance for contaminant fate and transport, effective porosity should be based on field measurements, or at the very least accounted for in the sensitivity analysis.	2. Please provide information on how the site-specific effective porosity values from tracer tests or pumping tests, were considered in the numerical models. Section 2.2.1.4 of the EIS asserts that tracer tests were carried out in 2021 – this information should thus be available for improving/updating models. Alternatively, provide a sensitivity analysis for the effective porosity in the Desilicified Zone, or contaminant transport simulation results with more conservative effective porosity values.	Effective porosity is an important parameter to understanding groundwater flow and contaminant transport. The Proponent states that "As tracer test results to estimate effective porosity were unavailable at the time of modelling, effective porosity values for the sandstone bedrock and basement units were sourced from literature values", including porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to explain this value. Additionally, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". In response to the IR, the Proponent explained and supported their methodology for selecting a value for effective porosity. This method included consideration of literature values and a regional analogue at Cigar Lake. ECCC notes that a tracer test was conducted, the results of which were not considered in the selection of the effective porosity parameter. If field test data is available that is potentially relevant to determining effective porosity, it should be included in the EIS when discussing effective porosity. The field test data should also be made available for review by the FIRT, to confirm the conclusions reached by the Proponent. Other sources of information can be useful when explaining the most appropriate value for effective porosity such as literature values and regional analogues, as per the Proponent's IR response. However, field test results should be presented in the EIS and considered as a part of such an explanation. If the Proponent feels that not utilizing field test data is the most accurate approach when selecting an effective porosity value, then this conclusion should be reached with consideration of the field test data as a part of the evaluation. Provide a discussion of how the effective porosity values are selected, including a discussion of how field test results were considered. This information is necessary to confirm that the selected effective porosity values are valid. This also relates to IR-52.	
IR-79	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4, Groundwater Chemistry	**Context:** Table 4-1 in Section 4 of Appendix 7-A provides groundwater monitoring results from sampling activities carried out at 26 monitoring wells in 2019, 2020, and 2021. The majority of these wells were only sampled once (n = 8) or twice (n = 17). In some cases (Lower Sandstone Aquifer/Intermediate Sandstone Aquitard), the variability of results between sampling events is quite high. Data for the Paleoweathered Zone is sparse. **Rationale:** Insufficient information is presented in the EIS and associated Appendices to concretely define baseline groundwater chemistry for the different hydrostratigraphic units. As defined in the CNSC's Generic Guidelines for the Preparation of an EIS: "Based on the scope of the project, the EIS will present sufficiently detailed baseline information to determine the effects the project could have on the VCs and analyze those effects". This is particularly important given certain features of the study area (i.e., presence of zones of thermal alteration/desilicification, as well as hydraulically active	Please provide the statistical basis (number of samples and variability) by which "baseline" is defined and the justification that the current information is sufficient to adequately characterize groundwater quality. In order to ensure sufficient baseline information is collected, further iterations of sample collection for groundwater monitoring wells in all defined hydrostratigraphic units may be required. In addition, groundwater quality downgradient from the proposed mining area should be further characterized to assess spatial influence of alteration and hydraulically active features,		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					fractures/faults), and the need to adequately characterize baseline conditions in the Desilicified Zone downgradient from the proposed mining area. As an example, the US Nuclear Regulatory Commission (NRC) typically requires a minimum of four (4) quarterly samples from (i) surficial aquifers, (ii) production aquifers, (iii) overlying aquifers, and (iv) underlying aquifers to characterize preoperational groundwater quality (E. Striz, pers. comm.).			
IR-80	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** This section provides data for groundwater samples collected during the Cigar Lake analogue study and Millennium Project for further regional context. The previous studies are heavily referenced to support interpretations made for the conceptual site model. **Rationale:** The Piper Plots in Figure 26 are difficult to interpret (many overlapping circles with variegated colors), and Cigar Lake samples plot predominantly as Na/K-Cl/SO4 groundwater facies. Conversely, samples collected as part of the Phoenix Project (current), plot either as Ca-HCO3 or Ca-SO4/Cl groundwater facies. No explanation is provided for the observed hydrogeochemical differences between groundwater from the Phoenix project and the Cigar Lake analogue study/Millenium Project.	Please provide additional clarity to and interpretation of Figure 26 in Appendix 7-A, including a revision to the Figure to allow for easier interpretation. This could include clear identification of end members, as well as arrows indicating proposed evolution of groundwater chemistry. Further discussion should be provided describing observed differences between groundwater chemistry at the Phoenix project compared to Millenium/Cigar Lake.		Accepted
IR-81	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** The report states in the description of hydrochemistry of the Lower Sandstone Aquifer that, "On the basis of groundwater chemistry and tritium values in that groundwater, the authors (of the Cigar Lake analogue study in 1994) concluded that the groundwater reflected a younger water component that had penetrated to depth along hydraulically active fractures/faults. The same conclusion is made here (in the Wheeler River EIS) for the Phoenix study area – meaning that fracture/fault conditions are such that some areas of the MFa are characterized by younger/recharge groundwaters". **Rationale:** Tritium results for most wells in the Lower Sandstone Aquifer (MFa) reported in Table 4-1 of Appendix 7-A exhibit tritium concentrations <15 Bq/L for the 2020 sample, and 0.1 or <0.1 Bq/L for the 2021 sample. Tritium in modern precipitation typically varies from 1 – 3 Bq/L. Conclusions made in the text are not supported by data, especially given that tritium values are not reported in the EIS for local precipitation or surface water. This is important in reinforcing the assumption from the conceptual model that modern meteoric water circulates at depth in the Lower Sandstone Aquifer.	Provide a further discussion on the interpretation of tritium in groundwater, rather than echoing conclusions from the Cigar Lake analogue study. Consideration should be given to the assertion that modern meteoric water circulates at depth in the Lower Sandstone Aquifer. Collection and analysis of stable isotope (e.g., δ2H, δ18O) samples is a cost-effective solution which would greatly improve understanding of groundwater hydrology and support the development of a conceptual model.		Accepted
IR-82	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit Appendix 7-C, Section 3.5	**Context:** A. In-field measurements of Oxidation-Reduction Potential (ORP) for three (3) out of twenty-six (26) groundwater samples are presented in Table 4-1 of Appendix 7-A. Although sparse, these values are also used to characterize redox conditions for representative groundwaters in Table 3-5 of Appendix 7-C. B. In Section 3.5.5 of Appendix 7-C it is stated that groundwaters in the PHREEQC model were allowed to equilibrate with atmospheric concentrations of oxygen, resulting in oxidizing subsurface conditions. In Section 3.7 of Appendix 7-C it states that input files for 3D reactive transport were generated based on outcomes for PHREEQC modelling. However, in reading Section 4 of Appendix 7-C, it is unclear whether this assumption (equilibration with atmospheric oxygen) was carried forward for the 3D model.	1. Provide further discussions and information (i.e., ORP measurements or analytical data for redox couples) on redox conditions at the Phoenix site. Particular focus should be given to the spatial heterogeneity of redox processes. Tools such as the reference provided [2] below provide an example of simplified framework for characterizing redox conditions in aquifers. 2. Clarify assumptions regarding initial redox conditions for the 3D solute transport model. 3. Provide the % reactive pyrite by weight assumed for models	Please see AD-65 in the Advice to Proponent table.	Accepted

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					C. As per p. 3.49 of Appendix 7-C, "A small amount of reactive pyrite was assumed for the first 500 m of transport away from the ore zone in the model, primarily in the desilicified sediments of the Lower Sandstone Aquifer, and deeper portion of the Intermediate Sandstone Aquitard". **Rationale:** A. Given the importance of redox conditions for U mobilization and precipitation/dissolution of minerals (e.g., pyrite/metal oxyhydroxides) and the corresponding influence on contaminant transport from both a modelling and monitoring perspective, these should be further characterized. It should also be noted that the measurement of Oxidative-Reductive Potential (ORP) in natural waters can be complex and difficult due to the variability and disequilibrium of natural systems and issues inherent to electrode calibration (e.g., Schuring et al., 2000). Measurements of redox couples (e.g., As(III)/As(V); Fe(II)/Fe(III); S(-II)/S(VI)) are typically recommended to accurately characterize redox conditions in natural waters (Schuring et al., 2000). B. The assumptions regarding redox conditions for the 3D solute transport model should be clarified. C. The amount of pyrite (e.g., % by weight) assumed for the purposes of modelling should be clarified, given the potential role of pyrite as a reducing agent in limiting the transport of COPCs. **Reference**: [1] Schuring J.; Schulz, H. D.; Fischer, W.R.; Bottcher, J.; and Duijnisveld, M.H.W. 2000. Redox: Fundamentals, Processes and Applications. Springer: Berlin.	in the text. Justification for proportions used, such as analytical data, should also be provided. **Reference**: [2] Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.		
IR-83	-	CNSC	Geology and Groundwater	Appendix 7-A, Section 7.4.2.2 and Appendix K	**Context:** Leaching of uranium from the ore zone will generate voids within the ore zone, which could fail and collapse. Failure of the voids would cause displacement in overlying rocks, which will lead to the eventual ground subsidence. Based on the developed geological model, a geomechanical study was conducted to assess potential maximum vertical displacement in the overlying rock formations and predict the ground subsidence. While a layer of altered sandstone is modeled above the ore zone, the desilicified zone, a zone that is comprised of completely to partially unconsolidated sands and has very low rock quality, high fracture intensity, and high friability, and low strength in the area overlying and east of the Phoenix deposit, appears not to have been included in the model for geomechanical modeling. The evaluated displacement/deformation in the overlying rock formation and the resulted ground subsidence would not be conservative without including the desilicified zone. **Rationale:** Stability of the ore zone rock matrix and the potential displacement/deformation in the overlying rock formations when voids in the extracted ore zone collapse are critical for protecting the overlying aquifers, preventing substantial ground subsidence, safeguarding casing integrity, and mitigating plug-off of the remaining ore as well as efficiently mining extraction. The deformed zone in the overlying rock formations will change in hydraulic conductivity that will impact on the assessment of potential effects on groundwater flow and contaminant transport in the zone. Therefore, the rock mass behavior including and above the ore zone should be	Please provide details whether and how the desilicified zone is considered in the geomechanical modeling of the detailed strip model. Such details should include figures and the linkage between the geomechanical model including the determination of strength parameters of the desilicified zone and the geological model including information on the core delineation of the desilicified zone.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					adequately understood and the potential displacement/deformation should be assessed and quantified with adequately defined geological model.			
IR-84	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.5.2.4 (p. 2.35, Appendix 7-C) that "In addition to calibrating to water level elevations targets, the model was calibrated to estimates of groundwater discharge to Whitefish Lake. A match between simulated and observed flows helps to support that groundwater recharge rates are reasonable, and to provide validation for water budget assessments. Baseflow calibration targets were developed using point streamflow measurements collected upstream and downstream of Whitefish Lake. Figure 2-10 (p. 2.26, Appendix 7-C) shows the locations of the baseflow calibration targets, and Table 2-7 (p. 2.35, Appendix 7-C) illustrates the model-simulated groundwater discharge rates in relation to the estimated range of baseflow from stream measurements. The simulated baseflow to Whitefish Lake is in good agreement with the estimated representative baseflow". **Rationale:** It is not clear in Figure 2-10 (p. 2.26, Appendix 7-C) where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. Additionally, it is not clear how the groundwater discharge to Whitefish Lake is simulated, since the model domain does not cover the whole Whitefish Lake.	1. Please clarify in Figure 2-10 where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. 2. Please clarify how the groundwater discharge to Whitefish Lake is simulated considering that the model domain does not cover the whole Whitefish Lake.		Accepted
IR-85	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** Section 2.7.3 (Appendix 7-C) mentions Wells A, B and C, and Figure 2-17 (p. 2.43, Appendix 7-C) illustrates the predicted drawdown ranges at Well B and Well C. **Rationale:** It is not clear where Well A, Well B and Well C are located.	Please provide the locations of Well A, Well B and Well C illustrated in a Figure.		Accepted
IR-86	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.7.3 (p. 2.41, Appendix 7-C) that "Both the pumping demand and the recharge changes were incorporated into a transient simulation performed using the calibrated groundwater flow model. The model simulation was started at the beginning of mine construction, with initial conditions taken from the calibrated model. The simulation period was extended for 40 years to include the entire period of construction, operation, and decommissioning, and extending through 17 years post decommissioning". **Rationale:** It is not clear what is the difference between the calibrated model and transient model in terms of parameters (such as the K values for the mining zone), boundary conditions, etc.	Please clarify the parameters, boundary conditions and any other aspects as used in the transient model that are different from the calibrated model.		Accepted
IR-87	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** In Section 2.8 (p. 2.45, Appendix 7-C) Parameter uncertainty assessment, only parameters for certain zones (part of each specific hydro-stratigraphic unit as shown in Figure 2-19, p. 2.46, Appendix 7-C) related to the pathway from the ore zone toward Whitefish Lake were allowed to vary in order to find combinations of parameter values that met statistical calibration criteria. If each hydro-stratigraphic units within the whole model domain were treated as parameter zones that can have varied hydraulic conductivity values, a different combination of parameter values could be obtained that meet statistical calibration criteria too.	It is recommended that the parameter zones in the Parameter uncertainty assessment include hydro-stratigraphic units in the whole model domain to investigate the possible combination of parameter values that could make the groundwater in the mined-out zone more active hydraulically.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: The parameter values for parameter zones between the mining area and Whitefish Lake is important in determining the hydraulic connection between the mining area and Whitefish Lake. Parameter values in other parameter zones could also be important. For example, if the K values for the intermediate sandstone aquitard are significantly larger than in the current calibration results, the interaction between the upper sandstone aquifer and the lower sandstone aquifer could be more active, and the mined-out zone could be more active hydraulically and groundwater in the minded-out zone could have a shorter residence time than in the current calibrated model. Additionally, it is noted that Figure 2.19 (p. 2.46, Appendix 7-C) illustrates the parameter zone for the intermediate sandstone aquitard. However, Figure 2.20 (p. 2.49, Appendix 7-C) did not include the intermediate sandstone aquitard in the results.			
IR-88	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** The conceptual hydrogeological model includes upper sandstone aquifer, intermediate sandstone aquitard, and lower sandstone aquifer. The desilicified zone above the ore zone have enhanced hydraulic conductivity. The boundary condition for the lower sandstone aquifer on the west (upstream) side was assigned to have specified head, which provide source of water for the lower sandstone aquifer. As a result of the conceptual model setup, the upper sandstone aquifer is hydraulically active and the groundwater residence time within the upper sandstone aquifer is relative short. In contrast, the lower sandstone aquifer (and the ore zone) is hydraulically inactive, and the groundwater residence time in the lower sandstone aquifer is relatively long (as shown in the particle tracking results in Figure 7.6-2 (p. 7-71, main EIS report), and the simulated plume for chloride in Figure 7.6-7(p. 7-86, main EIS report)). It is stated in Section 2.6.4 (Appendix 7-C) that "As noted above in section 2.6.3, it is estimated that 99% of the groundwater discharge to Whitefish Lake is derived from groundwater that has only flowed through shallow deposits (i.e., Overburden and Upper Sandstone Aquifers). Contribution of deep groundwater flow through the Desilicified Zone within the Intermediate Sandstone Aquitard is estimated to be < 1% of the groundwater discharging to Whitefish Lake". This simulation result is reflective of the conceptual model. Section 7.3.3.3 (p. 7-42) states that "The Lower Sandstone Aquifer is characterized spatially by two types of groundwater. The first groundwater type is most like that observed in the Local Flow System. This reflects hydraulically active fractures and fault systems that allow fresh recharge water to penetrate and mix with deeper waters in the aquifer. The second type of groundwater is within the zone of thermal alteration around the ore zone ……". The hydraulic connectivity of the ore zone with the upper sandstone aquifer has important implication on the groundwater restoration. The ore zone is not hydraulically active locally because it is enclosed by a clay zone before the mining operation. But if it is located within a hydraulically active area, or on a groundwater flow pathway that is hydraulically active, the mined-out zone (with much larger porosity and hydraulic	It is recommended to conduct the following work to demonstrate if the mined-out zone is hydraulically active: 1. Determine the groundwater residence time in the lower sandstone aquifer and compare it with the simulated residence time in the numerical model. 2. Conduct additional particle tracking to demonstrate where groundwater originating from the mined-out zone flow towards (forward tracking) and where groundwater flowing towards the mined-out zone originates from. This would help determine why groundwater in the mined-out zone is not hydraulically active. 3. Conduct sensitivity analysis to investigate the effect of higher K values for the intermediate sandstone aquitard and the K and porosity values of the mined-out zone on the plume migration.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					conductivity) could become active hydraulically after mining operation is finished. Figure 7.6-7 (p. 7-86, main EIS report) shows that the chloride plume is most persistent within the mined-out mining area. This seems to indicate the mined-out zone is hydraulically inactive after the mining operation is finished. It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that “Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone.” So, there is possibility that the unplugged borehole could increase the hydraulic connection between the upper and lower sandstone aquifer. **Rationale:** It is important to understand if the larger area containing ore zone is hydraulically active. Additional confidence would be gained if there is any other evidence that support that the area containing the ore zone is not hydraulically active, and groundwater residence time in the lower sandstone aquifer surrounding the ore zone is comparable with the simulated results. Table 2-4 (p. 2.16, Appendix 7-C) shows the effective porosity (0.01-0.05) of the ore body. Figure B7 (p. B.8, Appendix 7-C) shows that the calibrated K values for the mined-out zone is 1x10-6 m/s. Section 3.5.2 (p. 3.24, Appendix 7-C) states that “The same average linear velocity was assumed for the mining area (source zone), following from the discussion in Section 4.4.2, where the hydraulic conductivity value in this zone following mining was set to 5x10-6 m/s, and a porosity of 0.2 is assumed for the ore zone (Table 4-2)”. It is not clear what the justification is for the selection of the porosity and K values for the mined-out area, and whether they are conservative. It is also not clear, what the potential impact on the groundwater flow and COPCs transport would be If the mined-out zones collapse.			
IR-89	-	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone	**Context:** The Proponent states that a hydraulic conductivity value of 5x10-6 m/s was uniformly assigned to the model layers representing the Desilicified Zone. They additionally state that this value is consistent with packer and pumping tests screened in this unit that have interpreted hydraulic conductivity values ranging from 1x10-6 to 3x10-5 m/s (Appendix C), with a geomean of 6.0x10-6 m/s. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on fish and fish habitat. **Rationale:** The Desilicified Zone is a critical layer in the hydrogeological model as it represents a key potential pathway of contaminants to Whitefish Lake. The base case hydraulic conductivity value (5x10-6 m/s) is even lower than the geometric mean, not to	1. Provide an in-depth rationale for choosing a value of 5x10-6 m/s as the base case for the hydraulic conductivity, in both the PH REdox EQuilibrium (PHREEQC) and Finite-Element Ground Water Flow (FEFLOW) models. 2. Provide a rationale for keeping the sensitivity analysis within one order of magnitude considering the lack of physical data on the Desilicified Zone. Alternatively, provide contaminant transport simulation results with more conservative hydraulic conductivity (e.g., more than 3x10-5 m/s) values in the Desilicified Zone. See also related: IR-96.	The Desilicified Zone is a critical layer in the hydrogeological model because it represents a key potential pathway of contaminants to Whitefish Lake. There is a limited amount of field data for the Desilicified zone. A sensitivity analysis should allow the model to test slightly outside of the observed field data values. Following a supplementary submission provided by Denison on July 2nd, this IR is accepted for the purposes of the EA review, subject to the addition of a commitment to: • revisiting and updating the groundwater models as necessary, as more data becomes available through the EA follow-up monitoring program to improve confidence on the hydraulic values of the desilicified zone. This commitment must be provided in the updated commitment report, as part of the final EIS submission package. Denison should also take this commitment into account when developing the EA follow-up monitoring program.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					mention the highest value found. When simulating geochemical processes and contaminant transport within this important pathway a more conservative approach should be employed. Modifying this parameter will affect travel times and distribution of COPC in the subsurface.			
IR-89	IR-89-R1	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone IR-89 Response from Denison	**Context:** The Proponent states that the range of hydraulic conductivities considered in sensitivity analysis was limited to values that fit within a calibration constrained uncertainty analysis of the model. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on the aquatic environment. The Proponent clarified the details of the calibration-constrained uncertainty analysis that was used for parameter bounding within the model, with hydraulic conductivity sensitivity bounds determined based on model calibration values that were supported by the available physical data. **Rationale:** ECCC agrees that calibration constrained uncertainty analysis using hydraulic head field data is useful to determine probable upper limits of K values. However, there is always some degree of uncertainty in groundwater data and models. Sources of such uncertainty may include errors, lack of complete and representative field data to determine key parameters, or any number of heterogeneities associated with groundwater systems over large scales. Such uncertainties will always exist and can be accounted for by conducting a sensitivity analysis that accounts for the lack of physical data in the Desilicified Zone by running modelling scenarios using parameters that are outside of the calibration constrained values.	Expand the sensitivity analysis of hydraulic conductivity outside of calibration constrained parameters to account for the lack of physical data in the Desilicified Zone.	See IR-89 (above).	Accepted
IR-90	-	ECCC	Fish and fish habitat	Appendix 7-C, Section 2.4 and 2.6	**Context:** Hydraulic conductivities and hydraulic gradients play an important role in groundwater flow, geochemical modeling, and contaminant transport for the PHREEQC and FEFLOW models. Although there is an important vertical component to the contaminant transport, there is no distinction made between lateral and vertical hydraulic conductivities of hydraulic gradients. **Rationale:** According to the conceptual model, there is an important vertical aspect to the groundwater flow thus incorporating any vertical hydraulic gradient or hydraulic conductivity information into the calibration would increase confidence in the results. Providing a distinct value for vertical hydraulic conductivity will improve the accuracy of the model in regards to the transport of contaminants to Whitefish Lake through the Desilicified zone, which is important to understand potential impacts to aquatic life.	1. Explain if the vertical and lateral hydraulic gradients and hydraulic conductivities are assumed to be equivalent. 2. Provide a rationale for not distinguishing between vertical and lateral hydraulic gradients. 3. Alternatively, provide both lateral and vertical hydraulic gradient estimates and the implications on contaminant transport.		Accepted
IR-91	-	NRCan	Fish and fish habitat	Appendix 7-C, section 2.5.2	**Context**: The numerical model calibration quality plot (Appendix 7-C, sec. 2.5.2.1, Figure 2-13) contains a small error. The vertical (simulated heads) and horizontal (observed heads) axes do not have the same scales (499 to 521 masl versus 499 to 522 masl). Therefore, the line of ideal fit is offset.	The Proponent should correct the scales on the axes of Figure 2-13 in Appendix 7-C. The Proponent should also comment on the effect on calibration of the clustering of most observation wells in the ore zone.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: As a result, NRCan notes that observed heads in the 510-512 masl range are underpredicted by the model. NRCan also notes that the calibration statistics (Appendix 7-C, sec.2.5.2.3) are highly leveraged by two data points from open boreholes south of Kratchkowsky Lake where simulated values are largely controlled by the nearby constant-head boundary in the Lower Sandstone aquifer (520 masl).			
IR-92	-	CNSC	Geology and groundwater	Appendix 7-C, Section 3.2.1, Mineralogical Composition	**Context:** Table 3-2 summarizes the clay content of the Athabasca Group sandstones and the Paleoweathered Zone. Although minimum, maximum and median values are provided, the number of samples and variability of the dataset are not. Rationale for incorporating illite into reactive transport modelling and excluding kaolinite/dichlorite is provided in the text. From p. 3.29 in Appendix 7-C: "The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 7.68%; Table 3-2) and using portable infra-red mineral analysis indicating median illite content by mass is 13.1% (data not shown)" From p. 3.30 in Appendix 7-C: "Using the minor amount of illite compared to the more dominant chlorite is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone". This conservative assumption appears contrary to assumptions for the desilicified zone (DSZ) and Athabasca Group sandstones "Illite was used to represent the total clay content, which varies from 1.74% to 5.85% by mass in the hydrostratigraphic units within the Athabasca Group sandstones and Desilicified Zone". **Rationale:** Information is missing in the EIS regarding the clay composition of hydrostratigraphic units. Results from infrared mineral analysis are not reported. The assumption for the solute transport model is that all clays in the downgradient DSZ are illite. However, clay content in the Read Formation (Lower Sandstone Aquifer) downgradient of the ore zone is low in illite (0.42%) compared to kaolinite (0.52%) and dichlorite (1.18%). A value of 3.9% illite clay by weight is used for the DSZ, but Table 3-2 indicates median content is 2.42% illite. It is not clear why illite was used to represent total clay content for the DSZ, as opposed to the conservative assumptions used for the Paleoweathered Zone, nor has any basis or justification been given.	1. Please provide in Table 3- the number of samples and variability of the datasets used to estimate the clay content of hydrostratigraphic units for the model. Include results from infrared mineral analysis in the text if the information is used to support assumptions for modelling. 2. Please provide further information/discussion within the EIS relating to the assumptions of clay content in hydrostratigraphic units for modelling. Provide further justification and rationale as to why total clay content in the Athabasca Group sandstones and Desilicified Zone is assumed to be illite, and how this assumption is conservative. This discussion could include a comparison of the properties (cation exchange capacity, surface area) of illite vs. kaolinite vs. dichlorite for the anticipated range of subsurface conditions (pH, redox, U concentrations, etc.).		Accepted
IR-93	-	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-10: Properties of Adsorbing Mineral Phases	**Context:** In Appendix 7-C, section 3.5.6.2.2 Ion Exchange and Surface Complexation, the consideration of ion exchange and surface complexation and the corresponding parameters and chemical reaction are discussed. **Rationale:** The site density of sorbent Geothite was reported in Table 3-10 to be 1.6E3 mol/kg. Taking into account the specific surface area of 60 m2/g, this equals to 1600/6E4 mol/m2, or 0.0266 mol/m2, 1.6e4 sites/nm2. This value largely overestimates the site density of goethite, which is reported to be in the range of 2~6 sites/nm2. The reference used in the EIS report indicates the similar	Please provide additional evidence to justify the model parameter of site density for goethite, applied to the numerical model. If necessary, the reactive transport modelling should be re-run to update the contents presented in the EIS report.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					range of variation for this specific parameter. There are plenty of similar studies on SCM of iron oxides in literature. It is suggested to consult with more than one single study to enhance the reliability of model parameters. The overestimation of sorption site density will directly result in underestimation of the affected COPCs' concentrations in pore fluid. This will result in underestimation of COPC transport plume in the affected underground space, and potentially the dissolved concentrations in the hydrogeological sink.			
IR-94	-	CNSC	Geology and Groundwater	Appendix 7-C, Numerical modelling: post-decommissioning evaluation, Section 3.5.5, Subsurface Conditions Incorporated	**Context:** It is reported in this section the assumed subsurface conditions that were applied in the geochemical site conceptual models. Critical phenomenon of pH tail was mentioned. Inclusion and exclusion of corresponding geochemical reactions were discussed briefly. **Rationale:** It was reported that the residual reduced minerals of uraninite and pyrite were not included in the modelling of the remediated mining area. The argument was based on consideration of the upstream groundwater, passing through the mined zone, will not be oxidizing and groundwater conditions are expected to be similar to pre-mine conditions. However, this ignores the pH tail effect that releases proton H+ sorbed to solid surface during ISR flooding. By ignoring this process, there is a potential risk of underestimating the source terms for some key COPCs. Exclusion of uraninite and pyrite in remediated mining area modelling is contradictory to pH-tail effect. The justification is not sufficient in the current form.	Please provide additional evidence to justify the approach for excluding uraninite and pyrite from the analysis of remediated mining area. This may require the results from additional modelling.		Accepted
IR-95	-	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-11	**Context:** The Table 3-11 reported the Solid-Phase Concentrations and Partitioning Constants for COPCs. Data were both measured and simulated. **Rationale:** It is unclear how the partition coefficients of various COPCs upon desilicified and paleoweathered rocks were obtained. It was not reported at what pH were these K_d analyzed. Sorption of chemicals on solid phase is known to be pH dependent. It is unclear whether pH influence was considered in the measurement and analysis of apparent partition coefficients. In addition, uptake of metals on clay is highly nonlinear, and always has a maximum capacity. Even with a very strong affinity towards specific metal ions, the sorption will be saturated at elevated concentrations. Therefore, assuming a linear correlation needs to be cautious of the concentration range of target COPC species, and the applicable sorption capacity of the clay mineral. In the current model, only the linear form of sorption is considered, although with discussion of K_d value selection. Additional rationale is needed to justify if the applied methodology is sufficient for assessment.	Please justify the choice of applying a linear form partition coefficient for the modelling and assessment, and whether it provides a conservative approach to the assessment results. Clarity around the experimental conditions during the measurement of partitioning coefficient of various COPCs on the target rocks may help support this assumption.		Accepted
IR-96	-	CNSC	Geology and groundwater	Appendix 7-C, Section 4.4.4, Sub-	**Context:** From the text, "Transport parameters were specified for diffusion (1x10-9 m2/s), longitudinal dispersivity (10 m along the plume trajectory), and transverse	1. Please provide the source of the numerical value used for diffusion and longitudinal and transverse dispersivity, and	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews,*	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Domain Model Transport Boundary Conditions	dispersivity (5 m)". The source of this information is not provided in Appendix 7-C. It is unclear if the values used are defaults in the modelling software, from literature, from small-scale laboratory tests, or are site-specific values determined through tracer tests. **Rationale:** The use of a calibrated flow model does not imply that the solute transport model is calibrated. The transport parameters (such as effective porosity, dispersivity and reactive transport parameters) can only be calibrated by matching simulated and observed spatial and/or temporal distributions of a solute. Sensitivity analysis indicates that decreasing longitudinal and transverse dispersivities by a factor of two resulted in exceedances of groundwater criteria for both selenium (Se) and cobalt (Co). Given the clear influence of these values on contaminant transport, it is important that transfer parameter values are justified in the solute transport model. In addition, the influence of large-scale heterogeneity on dispersion and solute transport predictions should be discussed, to identify any uncertainty in the model predictions, and provide confidence that the applied model is adequately representing groundwater flow and solute transport. Further guidance on solute transport modelling can be found in BC MOE (2012) [1]. **Reference**: [1] British Columbia Ministry of the Environment (BC MOE). 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report no. 194001, 385 p.	provide justification if default values by the model code were used. 2. Please provide a discussion on the influence of large-scale heterogeneity on dispersion and solute transport predictions in the modelling report. See also related: IR-89.	*prior to the granting of a Licence.* CNSC staff appreciate the comprehensive information provided relating to longitudinal dispersivity and variation based on scale. However, it should be noted that guidance from Gelhar et al. (1992) and the BC MOE (2012) indicate that horizontal transverse dispersivity values should be approximately 1 order of magnitude lower than longitudinal dispersivity values, and vertical transverse dispersivity values should be approximately 2 orders of magnitude lower than longitudinal dispersivity. For the model presented in the EIS, transverse dispersivity is represented by a singular value of 5 meters, with the supporting rationale that the Gelhar et al. (1992) identified 5 meters as a representative value. It is important to note that the Gelhar et al. (1992) paper considered 5 meters to be representative for horizontal transverse dispersivity and identified that vertical transverse dispersivity is smaller than horizontal transverse dispersivity. Additionally, it is important to note that Petrotek (2021) used a transverse dispersivity of 1 m in their numerical models of the ore zone aquifer. CNSC staff thus request that Denison provide further information relating to why horizontal and vertical transverse dispersivity are represented using a singular value, and how this value is considered appropriate to represent both dimensions. **Reference:** Petrotek 2021. Groundwater Model Report Phase 1, Phoenix Deposit Wheeler River Project. Prepared for Denison Mines. December 2021.	
IR-97	-	ECCC	Fish and fish habitat	Appendix 7-C, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b	**Context:** Appendix 7, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b present contaminant transport simulations of chloride, selenium, cadmium, and uranium. All simulations use initial condition concentrations at t=0 (or end of mining operations. In the 3D FEFLOW contaminant transport model it is not clear why initial condition concentrations were chosen rather than a constant concentration boundary. It is also unclear if mining activities will cause mobilization of the contaminants beyond the end of operations. **Rationale:** The choice of boundary conditions may impact the predicted transport of contaminants that reach Whitefish Lake through groundwater, which may have impacts to aquatic life.	1. Explain and clarify if mining operations will mobilize contaminants beyond operations? 2. Clarify if the source of contamination, (e.g., uranium, selenium) will cease after operations? 3. For the 3D model please provide the rationale for using initial concentrations rather than constant concentration boundary conditions for contaminant concentrations.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, if required.* It should be noted that the fate and transport simulations of the COCs are dependent on groundwater flow. Therefore, the Proponent's conclusions on the transport of COCs, may need to be revisited depending on how IR-89 is resolved.	Accepted
IR-98	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 8, Aquatic Environment	**Context:** It states in EIS in Section 8.3.7.1 (p. 8-151) that "Cameco's Key Lake Operation will overlap spatially and temporally with the Project". **Rationale:** It is not clear whether there is the possibility that planned Denison discharges would eventually flow into and influence a background reference lake used by Key Lake operation.	Please provide supporting information to demonstrate whether discharges from the proposed operation will not eventually flow into a reference lake used by another existing operation.		Accepted
IR-99	-	CNSC	Aquatic environment	Section 8, Water Quality, Table 8.2-13	**Context:** Table 8.2-13 shows the maximum concentration of hazardous and radiological COPC's in surface water throughout the local study area. However, the concentration for all constituents is stated as mg/L.	Please use Bq/L when displaying concentration of radiological COPC's. If this was a typographical error in the table, please indicate as such and revise the table to indicate values are		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: It is unusual for radiological COPC's to be displayed in mg/L, radiological constituents are typically displayed in Bq/L	indeed in Bq/L. Please also review other tables displaying concentrations of radiological constituents to ensure this error is not repeated in other tables.		
IR-100	-	HC	Indigenous Peoples' health / Socio- economic conditions	Section 8, (p. 8-195) Section 8.5.3, Table 8.5-2, (p. 8-226)	Mercury is excluded as a COPC in the assessment. Inadequate consideration of mercury and methylmercury in fish and other country foods, and use of incorrect Hg-related health guideline values can underestimate the risks to human health among country food consumers. **Context:** Section 8 states "Mercury has not been identified as a COPC for the Project as it is currently not present in the receiving environment (i.e., background condition) at detectable concentrations and will not be produced as part of the mine process; therefore, it will not be discharged to the aquatic environment. However, it is understood that potential nutrient enrichment-related effects are possible and can be linked to increases in mercury in the environment" (p. 8-195). Table 8.5-2 shows that there is mercury present in the tissues of Northern Pike and White Sucker sampled in the waterbodies within the local study area and in Russell Lake. These fish are regularly consumed by nearby communities according to the ERFN 2017 dietary survey. In Section 8.5.3, fish tissue concentrations are compared to Health Canada's human health risk- based maximum permissible mercury concentration (0.5 µg/g wet weight), which is applicable to most species of commercially sold fish rather than country foods. **Rationale:** It is recommended that mercury be listed as a COPC considering it is in fact present in fish tissue under existing conditions, the significant consumption of fish by the local Indigenous communities, and its toxicological significance to human health. Further, the Health Canada provisional tolerable daily intake (pTDI) value of 0.2 µg/kg/bw/day (Health Canada, 2007) is a more appropriate reference level when evaluating consumption of mercury in fish by Indigenous people, as it allows for the consideration of food consumption patterns in the risk assessment that differ from the general population and is protective of the most sensitive sub-group (i.e., developing foetus). It is important to note that methylmercury, rather than inorganic mercury, is generally the predominant mercury species present in fish and is also the most toxicologically significant form. The assumption of 100% of mercury in fish and other country food items being present as methylmercury ensures that the potential health risks are not underestimated. It is unclear, however, if the mercury data presented throughout the EIS represent total mercury, inorganic mercury or methylmercury.	1. Include mercury (including methylmercury) as a COPC in the assessment given the baseline presence of mercury in sampled fish, the potential increase of methylmercury in receiving waters due to nutrient enrichment resulting from the Project, the significant fish consumption by the local population and that country foods, particularly fish, are an important source of dietary exposure to mercury. 2. Assess health risks from fish consumption by calculating hazard quotients for baseline and predicted methylmercury levels in country foods using Health Canada's pTDI for methylmercury (Health Canada, 2007). 3. Clarify whether mercury data represented throughout the EIS represents total mercury, inorganic mercury or methylmercury. **Suggestions for mitigation and follow-up measures:** Health Canada recommends including methylmercury in the list of COPCs to be monitored in fish throughout all project phases. See also related Advice to the Proponent: AD-31.	The July 2nd, 2024 supplementary submission for IR-100 and version 2 of the Commitment Register (July 17th) included a commitment to assess health risks from fish consumption by comparing fish tissue data collected during operation from the monitoring program against Health Canada's mercury guideline of 0.5 ug/g wet weight, as applicable (ID 8-44). Reviewers note an apparent contradiction between use of the provisional tolerable daily intake (pTDI) and the commercial guideline for mercury in fish. The Proponent states that the health risks from fish consumption will be assessed by comparing mercury concentrations from monitoring activities to the Health Canada maximum level for mercury in retail fish. As noted in HC's review of the Round 2 Response, the mercury guideline for commercial fish (0.5 ppm) may not be protective of human health because fish consumption patterns of local Indigenous populations may differ from that of the general Canadian population who generally obtain fish from retail sources. The health risks of mercury exposure should be assessed using local fish consumption rates and the provisional tolerable daily intake (pTDI) value of 0.2 µg/kg bw per day. Denison are expected to remove reference to the use of commercial guideline for mercury in fish to remove apparent contradiction with provisional tolerable daily intake in the final EIS submission package, and this IR can be resolved for the purposes of the EA process. *The following outstanding issue will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: • Local fish consumption rates should be discussed and refined as needed during planned engagement with Indigenous Nations and communities.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-101	-	ECCC CNSC	Fish and fish habitat	Section 8.1.1.3, Section 8.2.1.3 Aquatic Environment	**Context:** In Section 8.1.1.3 Spatial and Temporal Boundaries the Project Area, Local Study Area (LSA) and Regional Study Area (RSA) are established as they pertain to surface water quantity. The same is done in Section 8.2.1.3 for surface water quality. In Section 8.1.1.3 Figure 8.1-4, the locations of the Project Area, LSA, RSA and surface water features and monitoring stations are provided. However, the locations of wetlands located near the Project area and within the LSA and RSA have not been provided. The location of wetlands within or near the Project footprint, as well as the other wetlands existing within the LSA can be confirmed from Part II_S9 Terrestrial Environment, Section 9.2.3.3 Figure 9.2.-8, including the wetland classifications. There appears to be at least one shallow open water wetland and several bogs located within the Project Area. There is no consideration of wetlands or potential effects to wetland hydrology, surface water or sediment quality throughout the aquatic environment assessments. There is no baseline information regarding wetlands and their status as fish habitat and ecological function, or assessment of potential effects to flow rates, water levels, water quality, sediment quality, or biota. **Rationale:** There is currently not enough information provided for ECCC to provide advice on the potential risks of the proposed Project to wetland hydrology, surface water and sediment quality within the LSA. This pathway of effects is important to assess in terms of potential effects to wetland habitat availability and quality due to changes in flow rates, water levels, water quality, sediment transport, sediment quality and potential effects to terrestrial and aquatic receptors. It is necessary to evaluate if changes in groundwater and surface water runoff flows and routing will affect water levels and habitat availability within wetlands. Potential effects from COPCs and radionuclides to surface water and sediment, or potential effects to ecological receptors within wetlands have not been evaluated.	1. Provide baseline information regarding wetland characterization within the Project Area and LSA, including: locations, wetland type, size, water surface elevation, depth, water flow pathways, and the presence of wildlife receptors including presence of fish/fish habitat within the Aquatic Environment section of the draft EIS. If this information is available in annexes or baseline studies, summarize it within the main body of the Aquatic Environment section of the draft EIS with references to respective documents for review. 2. Provide baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint. 3. Provide an assessment of potential effects to wetlands within the LSA and potential effects to ecological receptors during all phases of the proposed Project. 4. Provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.	Denison has not adequately responded to the request to identify potential effects to sediment quality to support identification of project-related effect pathways to wetlands, in either the February 10th, 2024 responses to IRs or the July 2nd, 2024 supplemental submission. The K_d values could differ significantly in wetland environments compared to in lake/stream measurements where all samples were taken and there are discrepancies in wetland classification within the EIS and information provided in IRs with the actual classification standards for various wetland types. For further explanation, the descriptions of the wetland areas provided in the February 10th response do not correspond to the information provided in the supplemental round of responses received from Denison. For example, Figure 2 of Appendix 8-F: Wetland Effects Assessment Report identifies a black spruce treed bog (ecotype BS17) between Whitefish Lake North and Whitefish Lake Middle (La-5), where effluent will be discharged. According to the Canadian Wetland Classification System (Warner & Rubec, 1997), bogs are defined as receiving water only from precipitation, with no hydrological connections to groundwater or littoral areas. This does not match with the response of "*littoral areas and these wetland portions are not cut-off from or isolated from the main basin of the lake.*" The response also does not correspond to the BS17 ecotype described in Appendix 9-B: Terrestrial Environment Wildlife and Vegetation Baseline Inventory. The uncertainty introduced as to the conditions on site complicates the discussions on baseline conditions and potential impacts in wetlands which the Proponent assumes to provide fish habitats. Bogs and fens (ecotypes BS17, BS18, BS19, BS21) are identified in and around Whitefish Lake and these wetlands will have different water and sediment chemistry than lakes and creeks. For example, the partitioning coefficients of sediments in a fen would not be expected to be the same as those in a lake, though both may be depositional environments, sediments in the fen would be richer in organic matter because of the vegetation present. Organic matter in sediment is an important factor affecting soil-water partitioning coefficients. Because of this, the sediment in wetlands is likely to adsorb more metals than sediment found in lakes. For this reason, it is important to understand baseline conditions and model impacts in order to ensure the aquatic environment will not be impacted by the project's planned discharges. The Proponent should clarify if the wetlands were misidentified in the Terrestrial Environment Wildlife and Vegetation Baseline Inventory. If they have been misidentified, then corrections should be made to the Baseline Inventory and Wetlands Assessment Report, and information provided in the Proponent's round 3 response should be integrated in Section 8.3 of the EIS. If they have not been misidentified, then the Proponent should respond to round 3 information requests considering the wetland environment. In order to resolve this IR, Denison are expected to: 1. Update wetland classification in the LSA according to the Canadian Wetland Classification System (Warner & Rubec, 1997). Focus should be applied to updating areas with hydrological connections to groundwater and littoral sources, which may have been misclassified as bogs. This should include any sub-classification of	Not Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							wetlands currently categorized as Shallow Open Water in Appendix 8-F: Wetland Effects Assessment Report. Updates should be made as necessary to all relevant reports, including the Terrestrial Environment Wildlife and Vegetation Baseline Inventory as needed. 2. Update habitat mapping for wetlands to reflect any changes in wetland classifications, particularly for wetlands that may include fish and fish habitat. 3. Update Table 8.3-3 and 8.3-4 in Section 8 of the EIS to include more specific information on wetlands that may contain fish and fish habitat, such as information on wetland type & extent, vegetation, substrate type, organic matter content, etc. 4. Provide a table with summary statistics (grain size analysis and sediment quality) from sediment sampling specific to each individual sampled lake or stream, rather than summary statistics for all waterbodies and watercourses pooled together. 5. Provide the source reference for the K_d values used for the ERA in Table 3-6 and the specific characteristics of sediments (i.e. grain size and composition) of the regional study areas as they compare to LA-5, the LSA and the RSA. 6. Conduct a statistical analysis with a power analysis comparing sediment characteristics (grain size analysis and sediment quality) from the various sub-samples taken within each waterbody to conclude if there are any significant differences between sub-sampling stations, and determine if there is within-lake variation in sediments. Denison should provide the methodology they will use to conduct the statistical analysis and power analysis for CNSC review and acceptance prior to completing the analysis. Based on the results of this statistical analysis, Denison should: a. If the results determine that there is enough statistical power to confirm there is no within-lake variation in sediment characteristics within LA-5, Denison should then complete a statistical analysis and power analysis comparing LA-5 to other sampled areas to determine if there is any between-lake variation in sediment characteristics. b. If the results determine that there is not enough statistical power, or that there is enough statistical power but there is significant within-lake variation between sub-samples in LA-5, Denison will require the additional baseline data that Denison has already committed to collecting, to update the modelling during the EA phase to support conclusions on significance of effects to the receiving environment. This IR relates closely to IR-107 that demonstrates that there is not enough baseline data to support conclusions on significance of effects.	
IR-102	-	ECCC CNSC	Fish and fish habitat	Section 8.1.3.1 Appendix 8-C, including Appendix II, Table 1 (p. 2)	**Context:** Only one measured-results dataset for baseline stream flow exists that is relevant to the Project data from the Water Survey of Canada (WSC) station for Wheeler River (06DA005), and the Proponent used constructed records. The Proponent states that data from 06DA005 was used to extend local hydrometric station records and calculate baseline water quantity metrics. However, this was done through a complex combination of daily data correlation or monthly unit area runoff relationship, with or without offset, where some stations were based off constructed records instead of the	1. Provide more information on the extension of Project hydrometric station data using WSC station 06DA005. 2. Discuss the accuracy of any correlations/relationships and justify any deviations from simple unit area runoff relationships in the estimation of baseline water quantity values for the Project hydrometric stations. Constructing		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					real long-term dataset at 06DA005 (see Section 8.1.3.1 and Appendix II of Appendix 8-C, Table 1, p.2 (PDF p. 569)). Appendix 8-C references previous reports in its own appendices, but no equations are shown and there is no description of the accuracy of the fit, or explanation for not referring back to the one dataset (WSC station). Subsequent statistics calculated from these constructed records (e.g., 7Q10 needed for SK water Licenses) would be affected by this uncertainty. **Rationale:** Fish habitat can be altered by changes to depositional and erosional patterns in streams. Confidence in the Proponent's estimate of baseline water quantity, and by extension Project effects to fish habitat, cannot be established without a complete description of the method applied, as well as a discussion of its accuracy.	records from records that are themselves constructed is not recommended. 3. If baseline water quantity metrics need to be revised, discuss (if any) resulting changes to the effects assessment.		
IR-103	-	ECCC CNSC	Fish and fish habitat	Section 8.1.3.4 Climate Change Influenced Extreme Events	**Context:** The Proponent notes that Intensity duration frequency (IDF) curves are used to estimate the size of water management structures around a site and that the IDF curves are often specific to climate monitoring stations. The Proponent used the IDF_CC Tool 5.0 developed by the Institute for Catastrophic Loss Reduction (2021) which generates Intensity Duration Frequency (IDF) curves at ungauged locations in order to estimate future IDF curve values under influences of climate change. This tool generates sub-daily values at ungauged locations by interpolation and distance weighing from gauged locations. **Rationale:** IDF trends exhibit random behavior at some locations and correlated behavior at other locations. The choice of gauged locations will infer the statistics for the ungauged locations, including the IDF trends. Without identification of the gauged locations, it is not possible to assess if the modelled data is realistic or not. If the modelled data is not accurate the design of water management structures on the site may not be sufficient resulting in the potential for impacts to the Project from flooding or extreme weather events.	Provide the gauged stations used to generate the sub daily duration values found in Table 8.1-6: Baseline of Intensity Duration Frequency data.	As Denison has added a commitment related to updating the IDF (1 in 100 year 24-hour rainfall) and demonstrate climate change resilience of the project (conduct climate risk and resilience assessment) in version 2 the Commitments Register (ID 8-50), this IR has been accepted for the purposes of the current EA process. *The following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence*. If future projections of IDF are going to be used in design, then the Proponent is advised to consult the CSA (2019) guidance and provide revised estimates of their potential changes over the project's duration. The Proponent should perform a statistical analysis of precipitation using historical data at the location of interest including, confidence intervals to consider uncertainty using the approach outlined in CSA (2019). Additionally, ECCC calculated that the IDF value for a 24h 100-year event is 91.2 mm at 95% confidence interval (using 10 years (2011-2021) of historical precipitation data at Key Lake). However, the same IDF value for a 24h 100-year event was presented as an average value of 67.2 mm with no confidence interval in the IR-103 Attachment. The Proponent value is neither representative nor conservative and the proponent should update the current value based on a new statistical analysis that considers uncertainty and longer record of historical precipitation. See also AD-72 in the Advice to Proponent table.	Accepted
IR-104	-	ECCC	Fish and fish habitat	Section 8.1.3.4.2 Probable Maximum Precipitation (PMP) Events Appendix 8C	**Context and Rationale:** The Proponent notes: "The probable maximum precipitation (PMP) event is a design standard value for an extreme rainfall event. The PMP event does not have an estimated return period but is instead based on the theoretical maximum amount of water that a storm could produce based on the maximum persisting dew point." The Proponent provides a PMP value of 489.3 mm, which is based on data and methodologies available in 1999, taken from the Atmospheric Environment Branch Report (1999), Report Number AHSD-R99-01. The Proponent references Appendix 8C for details. Appendix 8C contains no supplementary information other than what is already provided in Section 8.1.3.4.2.	1.Provide a revised PMP value (using up to date data) or justify the use of a PMP that is based on data and methodologies from 1999 as opposed to a more recent time series analysis. 2. Describe the alternative methods for determining PMP values that were considered. Include descriptions of both "statistical" outcomes and "rational" outcomes as applicable. **Technical Discussion Required**: Yes	Response to IR-104 is accepted by CNSC staff based solely on the Denison's response (E-DOC#-7220826, p.47/112) that states: "Despite Denison's reiteration that the PMP is adequate for the EA level design basis, Denison is committed to revisiting the estimates per CNSC's recommendations, as applicable, for the licensing phase of the Project." *This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.*	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					The assumptions and methodologies presented in the report are the results of time series analyses available in 1999. As time series evolve so do the derived statistics. In order to assess potential flood risks and impacts to the Project from flooding, data that is current and representative of the changing climate is needed. The Proponent should explain why they've used data from 1999 rather than using up to date data, describe what alternative methods for determining PMP they have considered, and describe how they will support their use of 489.3 mm as a PMP, or describe how they will generate a refreshed PMP. The main factor that influences the statistical data output is the length of the time series hence the reason to keep the statistical data. The PMP values can be substantially (>10%) different if two decades of data is used in the statistical analysis.		There are an additional 24 years of meteorological datasets since the 1999 study thus all historical rainfall extremes including those since 1999 study should be considered to estimate up to date PMP at the Project site The proponent's justification on whether the 1999 or 1994 PMP estimates are current and conservative should be substantiated based on meteorological data analysis. An estimation of updated PMP is achievable by the proponent as meteorological data is freely available and accessible from ECCC and the proponent should provide a revised PMP. The Proponent should also clarify how recent the data used to calculate the PMP or the time series is and explain the use of an older data set that will not produce as accurate of a PMP value as a more recent data set would produce, even when estimates are conservative. Specifically, a. Explain the rationale for the use of the data set which was used to derive the PMP. B. Clarify if the PMP and/or the time series was calculated using more recent data. This will allow for an accurate evaluation of the validity of results derived from the data sets selected by the Proponent.	
IR-105	-	Directorate of Fisheries and Oceans (DFO)	Fish and fish habitat	Section 8.1.4.1, Potential interactions between project and valued component/key indicators Surface Water Quantity Section 8.1.4.2.2, Surface Water Taking 8.3.4.1, Potential interactions between project and valued component/key indicators	**Context:** Table 8.1-8 and Table 8.3-6 in the EIS indicates a potential for freeze wall operation to influence groundwater interactions and surface water quantity and as a result, impact fish and fish habitat. Section 8.1.4.2.2 references Section 7 Geology and Groundwater for details on potential impacts. In addition, IR-63 notes the groundwater model does not describe the pathway in which groundwater would pass around the freeze wall during operation and any resulting potential effects on groundwater discharge to Whitefish Lake. **Rationale:** As per IR-63, the groundwater model analysis is insufficient to make conclusions on the potential effects of the freeze wall on groundwater discharge into Whitefish Lake. DFO requires this information to fully understand if altered groundwater regimes will result in changes to Whitefish Lake water levels and any potential impacts to fish and fish habitat as a result of changing water levels.	1. Provide a more fulsome analysis of the potential impact of freeze wall operations on local and semi-regional groundwater regimes, and subsequently to fish and fish habitat within Whitefish Lake. The analysis should provide a rationale of how the scope of the groundwater model is relevant to and able to detect changes at the scale of fish and fish habitat. 2. If impacts to fish and fish habitat in Whitefish Lake are predicted to occur due to changes in the groundwater regime, describe any mitigation measures that could be used to avoid these impacts. 3. If impacts are predicted that cannot be avoided, characterize residual effects on fish and fish habitat.		Accepted
IR-106	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 8.1.4.2.3, Surface Water Discharge	**Context:** It is stated in this section under construction that all site contact water will be held in the Clean Waste Rock Pond. **Rationale:** It is unclear from this section what will happen to the contact water held in the Clean Waste Rock Pond, and whether it will be removed from site or released at a later time. What is the contingency plan if more contact water is produced during construction than the Clean Waste Rock Pond has capacity for.	Please indicate what will happen to the contact water stored in the Clean Waste Rock Pond during construction activities, will it be released after the wastewater treatment plant is installed? Further, please describe the contingency plan if contact water produced exceeds estimates and will exceed the volume of the clean waste rock pond?		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-107	-	CNSC ECCC	Aquatic environment	Section 8.2.3.3, Existing Surface Water Quality	**Context:** Under the methodology and metrics section (8.2.3.1) it is stated baseline water quality was sampled in 2016, 2018, and 2019. Looking at the data in Appendix A of Appendix 8D it seems that some waterbodies have little data available for baseline characterization. For example, Whitefish Lake only has 3 and 5 samples taken between its two sample stations, with sampling frequency seeming intermittent. **Rationale:** The amount of data available for baseline water quality characterization does not seem sufficient to adequately characterize the baseline and the variation it would experience. An effective baseline characterization is vital to ensure water quality is indeed not being affected by the Project. In addition, it is not clear if data quality objectives were applied to determine baseline information was adequate. To meet CEAA 2012 requirements, and CNSC expectations outlined in REGDOC 2.9.1, Environmental Principles Assessments and Protection Measures, the applicant is required to complete a characterization of the baseline environment. As described in REGDOC 2.9.1 Appendix B.2, Characterization of the Baseline Environment for Environmental Assessment Under CEAA 2012, the "baseline information should be sufficient to support the use of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity" In addition, the "applicant or Licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed."	Please clarify which data quality objectives were used for the baseline characterization data. Please provide justification whether the number of datapoints collected with inconsistent frequency in baseline surface water characterization is sufficient to meet data quality objectives and to adequately characterize the baseline, and whether Denison is confident that the data collected is enough for a robust water quality baseline characterization. **Suggestions for mitigation and follow-up measures:** CNSC recommends that additional water samples are collected and analyzed at a consistent frequency to ensure a robust baseline	~~A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided.~~ Added November 20th, 2024 – draft response provided to Denison in October 2024: Denison has addressed item 1 in the IR Round 3 requests, but has not adequately addressed items 2, 3 and 4. In Appendix A-1 of Appendix 8-D Denison has provided summary statistics; however, these summary statistics are for the pooled dataset and not for individual waterbodies and watercourses. Summary statistics should be provided for each individual waterbody/watercourse so that within and between-lake variation can be identified. Denison has not acknowledged or discussed current gaps and limitations in the baseline data and studies and has not demonstrated how the current baseline data is sufficiently robust to characterize natural variation. It is not clear how Denison meets the requirements of the Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012 (referred to as "The Guidelines" from this point forward). In The Guidelines Section 8.1 Baseline Environment, it states: *"The EIS will include a description of the environment, including the components of the existing environment and environmental processes, their interrelations and interactions, and the variability in these components, processes, and interactions over time scales appropriate to the EIS. In characterizing the environmental effects of the project, the proponent will consider the current baseline environment and environmental trends within the project area."* Denison currently has only conducted three water quality sampling events with one sample each in LA-5, on August 8th, 2012, April 1st, 2014, and September 10th, 2016. Not only is most of the data over 10 years old, but sampling was also only conducted in two seasons. It is not possible to adequately characterize environmental processes, trends and natural variation with the current dataset, and pooling data from multiple lakes further reduces the understanding of these factors. The correlation analysis that Denison provided in their supplemental information Round 3 response did not contain a statistical analysis comparing baseline data between sampled lakes in the LSA and RSA, therefore no determination could be made regarding the similarities between waterbodies. A comparison of mean percent differences between pooled datasets does not conclude that there is no significant difference without supporting statistical tests. Additionally, at no point was LA-5 the primary receiving waterbody compared individually to other waterbodies, LA-5 data continued to be pooled with data from other lakes to form the Key Assessed Lakes pooled dataset, which was then compared to the full LSA dataset. Pooling data, use of reference lake data with exposure lake data in pooled datasets, and use of the geometric mean are all uncertainties and data limitations that should be acknowledged and addressed as minimizing the ability to detect natural variation, including seasonal variation, within-lake	

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							Note: Denison and the CNSC had a number of meetings and discussions on this Round 4 IR between Sept. 16, 2024 and October 9, 2024. The response provided here is focused on the central questions coming out of these discussions. Routine surface water quality sampling has started at the Wheeler River Project site. Denison made the commitment to collect additional preoperational surface water quality data in commitment 8-48 and this work has been initiated. The list of surface water quality sampling stations, sample frequency, and analyte list is included in Attachment IR-107 (Round 4). For the CNSC's consideration, a comparison of June, July, August, and September 2024 water samples collected at Whitefish Lake (LA-5) is provided in Attachment IR-107 (Round 4) Table 1. As shown in the table, the results collected in 2024 are within the range (minimum to maximum) of pooled results for both the full LSA dataset and key assessed lakes. The majority of minor differences between recently collected samples and pooled datasets are related to differences in analytical detection limits. We note that a low-level trace metal analysis was used in 2024 and this resulted in lower detection limits for some parameters compared to previous results. We note that pooling of data to establish a background is not an uncommon approach. For example, such an approach is contemplated by Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives (CCME 2003). This procedure acknowledges the use of "regional" data to derive background concentrations assuming the sites from which data are used "… are generally located nearby the site under consideration but have not been adversely affected by human activities." This description is accurate for the Wheeler River Project aquatic LSA which is in an unimpacted, remote area of Saskatchewan's boreal forest. We refer the reviewer to Appendix 10-A, Appendix A Section 3.2 for consideration of modelled average water baseline concentrations of COPCs and a comparison to measured values. The plots show trends over time for selected COPCs and the generally good agreement between the measured and modelled concentrations. Based on the data presented and methodology provided in relevant guidance, the baseline water quality data collected are suitable for the purposes of the EIS and the application of additional conservatisms in the use of the data provide a conservative (i.e., protective) framework for evaluating potential effects. As shown in Attachment IR-107 (Round 4) Table 2, surface water quality sampling will be conducted monthly during the open water period and twice 2 variation at sampling sub-stations, year-to-year variation and betweenlake variation. The requests below will serve to satisfy the principles of the Precautionary Approach and address these deficiencies. __**In order to resolve this IR, Denison are expected to:**__ 1. Meet the requirements of the CNSC's guiding principles for protection of the environment REGDOG 2.9.1 Section 2.1 that "the licensee's license application shall demonstrate (through performance assessments, monitoring or other assessments) that their environmental protection measures are assessed against performance indicators and targets that are based on sound science", Denison should provide a statistical analysis including a power analysis comparing LA-5 baseline water quality data individually to other waterbody water quality data to determine if there is a statistically significant difference between water quality at various sites in the LSA. Denison should provide the methodology they will use to conduct the statistical	

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							analysis and power analysis for CNSC review and acceptance prior to completing the analysis. Pending the results of the statistical analysis: a. a. If the statistical analysis demonstrates that there is not enough statistical power to detect a significant difference between waterbodies, or that there is enough power and a significant difference between LA-5 and other waterbodies in the LSA, Denison will be required to provide additional baseline data to update the modelling during the EA process and update risk and significance conclusions as needed. b. If the statistical analysis demonstrates that there is enough statistical power to detect a significant difference and that there is no statistical difference between LA-5 and the other waterbodies in the LSA, then Denison will not be required to provide further baseline data for the purposes of the EA, however Denison will still be expected to conduct further baseline characterization as per their commitments to collect more baseline data. Denison is also expected to still satisfy the other requirements in this IR. 2. If currently available, incorporate any existing new data (post-2019) into the baseline dataset and update the analysis for submission in the finalized under ice. Per CNSC licensing requirements, the new water quality data along with updated effluent quality data will be integrated into the environmental risk assessment used to support Denison's application for a CNSC licence to operate and prior to effluent release to Whitefish Lake. 3 EIS. Modelling should incorporate: a. Near-field modelling (LA-5) should utilize the 95th percentile values of data measured at LA-5 (i.e., not the pooled dataset); and b. Far-field modelling of the downstream environment should utilize the 95th percentile values of the pooled dataset. c. Water quality predictions should be updated accordingly. 3. Provide a commitment that, prior to the detailed design phase/ licensing to construct, the Proponent will: a. Conduct additional baseline monitoring to yield dataset(s) that provide robust water quality baseline characterization of seasonal conditions (i.e., freshet, summer, fall, under-ice during winter), including data collection for a range of flow conditions, at the receiver (LA-5) and downstream monitoring locations. At a minimum, data collection should prioritize collecting baseline water quality data for the immediate receiving environment (LA5); b. Update the baseline water quality characterization of seasonal conditions for LA-5 using the 95th percentile values of data measured at LA-5 (i.e., not the pooled dataset) and downstream environment using the 95th percentile values of locationspecific data instead of pooled data. c. Update the water quality modelling and predictions of risk as needed.	
IR-108	-	ECCC	Change to an environmental component due to	Section 8.2.3.3 Aquatic Environment	**Context:** Tables 8.2-2 and 8.2-3 provide summaries of the baseline surface water quality in the LSA. No justifications for the selection of water quality guidelines have been provided. COPCs that require calculations based on other parameters such as hardness,	1. Update Tables 8.2-2 and 8.2-3 to include all COPCs that require effluent characterization and receiving environment	A number of additional corrections were provided in the supplementary information provided by Denison on July 2nd, 2024. However, the following remains outstanding:	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			hazardous contaminants		pH, or temperature to derive guidelines (i.e., ammonia, cobalt, zinc, etc.) should be indicated within the table, with a note specifying the parameter values used in the calculations, so that thresholds may be confirmed. No baseline data for un-ionized ammonia has been provided, which is a Schedule 4 substance requiring monitoring under the MDMER. For cobalt, manganese, and vanadium, Federal Environmental Quality Guidelines (FEQGs) and/or CCME Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life have not been included. A guideline of 26 mg/L has been provided for molybdenum as a Saskatchewan Environmental Quality Guidelines (SEQG), however the actual SEQG is 31 mg/L and the CCME CWQG is 0.073 mg/L. **Rationale:** In order to assess potential changes to surface water quality from Project related activities, ECCC requires that data on all parameters that require MDMER effluent and receiving environment monitoring be provided for assessment, including accurate water quality guidelines where available.	monitoring under the MDMER. 2. Update Tables 8.2-2 and 8.2-3 to include missing or corrected water quality guidance thresholds, and information on values used to derive thresholds for COPCs that are dependent on general parameters.	• In Table 8.2-3, the long-term benchmark for ammonia as N is 5.74 mg/L for all stations except SA-4, SA-5 and SA-6, where it is 6.98 mg/L. Additionally, the TDS long-term benchmark of 500 mg/L based on SEQG, found in Table 8.2-8 is not included in Tables 8.2-2 or 8.2-3. This IR is accepted for the purposes of the EA review, and the following must be corrected in the final EIS submission package: 1. In Table 8.2-3, confirm if the long-term benchmark of 6.98 mg/L for ammonia as N for stations SA-4, SA-5 and SA-6 is correct and provide justification as to why the benchmark differs at these stations. 2. In Table 8.2-2 and 8.2-3, confirm the correct long-term benchmark for unionized ammonia as it currently differs between various stations. 3. For consistency, update Tables 8.2-2 and 8.2-3 to include the Total Dissolved Solids (TDS) benchmark utilized in Table 8.2-8.	
IR-108	IR-108-R1	ECCC	Change to an environmental component due to	Section 8.2.3.3 Aquatic Environment IR-108 Response from Denison	**Context:** Incorrect benchmark environmental quality guidelines and guidelines that cannot be verified remain within the updated Tables 8.2-2 and 8.2-3 provided in the Proponent's response. The Proponent provided an Aluminum Saskatchewan Environmental Quality Guidelines (SEQG) value of 0.005 mg/L in both tables. This is incorrect and appears to be the guideline for irrigation, not the guideline for protection of aquatic biota. The Proponent provided a Molybdenum SEQG of 26 mg/L in both tables. This value is incorrect. The correct SEQG for Molybdenum is 31 mg/L and the Canadian Water Quality Guideline (CWQG) is 0.073 mg/L. The Proponent provided a Nitrate SEQG of 13.29 mg/L in both tables. This value is incorrect. The correct SEQG for Nitrate is 3 mg/L and the CWQG is 13 mg/L. **Rationale:** In order to verify the benchmark environmental quality guidelines that are calculated based on environmental modifying factors such as pH, hardness and dissolved organic carbon (DOC), the specific concentrations of these environmental modifying parameters used in the calculations must be provided. Additionally, incorrect benchmarks for Aluminum, Molybdenum, and Nitrate remain within the updated tables provided by the Proponent. No benchmark was provided for Manganese. It is not clear if Total Chromium or Hexavalent Chromium was measured as the table does not specify, and the benchmark provided was for Hexavalent Chromium. This information is required to understand potential changes to surface water quality from Project related activities and facilitate threshold confirmation. Use of the incorrect threshold could allow for effluent to be discharged at the wrong concentration.	1. Update Tables 8.2-2 and 8.2-3 to include footnotes with the concentrations of environmental modifying parameters such as pH, hardness and DOC used to derive guidelines for Aluminum, Cadmium, Copper, Lead, Manganese, Nickel and Zinc. 2. Update Tables 8.2-2 and 8.2-3 to include the correct benchmark guideline value for Aluminum, Molybdenum and Nitrate. Include the concentrations of environmental modifying parameters needed for deriving guidelines. If the most stringent guideline value is not selected for use, provide a rationale for use of the chosen guideline. 3. Update Tables 8.2-2 and 8.2-3 to include the calculated guideline value for manganese and the environmental modifying parameter concentrations used to calculate the guideline. A benchmark environmental quality guideline has not been provided for Manganese, however a chronic CWQG guideline exists that can be derived based on environmental modifying parameter concentrations. Update Tables 8.2-2 and 8.2-3 to specify if Total Chromium or Hexavalent Chromium was measured. See also related IR-115-R1.	In follow up to outstanding corrections following the Feb 10th submission, supplementary information provided by Denison on July 2, 2024 resolved these issues.	Accepted
IR-109	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment	**Context:** In this section it is stated "Treated water from the IWWTP will be pumped to the three Effluent Monitoring and Release Ponds (each 3,300 m3). These ponds will be designed to hold effluent for 72 hours for testing before discharge to the environment" (p. 8-75). It is unclear what procedure will be followed if effluent in monitoring ponds does not meet discharge requirements following testing. Additionally, it is also stated that "Treated water in the Effluent Monitoring and Release	Provide further information regarding management of effluent in monitoring ponds that does not meet the requirements for discharge under the MDMER.		Accepted

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					Ponds will be monitored prior to release to a surface waterbody or injected into groundwater via deep well injection." However, the MDMER pursuant to the Fisheries Act requires all mine effluent and seep. From the mine site that contain deleterious substances be discharged through a final discharge point. **Rationale:** In order to fully understand effluent management, more information is required regarding the procedure for managing effluent in monitoring ponds that does not meet discharge requirements. It is unclear how effluent that does not meet discharge requirements will be managed if it needs re-treatment and re-testing prior to discharge. ECCC reminds the Proponent that Project effluent from all final discharge points must meet federal legislation requirements.			
IR-110	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment Appendix 8-E, Section 2.1	**Context:** It is stated that the diffuser at the final effluent discharge point will be located in approximately 3m of water. However, in Figure 8.2-5 displaying the location of the proposed diffuser and lake bathymetry, the diffuser location seems to be located in 2-2.5m of water. A similar image in Figure 1 Section 2.0 of Appendix 8-E also indicates that the diffuser seems to be located in 2-2.5m of water. Additionally, while thermal effects are unlikely, this cannot be confirmed until a more detailed diffuser design is provided for review. **Updated Rationale:** The Proponent should confirm the location and depth of the proposed diffuser in order to confirm that modelling predictions for effluent discharged into the receiving environment are accurate. A review of the final discharge design is necessary to confirm the location and depth of the proposed diffuser and modelling predictions for effluent discharged into the receiving environment.	Provide confirmation of the diffuser depth and location. ECCC requests the opportunity to review the finalized diffuser design once it is available.	Denison has captured a commitment in version 2 of the Commitments Register (July 17, 2024) that the final diffuser configuration will not change the environmental assessment conclusions of risk to aquatic receptors and that water quality will remain below guidelines (ID 8-9), so this IR has been accepted. Note, if there are deviations from predicted effluent and near-field surface water concentrations of COPCs and risk to aquatic receptors due to the finalized diffuser design, this is expected to be addressed through Denison identifying and implementing mitigation measures (e.g., treatment) to ensure that the environmental assessment conclusions of risk to aquatic receptors will not change and that water quality will remain below guidelines. This must also be factored into Denison's EA Follow-Up Program *Any outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.*	Accepted
IR-111	-	CNSC	Fish and fish habitat	Section 8.2.4.2.2, Controlled Discharge	**Context:** This section of the EIS indicated that the scenario was assessed using a conservative assumption of a continuous freshwater withdrawal rate of 40.5 m3/hr, and a continuous effluent discharge rate of 81.0 m3/hr. **Rationale:** The withdrawal rate assessed is half of the effluent rate, it is unclear from the text where the other half of the volume of effluent is coming from, if not drawn from the lake.	Please clarify where the other half of the total volume of effluent discharged is from in the water balance between water intake and effluent.		Accepted
IR-112	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.2, Aquatic Environment Appendix 8-E, Section 1.2.1 Appendix 10-A (ERA), Section 3.1	**Context:** This section of the EIS states that, "for the purpose of assessing the scenario of greatest potential effects, the Project was assessed as having a continuous freshwater withdrawal rate of 40.5 m³/hr and a continuous effluent discharge rate of 81.0 m³/hr." (p. 8-21) However, several sentences later it is stated that, "The approach to assessing Project-related effects on the Surface Water Quality VC was conservative for the following reasons: The assessment was based on a continuous (year-round) discharge rate at an expected average effluent discharge of 0.0101 m3/s (or 36.5 m3/hr) throughout	1. Confirm that the surface water quantity, quality, and aquatic biota risk assessments and modelling, were conducted using the discharge rate for 36.5 m3/hr within the draft EIS. 2. Revise any statements or conclusions in the draft EIS to improve clarity about the usage of the maximum upper bound discharge rate of 81 m3/hr. Remove statements regarding use of the discharge rate of 81 m3/hr during modelling and risk assessments to the receiving environment as needed.		Accepted

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					Construction, Operation, and Decommissioning…" This is a continuous theme throughout Section 8, Aquatic Environment, where the discharge rate for the surface water quality assessment changes between 36.5 m3/hr and 81.0 m3/hr. However, in Appendix 10-A (ERA) the 36.5 m3/hr discharge rate is the only value used for the near and far-field modelling. It should be made clear in the main body of the draft EIS that the average effluent discharge rate of 36.5 m3/hr has been used as the input for the near- and far-field modelling for effluent, surface water and sediment quality predictions. The maximum upper bound discharge rate is 81 m3/hr; however, modelling for effluent, surface water and sediment quality was not completed for this discharge rate. **Rationale:** It remains unclear throughout the draft EIS that all predictions of COPC concentrations in effluent, and receiving environment surface water and sediment are based upon the effluent discharge rate of 36.5 m3/hr, and not the maximum upper bound discharge rate of 81 m3/hr. All conclusions about risk to the environment and aquatic and terrestrial biota must make this clear. If the Proponent wishes to make conclusions based on the maximum upper bound discharge rate of 81 m3/hr, modelling needs to be conducted using this rate of discharge.			
IR-113	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment	**Context:** No quantitative assessment of climate change has been conducted. Representative concentration pathways (RPC) projections for climate change have not been integrated with near-and far-field modelling to assess impacts to surface water quality or sediment quality in the future. **Rationale:** Changes in air and water temperatures, precipitation, snow melt, ice formation, etc., due to climate change can all influence COPC concentrations in surface water and sediment. It is not possible to assess the potential impacts from climate change on predicted surface water and sediment COPC concentrations with the current information.	Provide a quantitative analysis of the potential impacts of predicted COPCs from mine effluent to surface water and sediment quality with climate change scenarios for the Project lifespan incorporated into modelling. Include modelling predictions regarding the influence of changes to air and water temperatures, precipitation, snow melt, ice formation, etc., on COPC concentrations in surface water and sediment.	In order to resolve this IR, CNSC Staff expect that Denison: 1. Make a commitment to not discharge during unusually low flow scenarios, and, 2. Make a commitment to complete a sensitivity analysis during licensing after the BATEA has been completed. These commitments must be reflected in the final EIS submission package. *This IR has been accepted for the purposes of the current EA process, the outstanding issue below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent suggests that the requested quantitative analysis is not necessary and contends that potential climate change effects on water quality should instead be addressed through mitigation measures, monitoring and adaptive management. The Proponent's approach does not sufficiently characterize the range of potential effluent and water quality predictions. Climate change analysis is lacking, and a sensitivity analysis was not conducted in order to further understand uncertainty and drivers of the model results. Further, some aspects of water quality modeling are not sufficiently conservative, including use of the geometric mean (instead of the 95th percentile) as the baseline concentration for constituents, and pooling data from all lakes, which would mask any differences between the lakes. It is therefore not known whether water quality exceedances may be predicted under climate change scenarios. Without estimating the potential influence of climate change on water quality, it is unclear whether the proposed water quality mitigation measures	Accepted

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							are adequate. Climate change may impact the assimilative capacity of the receiving waterbody, therefore the present day 7Q10 or low flows may vary under future climate conditions. A sensitivity analysis would further refine predictions of how the 7Q10 or low flows may vary with climate change and therefore provide insight into how water quality may be impacted as well. In order to resolve this issue, Denison will be expected to: • Conduct a sensitivity analysis of low flows (7Q10 low flow, monthly low flow and monthly average flow) and high flows to assess how low and high flows may change under future climate conditions and the potential implications on water quality predictions made during the EA phase.	
IR-113	IR-113-R1	ECCC	Fish and fish habitat	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment IR-113 Response from Denison	**Context:** The Proponent states the following, *"*The PMP is very conservative (e.g., assumes effectively a full year of precipitation in one event) under both existing and future conditions (climate change)". This statement suggests that the PMP value utilized considers future climate changes such as possible changes in the frequency or intensity of extreme precipitation events. **Rationale:** As noted by the Proponent, increases in extreme rainfall are anticipated with a warmer climate. For precipitation extremes across Canada, the relative change in event frequency is expected to be larger for more extreme and rarer events. Given that the extreme precipitation is expected to intensify in the future (Kunkel et al. 2013), the Proponent should consider how these potential changes will influence design values such as PMP.	Clarify if climate change has been considered in the PMP value provided. If it has not been considered, discuss how potential increases in PMP have been and/or need to be considered in the Project design. **Reference:** Kunkel, K., Karl, T. R., Easterling, D. R., Redmond, K., Young, J., Yin, X., & Hennon, P. (2020). Probable maximum precipitation and climate change. *Geophysical Research Letters*, 1402-1408.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent has not clarified if climate change has been considered in the PMP value provided or discussed how potential increases in PMP have been or need to be considered in the Project design. Thermodynamic effects on atmospheric moisture will lead to intensification of local extreme precipitation in the future. Probable maximum precipitation (PMP) is defined as the greatest accumulation of precipitation for a given duration meteorologically possible for an area (Kunkel et al., 2013). PMP values may increase with climate change. In the response to IR-113 R1, the Proponent states that "the design basis PMP is robust and inclusive of projected total annual precipitation under a high carbon scenario". It is unclear from this statement how the analysis provided indicates that the PMP is inclusive of climate change. The Proponent should clarify how the analysis that they provided shows that the design PMP considers climate change, and indicate if or how the potential for increased PMP has informed site water management for the mine life and into post-closure and considered in the development of mitigation measures. **Reference**: Kunkel, K. E., Karl, T. R., Easterling, D. R., et al. 2013. Probable maximum precipitation and climate change. Geophysical Research Letters 40(7), 1402–1408. Available at: 10.1002/grl.50334	Accepted

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IR-114	-	ECCC CNSC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.2.4.2.4	**Context:** Tables 8.2-9, 8.2-10 and 8.2-13 demonstrate predicted maximum effluent concentrations of COPCs and maximum predicted receiving environment concentrations in the near- and far-field. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, TSS and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. For zinc, it is unclear how guidelines have been calculated when CCME thresholds can only be derived with hardness values <250 mg/L. Additionally, water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. Mercury has been identified as a COPC of interest to Indigenous groups for the proposed Project. Table 8.2-8 indicates that background concentrations of mercury in LA-5 are low, and predicted effluent concentrations are also low. However, no information has been provided on background methylmercury concentrations or expected atmospheric deposition of mercury from Project related emissions. Predicted effluent concentrations of 3915 mg/L of sulphate are quite high, and sulphate is known to increase mercury methylation rates in aquatic environments. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment. ECCC recommends the use of the most stringent guidelines for the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds. Increased sulphate availability can lead to increased methylation rates of mercury and methylmercury in sediment and surface water. Methylmercury is a toxin that can bioaccumulate within the food chain and present risks to aquatic biota and wildlife consuming aquatic biota. Potential changes to methylmercury concentrations in water quality, sediment and fish tissues should be assessed due to the proposed sulphate loadings in effluent. Additionally, in accordance with the MDMERs, Denison will be required to demonstrate that their effluent quality meets the limits in the MDMER. Denison is expected to provide the predicted effluent quality for lead, nickel, and un-ionized ammonia to demonstrate compliance with the MDMERs.	1. Update all tables to include all COPCs with required monitoring under the MDMER including acute and chronic thresholds. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. 3. Provide baseline data on the concentrations of methylmercury in surface water, sediment and fish tissues (i.e., large- bodied sports fish and small-bodied forage fish) in the LSA and RSA receiving environment to establish a baseline prior to potential Project impacts. 4. Provide an assessment of risk from methylmercury to ecological receptors due to changes in sulphate concentrations in effluent, and potential deposition of mercury from Project related atmospheric emissions in the receiving environment.	In a supplementary submission provided on July 5th, 2024, Denison provided corrections to some tables. However, errors and conflicting information remain within and between tables. <u>In order to resolve this IR, Denison are expected to correct the following issues:</u> 1. Provide the following updates to Tables 8.2-8, 8.2-10, 8.2-13, and 8.2-14 to correct the errors outlined. Additionally, in Table 8.2-13 MDMER Schedule 4, the maximum authorized effluent concentration limits are not appropriate for use as short-term benchmark water quality guidelines. The Schedule 4 limits are only applicable to effluent and represent concentrations in effluent that cannot be exceeded at end-of-pipe, not to receiving environment surface water concentrations, and are not a reliable indicator of acutely lethal concentrations of constituents in receiving environment surface water. • Tables 8.2-8 and 8.2-10: A. Temperature: long-term screening criteria is "ambient temp" and should be updated to "narrative", as has been used in updated Tables 8.2-2. The narrative is already included in the footnotes of Table 8.2-8 and 8.2-10, so the tables should be updated as well. • Table 8.2-13: A. Cadmium: both short-and long-term benchmarks are erroneous and should be corrected to values found in updated Table 8.2-2. B. Chloride: long-term benchmark is erroneous and should be corrected to value found in updated Table 8.2-2. C. Iron, Lead-210, and Uranium-234 & -238: long-term benchmarks are missing and should be the same values found in updated Table 8.2-2 or Table 8.2-8. D. Alkalinity and nitrate have been added to the table as requested, however predicted maximum concentrations are only presented for Whitefish Lake Middle and South. The proponent should describe why there are no estimates for these parameters in other lakes, and how they intend to fill these gaps. • Table 8.2-14: A. The removal of constituents of potential concern from future centuries review need to be justified by the proponent. Otherwise, all parameters included in Table 8.2-13 should also be included in Table 8.2-14. Presently alkalinity, nitrate, uranium-234 & -238 are missing. B. Uranium: the long-term screening concentration is erroneous and should be corrected to the value found in all other tables. • Footnotes: A. The footnotes for each table should reflect what is in the table. B. All tables: acronyms used in the references that need explanations in the footnotes include: "CCME", "HC", "BC MOE", "FEQG" and "MDMER". C. All tables: explanations in the footnotes for acronyms that were not used in the tables: "SSWQO", "TKN", and "TOC". Removing these would increase clarity.	Not Accepted

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							D. Footnote "*" should be removed. It explains how ammonia concentration is calculated and is not referred to in Tables 8.2-8, 8.2-10 & 8.2-13. In Table 8.2-14 it is associated by cadmium, which does not make sense. E. Footnote (4) should be removed. It states the short-term screening criterion for chloride limit is "*Based on water hardness >0 to <17 mg/L*". This appears erroneous since neither the CCME guideline nor the SEQG is hardness based. F. Tables 8.2-13 & 8.2-14 do not refer to the footnotes "TDS", "narrative", (4) and (7), and removing them would help clarity. 2. CNSC/ECCC staff agree that the minor baseline exceedances of copper concentrations in water do not constitute the use of a guideline that is a magnitude of order greater than the copper FEQG. The copper FEQG guideline is the most restrictive guideline and based on current science and site-specific conditions, whereas the CCME guideline is quite dated and does not incorporate the use of site-specific environmental modifying factors. As there are background concentrations of copper that do exceed the copper FEQG, there is the potential that biota may already be stressed due to these exceedances. However, there is not currently enough baseline characterization data within the immediate receiving environment to conclude the level of risk to receptors and if there are consistent exceedances of water quality guidelines. Following the principles of the Precautionary Approach, to be conservative Denison are expected to: A. Update the screening criteria used for the EIS and ERA (and all relevant tables) to utilize the more stringent FEQG guideline of 0.0002 mg/L as calculated using the currently available baseline data. B. Update the ERA effects assessment for copper to utilize the FEQG with regards to selected Toxicity Reference Values (TRVs) and risk characterization to receptors. C. Collect further baseline data in the immediate receiving environment (LA-5) to adequately characterize copper concentrations in water and sediment quality and any potential exceedances of baseline water quality guidelines.	
IR-115	-	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1	**Context:** Table 8.2-8 demonstrates baseline concentrations of COPCs in LA-5 South Whitefish Lake, their respective water quality guidelines from applicable sources, and proposed Project thresholds. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, Total Suspended Solids (TSS) and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. Water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. The water quality objective selected for molybdenum is the 31 mg/L SEQG rather than the CCME guideline of 0.073 mg/L.	1. Update Table 8.2-8 to include all COPCs with required monitoring under the MDMER. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. 3. Provide additional information to justify the use of the selected water quality guideline for molybdenum.	Please see the response to IR-115-R1 (below).	Accepted

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					Rationale: ECCC recommends the use of guidelines that will ensure the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds.			
IR-115	IR-115-R1	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1 IR-115 Response from Denison	**Context:** In the Proponent's response to item two, it is mentioned that the derived water quality thresholds used in Table 8.2-8 and in the assessment (Section 8.2.4.2.3, Aquatic Environment; Appendix 10-A (ERA), Section 3.1.1.1) are based on hardness concentrations found in effluent. The Proponent mentions that hardness derived from IWWTP discharge will consider IWWTP discharge on the receiving environment and provide "a reasonable estimate of expected hardness in effluent". However, this does not consider induced hardness (i.e., hardness concentration increases in the receiving environment over the lifecycle of the Project) from effluent contributions as a Project effect; the receiving environment baseline concentrations of hardness have been altered due to inputs from Project effluent. Providing only one estimate of expected effluent hardness in the receiving environment is not an appropriate means of conducting the effects assessment. Additionally, the following COPCs have not been included in the updated table provided in the Proponent's response: un-ionized ammonia, aluminum, iron, manganese, thallium and total dissolved solids (TDS). It is noted that these COPCs are also subject to monitoring requirements under the *Metal and Diamond Mining Effluent Regulations* (MDMER). **Rationale:** Background concentrations of un- ionized ammonia, aluminum, iron, thallium, manganese and TDS are required to determine potential effects to the environment. The Proponent will also require this information to satisfy their obligations under the MDMER. The purpose of the surface water quality assessment is to determine if changes to the receiving environment over the project lifecycle will have significant adverse effects on biota. Changes from baseline in hardness concentrations in the receiving environment due to the deposition of effluent is a Project related effect and therefore providing a single baseline water quality threshold which is applicable only to one set of conditions is not an appropriate method to evaluate impacts across a shifting hardness baseline. Water hardness is an environmental modifying factor, various concentrations of hardness influence the toxicity of other COPCs in the aquatic environment. Using water quality thresholds that have been derived from high effluent hardness concentrations will not be protective of aquatic biota, particularly in the early stages of the project lifecycle when receiving environment water quality will be similar to baseline water quality.	1. Update Table 8.2-8 to include the following COPCs: un-ionized ammonia, aluminum, iron, manganese, thallium and total dissolved solids (TDS). 2. Update Table 8.2-8 to include background concentrations of total hardness (in mg/L CaCO3) in the receiving environment. 3. Provide rationale that all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. See also related IR-108-R1	In a supplementary submission from July 5th, 2024 Denison has provided updated information. Denison will be required to update the screening criteria for ammonia, aluminum. iron and lead during licensing review of the ERA. These updates are not anticipated to impact the conclusions of significance to the EA, and therefore are not required at this time. *Any outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.*	Accepted
IR-116	-	ECCC	Change to an environmental component due to	Section 8.2.4.2.5, Section 8.4.4.2.5 and Section 8.5.4.2.3	**Context:** Tables 8.2-14, 8.4-9 and 8.5-5 demonstrate predicted mass flux (in mg/s) of COPCs in groundwater during the future centuries scenario. The table does not provide any information on actual surface water concentrations of COPCs or accumulation in concentrations over time. It is not possible to determine what the COPC concentrations	1. Provide the predicted water and sediment quality concentrations of COPCs in the receiving environment for the future centuries scenario.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			hazardous contaminants		in surface water and sediment will be during the future centuries scenario with the current information. Additionally, only a subset of parameters have been provided in this table based on parameters that were elevated in effluent after treatment. Groundwater may have a variety of different COPCs with elevated concentrations as it will migrate directly from the ore body area and not receive treatment. **Rationale:** It is not possible for ECCC to assess the predicted concentrations of COPCs in surface water and sediment, and therefore risk to aquatic biota during the future centuries scenario with the provided information.	2. Include data for a greater suite of COPCs that were assessed as having potential to be at elevated concentrations in groundwater.		
IR-117	-	CNSC	Human health with respect to hazardous contaminants	Section 8.2.4, Table 8.2-9	**Context:** CNSC staff note that some of the effluent quality predictions in the EIS are quite high for a uranium mine and mill facility compared to the existing facilities. For example, the upper bound effluent quality of molybdenum is 2.5 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.213 mg/L. Also, the upper bound effluent quality of copper is 0.022 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.002 mg/L. **Rationale:** Surface water quality models should be based on the anticipated effluent quality. From discussions with Denison, it appears that the effluent quality predictions may change based on the results of more bench scale tests that are still being conducted and continued optimization of the design of the water treatment plant.	Please provide the anticipated effluent quality of the constituents of potential concern during normal operations. Once Denison has refined the effluent quality predictions, Denison is expected to update the inputs into the surface water quality model.		Accepted
IR-118	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.6.1, Section 8.4.6.1 and Section 8.5.6.1, Aquatic Environment	**Context:** It is unclear if Tables 8.2-16, 8.4-12, 8.5-7 and 8.5-8 take into consideration potential effects from groundwater seepages of COPCS to surface water and sediment quality in the future centuries scenario. No information regarding the future centuries scenario has been provided in the rationale summary for ratings. **Rationale:** Groundwater seepage of COPCs may have future impacts to surface water quality, sediment quality and aquatic receptors; however, the extent of residual effects is unclear without further information.	Provide further information regarding how groundwater seep. Of COPCs may have future impacts to surface water quality, sediment quality, and aquatic receptors, and any residual effects that may persist.		Accepted
IR-119	-	CNSC	Fish and fish habitat	Section 8.3.1.2, Table 8.3-1, Sediment quality	**Context:** Sediment quality isn't considered a key indicator for fish and fish habitat, but the accumulation of contaminants in sediment porewater without habitat alteration is similar to the key indicator 'change in surface water quality from baseline conditions' that is considered. **Rationale:** It is not clear whether sediment was just considered for physical disturbance, and why chemical changes are missing from key indicator list for fish and fish habitat.	Please provide the rationale for exclusion of sediment quality from the key indicator list for fish and fish habitat.		Accepted
IR-120	-	CNSC	Aquatic species	Section 8.3.3 and 8.5, Aquatic Environment	**Context:** Although downstream impacts are not predicted by Denison it is important from an ecosystem perspective to establish baseline locations to monitor for potential cumulative effects to the aquatic environment due to the Key Lake and Wheeler River	If Denison has not collected baseline aquatic studies in the far-field downstream receiving environment of Russell Lake, please provide a rationale for why.	Response is accepted, but also see AD-51 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Operations to ensure the aquatic environment is being protected from cumulative impacts. Denison should consider adding a far-field exposure location and collecting baseline aquatic ecosystem baseline data in Russell Lake including: • Water quality/chemistry • Sediment chemistry/quality • Benthic invertebrate chemistry /community • Large-bodied fish tissue/chemistry **Rationale:** Russell Lake is identified as part of the RSA for the aquatic environment, but it appears that no detailed aquatic baseline data was completed in far-field location in Russell Lake. In addition, several Indigenous Nations and communities and local resource users have indicated that Russell Lake is an important body of water both culturally for traditional use and was once used as commercial fishery.	If a far-field Russell Lake location was sampled as part of baseline data collection, more information about the process and results with regards to sampling at Russell Lake should be included in the EIS. This information would be valuable to help determine potential cumulative effects downstream in the Russell Lake drainage system (due to the Key Lake Operation) which has been identified as a key concern and area of interest by several Indigenous Nations and communities.		
IR-121	-	CNSC	Fish and fish habitat	Section 8.3.3.1, Methodology and Metrics	**Context:** In the description of methodology for fish communities and spawning surveys, there's no mention that could be found for an any evaluation of fish condition, other than sexual condition. **Rationale:** Exposure to other pre-existing stressors could result in abnormal conditions or deformation(s) in existing population, but the extent of existing conditions should be evaluated to ascertain whether the rate is increasing as a result of proposed activities once in operation.	Please provide reference to where fish condition is considered or provide a justification for its exclusion.	Response is accepted, but also see AD-52 in the Advice to Proponent table.	Accepted
IR-122	-	CNSC	Fish and fish habitat	Section 8.3.8, Monitoring and Follow-up	**Context:** Section 8.3.8 of the EIS states: "Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development." **Rationale:** Tracking changes in fish communities / populations in reference lakes over time should be conducted, as reference lakes can be used to differentiate natural temporal variation with potential project impacts.	Please include reference lakes, and if it is provided, please reference where in the EIS these are discussed. If there are no reference lakes, these should be included in the monitoring program.	Response is accepted, but also see AD-53 in the Advice to Proponent table.	Accepted
IR-123	-	ECCC	Change to an environmental component due to radiological contaminants	Section 8.4.3.2.3, Aquatic Environment Appendix 8-D, Table 3-5	**Context:** Table 8.4-3 provides a summary of the baseline concentrations of COPCs in sediments in the LSA. Sediment quality thresholds and justification for the selection of those thresholds have not been provided. Table 3-5 in Appendix 8-D does provide benchmarks but the selection of benchmarks is not discussed, and the most stringent guidelines are not used for some COPCs. Additionally, there is no data provided for sediment concentrations of mercury, which is a COPC that requires surface water quality monitoring and effluent characterization under the MDMER. **Rationale:** Further information should be provided regarding any exceedances of sediment quality thresholds in baseline concentrations of COPCs, which should be recommended for further assessment of risk due to effluent discharges.	1. Provide sediment quality thresholds and justification for the selection of those thresholds for comparison against measured baseline COPC concentrations in the LSA. 2. Provide data on baseline concentrations of mercury in sediment. 3. Identify any COPCs with baseline concentrations that exceed sediment quality thresholds in the LSA.		Accepted

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IR-124	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.4.4.2.3, Aquatic Environment	**Context:** Table 8.4-7 provides maximum concentrations of surface water COPCs in sediment. The following COPCs, which are required to evaluate the risk from effluent to sediment quality, were not evaluated: 1. COPCs that have monitoring requirements in receiving environment surface water and effluent under the MDMER, 2. COPCs that exceed water quality guidelines in effluent, and, 3. COPCs that have baseline concentrations that exceed sediment quality thresholds in the receiving environment. **Rationale:** Due to the lack of information on COPCs with baseline concentrations that exceed sediment quality guidelines, and COPCs that require monitoring under the MDMER, a determination on risk to sediment quality and aquatic biota cannot be made.	1. Provide the information on baseline exceedances of COPCs in sediment. 2. Provide an assessment of risk for any COPCs that have baseline exceedances of sediment quality thresholds in the receiving environment. 3. Provide an assessment of risk from any COPCs that require monitoring in the receiving environment and effluent under the MDMER. Please include any COPCs in effluent that will exceed water quality guidelines.	Following review of a supplementary submission provided on July 2nd, 2024, concerns remain related to: • Denison's assessment of water/sediment quality for near field and regional receiving waterbodies using low flow scenarios based on return periods beyond 100 years, as well as near field and regional models. • The 7Q10 is considered acceptable low flow to provide conservative predictions for the assessment of water/sediment quality. • The modeled results for maximum concentrations of COPC's shown in tables 3.3 and 3.5 of Appendix 10-A, which show that copper may exceed the new FEQG in freshwater for both operational and post decommissioning phases of the project. For the purposes of this review, this IR is accepted, and these outstanding concerns will be addressed in responses to IR-113 (through sensitivity analysis) and IR-114. See also AD-76 in the Advice to Proponent table.	Accepted
IR-124	IR-124-R1	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.4.4.2.3, Aquatic Environment IR-124 Response from Denison	**Context:** In the Proponent's response it is stated, "Schedule 5 parameters will be monitored as per the MDMER once under this regulation (i.e., meeting regulated criteria of discharge to the environment [50 m3/day). Please refer to Table 8.2-13 of attachment IR-114. In these cases, COPCs including Schedule 4 parameters were below screening criteria." If concentrations of Schedule 5 parameters in effluent exceed water quality thresholds, these parameters are necessary for ECCC to examine in the risk assessment to determine the potential for effluent to be acutely lethal and for adverse effects to aquatic biota. These parameters will also be required to be characterized under Section 4, 5 and 7 of the MDMER. As per CSA N288.6-22 Section 7.2.5.2.1, "Screening of environmental concentrations of chemical and radiochemical substances released to the environment should be performed to identify COPCs for further evaluation in the risk assessment. Both measured concentrations and concentrations calculated from release rates may be used in the screening analysis. The screening concentrations should be compared to screening criteria, and chemicals that exceed screening criteria should be identified as COPCs." As per CSA N288.6-22 Section 7.2.5.4.2, "If COPCs exceed the screening level for one medium, they should be carried forward into the EcoRA for all media that are likely to contribute to exposure. For example, for a given COPC, if a water screening benchmark is exceeded, the same COPC should be carried forward for sediment if its concentration was above the detection limit." Additionally, updated Table 8.2-13 of attachment IR-114 has been found to be insufficient due **to** maximum concentrations in surface water for mercury, aluminum, total suspended solids, iron, thallium, manganese, nitrate and phosphorus being absent and the use of incorrect water quality thresholds.	Provide an assessment of risk from any MDMER Schedule 5 parameters that are required to be characterized in effluent and in surface water quality in the receiving environment and that have effluent concentrations that will exceed water quality guidelines derived from environmental baseline conditions.	See response for IR-124.	Accepted

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					Rationale: Due to the lack of information on COPCs with concentrations that exceed water quality thresholds in effluent, a determination on risk to sediment quality and aquatic biota cannot be made.			
IR-125	-	CNSC	Fish and fish habitat	Section 8.5, Aquatic Environment and Fish health	**Context:** Indigenous Knowledge studies and information collected in relation to the Project clearly identified the importance of water quality and fish health to local Indigenous peoples and is discussed throughout the Draft EIS. For example: • "Russell is one lake where I commercially fish. How will this effluent impact the water quality, fish health? Will I be able to sell fish from here? If there is going to water" pollution, I just want to know" (19-LK-ERFNTrap-134.255) " • "How are you going to protect the water quality? We are concerned about mercury in fish, other animals, etc. Is there mercury or arsenic in the uranium solution?" (p. 8-53) **Rationale:** Several Indigenous Nations and communities and local resources users have indicated Russell Lake is an important body of water both culturally for traditional use and was used as commercial fishery in the past and from an aquatic ecosystem perspective.	One of the many mitigation measures mentioned throughout the aquatic environment section states: "Denison will work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system." (p.10-32) Has Denison considered the collection of additional baseline fish tissue species that are of importance to Indigenous Nations and communities and local cabin owners from Russell Lake? Assuming the species would be walleye (commercially and recreationally) and lake white whitefish that is traditionally an important species consumed. Please provide more information on the engagement to date on the development of the Surface Water Management Program and Monitoring program that Denison is developing and engagement to date with interested Indigenous Nations and communities in the region on fish and fish health.	Response is accepted, but also see AD-51 in the Advice to Proponent table.	Accepted
IR-126	-	ECCC	Aquatic species	Section 8.5.3 Appendix 10-A (ERA), Section 5.3.1.1.8	**Context:** The Proponent has used the US Environmental Protection Agency (US EPA) guidelines for the assessment of selenium fish tissue concentrations in Section 8.5.3 of the draft EIS and in the Environmental Risk Assessment (ERA) in Appendix 10-A (ERA) of Section 10. **Rationale:** ECCC's Federal Environmental Quality Guidelines of 6.7 ug/g dry weight fish whole body tissue for selenium should be used, as it is more protective than the US EPA guidelines.	Update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA (Appendix 10-A (ERA) in Section 10) as needed using ECCC's FEQG.	Following a supplementary submission by Denison on July 2nd, 2024, it has been determined that item one and two of this IR have been resolved, but item three remains outstanding. Denison has not provided the information requested to address Item 3 of the Round 3 IR. Including the estimates of error for the predicted selenium concentrations in fish is necessary as the maximum predictions for Northern Pike in Whitefish Lake North and Middle are within 1-2 ug/g dw of the Egg/Ovary FEQG guideline of 14.7 ug/g dw. <u>In order to resolve this IR, Denison are expected to:</u> 1. Provide an estimate of error associated with the Northern Pike BAF. 2. Include this estimate of error for the results in Table -IR-126-2 and consider this in the effects assessment.	Not Accepted
IR-127	-	CNSC	Aquatic environment	Appendix 8-E, Section 1.2.1, Hydrological Inputs	**Context:** Within this section it states that the 7Q10 low flow rate used in the mixing assessment "was provided verbally to Ecometrix by NewFields Canada during a project meeting on 26 April 2022" **Rationale:** The statement that this value was provided verbally is not an infallible method of communicating data, as the value could have been misheard, misremembered, or recorded improperly.	Please verify that the 7Q10 value used in the assessment is the correct value determined by NewFields.		Accepted

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IR-128	-	CNSC	Current use of lands and resources for traditional purposes	Section 9 Various pages in section 11.1, Land and Indigenous Resource Use Section 12 Section 14	**Context:** The increased road traffic (14-18 trucks per day during construction/operations) may have indirect impact on ungulates, furbearers and wood land caribou presence/absence for traditional and subsistence hunting have been raised to CNSC staff when meeting with Indigenous Nations and communities and are presented in the EIS. **Rationale:** The increased traffic and therefore dispersal of game (moose, woodland caribou) due to increased traffic has been raised as a concern with respect to increased mortality on wildlife and decreased ability to practice traditional rights.	How have the potential residual impacts with respect to increased traffic and noise (due to current and future operations) been communicated to Indigenous Nations and communities who use the road #914 for cultural and traditional activities (such as moose harvesting, berry picking and small game and birds)? Please provide any additional information on the engagement that has taken place to date with Indigenous Nations and communities with respect to concerns and potential impacts on current use of lands and resources due to increased road traffic, and any mitigation measures proposed by Indigenous Nations and communities to minimize the potential impacts.	Response is accepted, but also see AD-54 in the Advice to Proponent table.	Accepted
IR-129	-	CNSC	Current use of lands and resources for traditional purposes	Section 9 Section 10 Section 11, including Section 11.1.4.3.1 (p. 11-46) Section 12 Section 16	**Context:** ERFN indicated they are concerned about declining moose populations from an influx of hunters; more people may be accessing the area year after year, and worried populations may be affected by the Project (21-EN-ERFN-473.13). Further, the EIS highlights that: "Vehicle collisions are the most likely source of direct mortality for moose. Effective mitigation measures (e.g., breaks in snowbanks; speed limits; and exclusion fencing around contaminated waste pads and ponds) will be implemented to reduce moose mortality." (p. 11-46) **Rationale:** The [Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012](#) notes: "The views of affected Aboriginal groups on mitigation be considered and included in the EIS. This could assist in ensuring that the environmental effects on the current use of land and resources for traditional purposes are at an acceptable level for the community." Sources for indirect moose mortality (e.g., increased hunter access, changes to health due to sensory disturbances, changes to predator-prey dynamics) may result in mortality outside the Wildlife LSA. The residual effect of change in moose mortality is likely to occur. Although mitigation measures are expected to reduce, but not fully eliminate, the residual effect on moose. The potential residual impact on the moose and other large game populations in the broader regional study area may potentially impact Indigenous treaty rights, culture, and community well-being if the harvesting of moose and large game declines due to increased traffic, noise, and vehicle mortality or increased outside hunting pressure.	Please provide additional information on the discussions Denison has had with Indigenous Nations and communities on how to mitigate any residual project impacts on their traditional harvesting activities of large game such as moose. More information is required to determine if Denison has engaged directly with ERFN/KML and other Indigenous Nations who utilize the area to harvest moose to determine current baseline harvest numbers that provide subsistence, continued cultural identity and community well-being, as well as discussions on how the Project could potentially impact moose populations and the harvesting of moose for traditional practices.	Response is accepted, but also see AD-62 in the Advice to Proponent table.	Accepted
IR-130	-	H. Mulye	Physical stressors (noise and vibration) on wildlife	Section 9, Terrestrial Environment	**Context:** Sensory disturbances such as noise have been identified as stressors for selected wildlife (Ungulates, Furbearers, and Woodland Caribou), birds and amphibians in the Project area. However, there is no consideration of impacts from vibrations on these species. Also, impacts of noise and vibration on reptiles have not been assessed in the Project area. **Rationale:** While noise has been qualitatively assessed for selected wildlife, birds, and	Please provide a discussion of impacts of physical stressors (specifically vibrations) on wildlife, birds, and amphibians in the Project area. Specific mitigation measures and/or monitoring for impacts from project-related vibrations should be considered, as appropriate. Also, include reptiles in the assessment of project-related		Accepted

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					amphibians, there is no consideration of project-related vibrations as a sensory disturbance/physical stressor. Sensitive terrestrial species (specifically, herpetofauna, amphibians, invertebrates, and caribou) can be impacted by vibrations emanating from the operation of heavy machinery, blasting activities, and other anthropogenic activities at the Project site. Also, impacts of physical stressors (noise and vibration) on reptiles were not assessed. These species should be included in this assessment due to their sensitivity to noise and vibrations.	noise and vibrations as sensory disturbance/physical stressor, or a justification for their exclusion.		
IR-131	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** As per the requirement outlined in Section 79 of the Species at Risk Act (SARA): *The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans. This is accomplished by ensuring that the Proponent has identified, avoided, lessened and will monitor effects to species at risk.* As per the CNSC's Generic Guidelines for the Preparation of an EIS pursuant to the Canadian Environmental Assessment Act, 2012: "*The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the Proponent intends to implement them and the environmental outcome the mitigation is designed to address. The EIS will describe mitigation measures in relation to species and/or critical habitat listed under the Species at Risk Act (SARA). These mitigation measures will be consistent with any SARA permit, applicable recovery strategy and/or action plan*". The draft EIS neither lists the adverse effects to all listed schedule 1 SARA species, nor outlines the measures that will be taken to avoid or lessen these effects. The Proponent references that additional species-specific mitigations will be detailed in environmental management plans but has not provided those plans for review.	Identify all species at risk listed on Schedule 1 of the Species at Risk Act and their critical habitat that are likely to be affected by the Project and describe how they may be adversely affected by the Project. Describe what measures will be taken to avoid or lessen the effects of each Project activity and stage, and how these effects will be monitored to ensure they are avoided or minimized.		Accepted
IR-132	-	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale:** ECCC has identified that three species at risk arthropods (yellow banded bumble bee, transverse lady beetle, and nine-spotted lady beetle) have ranges overlapping the Project area and these were not mentioned in the draft EIS.	1.Conduct an effects assessment for arthropod species at risk. 2. Explain what mitigation measures will be used to minimize potential effects.		Accepted
IR-133	-	ECCC		Section 9, Terrestrial Environment	**Context and Rationale:** There is potential for some species at risk (e.g., myotis species, barn or bank swallows, common nighthawk) to be attracted to and use mine infrastructure (buildings, roads etc.) once constructed for nesting, roosting, or foraging. Details on mitigation measures and adaptive management with respect to attraction to Project components should be identified to assess residual and cumulative impacts to species at risk.	For all Project phases, describe the mitigation measures and adaptive management to prevent and minimize effects on species at risk that may utilize mine infrastructure.		Accepted
IR-134	-	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale**: The draft EIS states in multiple places that vegetation clearing may occur year-round.	Provide important roosting dates for bat species at risk in the Project area.	The Proponent provided a complete response regarding the roosting dates for bat species at risk, however follow-up IRs are required.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					In order to correspond with the timing of emergence from hibernation, tree clearing should not be conducted during the bat roosting period. If maternity roost trees are removed after pregnant females have established a roost area, there is a higher likelihood of abortion than there would be otherwise. Species-specific mitigations are required to protect bat SAR.		See follow-up IR-134-R1.	
IR-134	IR-134-R1	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context:** The Proponent has committed to conduct pre-construction and pre-clearing surveys for multiple species, however the timing and methods for the surveys were not provided. Knowing the survey methodology for pre-construction and pre-clearing for little brown myotis and northern myotis is important for assessing cumulative impacts, effectiveness of adaptive management strategies as well as determining how bat species were considered in the EIS. **Rationale:** ECCC can determine whether the methodology the Proponent will use to collect data is appropriate and if the methodology would contribute to a more complete understanding cumulative effects and adaptive management strategies. A clear outline of how timing has been considered and incorporated into the methodologies is required to understand how sensitive periods for bats, such as roosting, have been considered in the EIS. An understanding of the methodologies and how these sensitive periods are being considered is required to evaluate the effectiveness of mitigation strategies and adaptive management strategies which are being developed by the Proponent.	The information provided by the Proponent regarding the roosting dates and potential habitat for bats is complete, however, the information related to the pre-construction and pre-clearing surveys is missing details on important habitat features for bat species at risk. As two Species at Risk Act (SARA) schedule 1 listed bat species, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis) have been identified in the Project area, effects need to be identified, avoided, lessened and monitored.	Following a supplementary submission by Denison on July 8th, 2024, this IR has been resolved. The response on bats is sufficient.	Accepted
IR-135	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** The mitigation measures for birds and wildlife presented in the draft EIS are very general. Additional detail is required for a complete assessment of residual and cumulative Project effects to birds and wildlife. The Proponent has committed to providing a number of plans including, a Decommissioning Plan, a Spill Response Plan, a Waste Management Plan, a Surface Water Monitoring Plan, a Remediation and Closure Plan, a Radiation Protection Plan, a Soil and Vegetation Monitoring Plan, a Wildlife Monitoring Plan, and a Woodland Caribou Management Plan. In order to assess potential affects to migratory birds and wildlife from Project related activities, ECCC requires details on species-specific mitigation measures, and monitoring plans.	The following information should be included in the various plans and should be provided for review during the environmental assessment: 1. For all Project phases, describe the species-specific mitigation measures and responses to prevent and minimize effects on migratory birds or species at risk (SAR) birds and mammals that may utilize mine infrastructure. 2. Explain how light pollution will be managed and what specific mitigation measures will be used to minimize effects to migratory birds and SAR birds and mammals. 3. Provide details on what methods will be used for erosion control and how they will prevent sediment from entering waters frequented by migratory birds or SAR. Explain what actions will be taken if the erosion control measures are not successful.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
						4. Provide details on noise and other sensory disturbance monitoring and mitigations if noise levels surpass thresholds. 5. Describe time windows and species- specific mitigations related to maintenance activities such as vegetation management, road or building repair and stream crossing replacements.		
IR-136	-	CNSC	Soil Salvage Monitoring	Section 9.1.8.2	**Context:** The Proponent plans to salvage and stockpile soil and organic matter/peat in order to use it in reclamation activities during decommissioning. Periodic monitoring of the stockpiles is proposed to be conducted to verify that soil and organic matter/peat are delineated, stripped, handled, and stockpiled as recommended, and to evaluate the stability of salvaged soil, e.g., in relation to potential erosion and/or degradation. It is unclear whether monitoring includes soil quality in terms of concentrations of COPCs. **Rationale:** It is expected that project-related activities (road and airport traffic, drilling) can result in open-source (i.e., fugitive) dust and process-source dust (incl. radionuclides), which can accumulate and result in changes in soil quality of the stockpiled soil and organic matter/peat as described in Sections 9.1.4.2.2 and 9.1.4.2.3).	Please clarify if COPC concentrations monitoring is planned to be performed for stockpiled soil and organic matter/peat.		Accepted
IR-137	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat, Vegetation and Wetlands	Section 9.2.1.3, Spatial and Temporal Boundaries for Vegetation and Ecosystems, Listed Plant Species and Wetlands Section 9.3.1.3.1, Spatial Boundaries for Ungulates, Furbearers and Woodland Caribou 9.4.1.3.1, Spatial Boundaries for Raptors, Migratory Breeding Birds, and Bird Species at Risk	**Context and Rationale:** The CNSC's Generic Guidelines for the Preparation of an EIS Pursuant to the Canadian Environmental Assessment Act, 2012 states that: "The EIS will describe the spatial boundaries, including local and regional study areas, for each VC to be used to assess the potential adverse environmental effects of the Project and provide a rationale for each boundary. Spatial boundaries will be defined taking into account the appropriate scale and spatial extent of potential environmental effects, community knowledge and Indigenous knowledge, current or traditional land and resource use by Indigenous groups, ecological, technical, social and cultural considerations." The information provided in the EIS does not enable a biologically relevant assessment of the Project's effects. The Proponent did not provide rationale for the selection of study areas for individual vegetation, wildlife or migratory bird valued components (VC). Different VCs may have different spatial boundaries for the LSA and/or RSA. For wildlife and bird VCs, the LSA is defined as a 1.7-km buffer from the Project area, and the RSA is defined as a 6.6-km buffer around the LSA. There is no information on how the spatial boundaries were derived. Specific to Woodland Caribou, boreal population (hereafter referred to as boreal caribou): Project Footprint: In a scientific assessment of critical habitat (Environment Canada, 2011) [1] ECCC demonstrated that the application of a 500-m buffer to mapped anthropogenic features best represents the combined effects of increased predation and	Provide a biologically relevant rationale for the delineated study boundaries (LSA and RSA) for all different valued components. Include the following information: • Descriptions of how the RSA and LSA boundaries were derived for all VCs. Specific to boreal caribou: Project Footprint: • Include a 500-m buffer of area of maximum physical disturbance to represent functional habitat loss for boreal caribou LSA: • Include a description of how the LSA takes into account boreal caribou avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance to individuals. RSA: • Include a description of how the RSA used in the draft EIS is an accurate representation of the SK1 boreal caribou range; **or** • Re-do the assessment with the RSA at the scale of the range See also related IRs: IR-154 and IR-156.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					avoidance on caribou population trends at the national scale. Adding a 500-m buffer to the Project footprint is required to represent functional habitat loss. The draft EIS does not appear to use a buffer for their Project area. The draft EIS (Section 9.3.1.3.1) states: "Project Area: the area within which the Project and all components/activities are located (i.e., the area of maximum physical disturbance). The Project Area covers 169.6 ha and is not VC-specific, but consistent throughout the EA." (p. 9-168) LSA: The defined LSA for boreal caribou has to consider avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance. This required information is not detailed in the draft EIS. Adverse effects of Projects including predator and prey access to undisturbed areas, reduction in connectivity, and sensory disturbance to individual boreal caribou can vary and extend several kilometers depending on Project activities and ecological context. At minimum, the LSA should capture the above- mentioned effects. For boreal caribou, the Project footprint should be defined as the immediate area to be cleared, plus a 500-m buffer to represent functional habitat loss. Following this guidance, the LSA should be defined as a buffer of the Project footprint with the 500-m buffer. RSA: The Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada states: *Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:* • *Assess the impact of all disturbances (anthropogenic and natural) at the range-scale;* • *Monitor habitat conditions, including the amount of current disturbed and undisturbed habitat, and amount of habitat being restored;* • *Account for planned disturbances; and* • *Assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.* The proposed Project's cumulative effects for boreal caribou are possible at the scale of the SK1 boreal caribou range. The RSA used for boreal caribou for this Project is only 40,173.6 ha, compared to the SK1 range, which is 18,034,870 ha. As such, it is too small to capture cumulative effects to this species and does not follow the Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) or the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. **Reference**:			

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					[1] Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011).			
IR-138	-	CNSC	COPC in Lichen	Section 9.2.4.2.2 Appendix 10-A (ERA)	**Context:** A quantitative assessment using modelling dispersion and uptake of COPCs in the environment was completed for the Project as part of the ERA, to support conclusions drawn in the EIS. In Appendix 10-A (ERA), COPCs in plant tissue was estimated for lichen. Table 5-5 of the ERA (p. 5.24) named “Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model” lists the exposure pathway for lichen as direct contact on soil. **Rationale:** Airborne COPC can deposition on lichen and subsequently enter the food chain; therefore, the “contact with air” pathway should be considered. In fact, lichen species are frequently used to monitor the deposition and accumulation of airborne contaminants (e.g., dust, metals). It is also noted that based on sampling results of the 2017 baseline studies, lichen frequently contain higher concentrations of COPC than blueberry (compare Table 9.2-6 and Table 9.2-7 in the EIS), especially at sampling sites with elevated concentrations (e.g., RSV9 and RSV10).	Please include the exposure pathway of direct deposition (dry and wet) of airborne contaminants on lichen in the quantitative ERA, or justify why this exposure pathway was not considered. See also related: IR-189.		Accepted
IR-139	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 9.2.5.2.7, Waste and Hazardous Materials Management	**Context:** In this section, the Proponent outlines various measures to mitigate air emissions, including implementation of the air quality programs within the Environmental Management System, regular maintenance and inspection of equipment, and elimination of unnecessary idling of equipment. However, the intention to use industry-standard emission control systems has not been substantiated. **Rationale:** For the protection of air quality, it is important to specify the emission standards that equipment will have (e.g., Tier 3 or Tier 4 engines). Vehicles and equipment with Tier 4 engines have much lower emissions of contaminants than those with Tier 3 engines. If non-Tier 4 engines are used, ECCC recommends that best management practices are followed, including proper maintenance of the engine and anti-idling measures.	Confirm if vehicles and equipment will be equipped with Tier 4 engines where feasible.	Response is accepted, but also see AD-55 in the Advice to Proponent table.	Accepted
IR-140	-	CNSC	Change in the Areal Extent of Wetlands	Section 9.2.6.4	**Context:** Predicted residual effects on the areal extent of wetlands include the direct effect of loss of wetlands and several indirect effects of alteration of wetlands. As stated in the EIS, wetlands can exhibit low resilience and high susceptibility to disturbance. At the same time, wetlands tend to support a high species diversity, and are considered to have a moderate to high potential to support listed plant species. Lastly, wetlands are rare on the landscape compared to terrestrial ecosites (see Table 9.2-5). **Rationale:** Several wetland ecosites (BS19/24, BS25, BS27) occur only in small areas (< 30 ha) in the RSA but are predicted to experience disturbance of 6-64%, most notably the ecosite BS19/24 where 0.8 of 1.2 ha are predicted to be disturbed. It is noted that wetlands are scattered throughout the landscape as shown in Figure 9.2-8. More information is requested regarding the ecological impact of this disturbance.	1. Please provide a discussion on the ecological impact of disturbance to rare wetland ecosites. 2. Please provide information on whether adequate other habitat is available for species impacted in these disturbed sites in close proximity, taking into account the home ranges of susceptible species. 3. Please provide additional information on whether wetland connectivity is maintained through the landscape within the LSA/RSA. See also related: IR-141.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
						Suggestions for mitigation and follow-up measures: CNSC recommends that Denison conduct monitoring of species present in wetlands before and after disturbance, with a focus on listed plant species.		
IR-141	-	ECCC	Wetlands	Section 9.2.6.4.1	**Context and Rationale:** The Proponent states that: "Direct loss of wetlands has been mitigated by reducing the size of the Project Area to the extent practicable during Project design. However, up to 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA are anticipated to be removed from the Project Area during Construction (Table 9.2-16)." Information is not provided on whether wetlands in the terrestrial RSA are considered ecologically, economically or socially important to the region. Information on the regional importance of the wetlands that will be lost is needed in order to assess effects, including a wetland compensation plan if the wetlands are considered regionally important.	1. Provide information that accounts for whether wetlands are considered ecologically, economically and socially important to the region. 2. If the above is affirmative provide a wetland compensation plan to offset the loss. Consistent with the Operational Framework For Use of Conservation Allowance [1] a minimum ratio of 2:1 should be the starting point when determining the amount to be offset. [1] Available at : https://publications.gc.ca/site/eng/9.696852/publication.html See also related: IR-138.		Accepted
IR-142	-	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.3.2.1 Scientific Literature Review – Wolverine Section 9.3.5 Mitigation Measures Section 9.3.6 Residual Effects Evaluation	**Context:** The Proponent did not conduct any field work to identify potential wolverine dens in the Project area and therefore did not present any mitigations for the potential impacts to wolverine dens. In Section 9.3.3.2.1, the Proponent states: "Denning females are sensitive to disturbance during denning season in February to April and may abandon their dens and, in some cases, their litter, which may decrease their reproductive success. " In Section 9.3.6, the Proponent states: "In the Project Area, 145.0 ha or 100% of available wolverine habitat is assumed to be removed and will not be available to wolverine for the duration of the Project (Table 9.3-13). Similarly, 145.0 ha (3.4%) of available wolverine habitat within the Wildlife LSA is anticipated to be removed, all from the Project Area, during site clearing in Construction. In the Terrestrial RSA, up to 0.5% (145.0 ha; from the Project Area) of available wolverine habitat is anticipated to be removed during site clearing in Construction." The residual effect assessment estimates that 8.2% of available wolverine habitat within the Terrestrial RSA may be altered or lost (Table 9.3-20). **Rationale**: As Wolverine is a Species at Risk Act Schedule 1 listed species, effects need to be identified, avoided, lessened and monitored. Mitigations, such as setback distances, should be used to protect important habitat features, such as dens. Wolverine occupy large home ranges and, therefore, need vast tracts of undisturbed land to maintain viable populations. The species avoids most human footprint types and linear features.	1. Please provide additional information on whether the lost and/or altered wolverine habitat overlaps with wolverine home ranges. 2. Describe any important wolverine habitat feature (i.e., dens) that may be lost as a result of the Project. 3. Assess the need for pre- construction/pre-clearing surveys to identify any wolverine denning sites. 4. Please provide additional information on whether the remaining, available, undisturbed wolverine habitat size is suitable to maintain populations.	The information provided by the Proponent is complete, however, a follow up IR regarding survey methods for all pre-construction and pre-clearing surveys is required. See follow-up IR-142-159-167.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-142 IR-159 IR-167	IR-142-159-167-R1	ECCC	Wildlife and Wildlife Habitat	**Reference to EIS:** Section 9.3.3.3, Baseline Studies Section 9.3.5 Mitigation Measures IR 142, 159, and 167 Responses from Denison	**Context:** The Proponent has committed to conduct pre-construction and pre-clearing surveys for multiple species, however the timing and methods for the surveys were not provided. **Rationale:** Knowing the survey methodology for pre-construction and pre-clearing surveys across multiple species is important because the Proponent is intending to collect data so that ECCC can determine whether the methodology used to collect the data is appropriate and if the methodology would contribute to understanding cumulative effects and adaptive management. Understanding how timing has been considered and incorporated into the methodologies is required to understand how sensitive periods, such as nesting, breeding, foraging and migration, have been considered in the EIS. An understanding of the methodologies and how these sensitive periods are being considered is required to evaluate the effectiveness of mitigation strategies and adaptive management being developed by the Proponent for each species mentioned in IR-142, IR-159 and IR-167.	Provide survey methodology and timing for all preconstruction and pre-clearing surveys, including avian and species at risk surveys (caribou, wolverine).	The Proponent notes that they will use visual searches for several bird SAR. This includes Bank Swallow, Barn Swallow, Common Nighthawk, and Horned Grebe. While visual observations are an appropriate method for detecting Barn and Bank Swallow nests, it is not suitable for detecting Common Nighthawk. The province of Saskatchewan provides appropriate protocols for detection of Common Nighthawk. The Proponent also notes that they will conduct call-playback or visual searches for Olive-sided Flycatcher and Short-eared Owl. While the call-playback surveys would be more likely to detect individuals in areas to be cleared, the visual searches are unlikely to be effective for these species. The Proponent should consider following the provincial detection survey protocols for Short-eared Owl and Olive-Sided Flycatcher. In order to resolve this IR, Denison are expected to: 1. Modify the Table in "Attachment IR-142, IR-159, IR-167-R1 (Round 3)" to incorporate appropriate protocols for detection of Common Nighthawk, Short-eared Owl, and Olive-Sided Flycatcher, as suggested by ECCC. 2. Incorporate the Table into the EIS documentation, e.g., Appendix 9-D. 3. Update any related commitments for pre-clearance / pre-disturbance surveys in their commitments register. See also AD-77 in the Advice to Proponent table.	Not Accepted
IR-143	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies	**Context and Rationale:** The baseline caribou data is insufficient to understand potential Project impacts to this species. Presence/absence detection was provided by camera traps, incidental observations, winter track and pellet survey. Additional information and analyses on caribou use of the landscape during all life stages of the Project area is required to assess impacts and to determine significance of impact from the Project to caribou.	Provide details on the baseline caribou data including: • Revision of map 9.3-8 to include all observations, categorized by type, season and year (see also IR-145); and • Description of seasonal use of the LSA, RSA and caribou range. • Description of Project areas used by caribou. • Description of future studies planned to assess habitat use by caribou. Include specific details on how many additional years of aerial surveys will be completed to assess the caribou baseline conditions. Utilizing additional data noted above and specified in IR-145, explain how caribou use of the area could be affected by the Project throughout all seasons and life stages (e.g., calving, post-calving, rutting, wintering). See also related: IR-152.	See also AD-81 in the Advice to Proponent table.	Accepted
IR-144	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies – map 9.3-8	**Context and Rationale:** The mapping of caribou observations during baseline studies provided in Figure 9.3-8, "Caribou Sign Observations in the Wildlife Study Areas," is insufficient to enable conclusions to be drawn. ECCC is not able to review the spatial aspect of caribou observations without a map of all available observations. Additional information is available, as stated in Section 9.3.3.3.3: *"A total of 200 observations were made between 2017 and 2019 and recorded as either*	Update map 9.3-8 to show all caribou observations during baseline studies, broken down by type of observation (camera, incidental, pellet, track) and season/year when the observation was made. Include additional data from the Province of Saskatchewan	See also AD-81 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					caribou sign (i.e., tracks, pellets, and evidence of feeding activity based on ground feeding craters and arboreal feeding evidence) or photographs (collected through the wildlife camera study) to document caribou presence in the LSA and RSA. Most observations occurred in the Terrestrial RSA, with observations concentrated in the north and southeast portions. *Three observations occurred in the southeast portion of the Wildlife LSA, and no caribou sign was observed in the Project Area. Figure 9.3-8 provides an overview of some caribou sign observed during the baseline studies."*	(see also IR-145) to help characterize caribou use on a spatial map.		
IR-145	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Woodland Caribou	**Context and Rationale:** The Proponent has not provided sufficient information on how caribou use the landscape, including identification of areas for different life stages of caribou (calving, post-calving, rutting and wintering). The University of Saskatchewan published a report entitled Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield. This report contains information on habitat types that are used during different life stages. Additionally, Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 20202 [1] details habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The scientific literature review (Section 9.3.3.3.1) on Woodland Caribou states: "While calving areas have not been documented within the SK1 range, it is recognized that caribou may use open fen and treed bog habitat types for calving during the spring/summer period. In Saskatchewan, caribou habitat used during the calving season in the SK2 range demonstrated a strong selection for treed muskegs, but avoidance of jack pine, mixed hardwood stands, and roads (Dyke 2008)." ECCC is not able to verify the Proponent's effects assessment without sufficient information on important habitat or biophysical attributes for caribou within the study areas. [1] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/woodland-caribou-boreal-2020.html#toc0	1. Provide, based off existing literature or available data and the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada: • information on known important habitat features or biophysical attributes in Project areas for different caribou life stages (calving, post-calving, rutting, wintering), • a map(s) of the type and spatial extent of important caribou habitat features or biophysical attributes of the study areas as defined in Appendix H of the Recovery Strategy, ○ mapping should be at the RSA/LSA level as well as larger-scale mapping at the scale of the Project footprint. 2. Assess the potential direct and indirect effects based on additional information on caribou from bullet A above. See also related IRs: IR-143 and IR-152. **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent contact the Province of Saskatchewan to enquire about obtaining caribou telemetry data in the Project area. The data can be analyzed to determine important habitat features in the Project area.		Accepted
IR-143 IR-144	IR-143-144-R1	ECCC	Wildlife and Wildlife Habitat	Section 9.3.3.3, Baseline Studies IR-143 and 144 Responses from Denison	**Context:** In the IR-143 response, the Proponent states: "As described in the EIS, caribou may use open fen and treed bog habitat types for calving during the spring/summer period. Information from Indigenous Knowledge (IK) was included in the EIS, including potential calving areas in the Terrestrial RSA." The Proponent provided a revised Map 9.3-8 to display these features. **Rationale:** While the revised Map 9.3-8 shows seasonal use, it is challenging to see the overlapping spatial and temporal features. The map is not adequate for fully understanding the seasonality of the data. The scale provided does not allow for a proper assessment of seasonal use, including differentiation of habitat use such as calving, movement or wintering habitats.	Provide individual maps by season and survey type or with larger scale insets that show areas with overlapping spatial and temporal features.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Some habitats, based on use, may be more used for more critical functions than others and this information cannot be adequately assessed based on the information provided.			
IR-143 IR-145	IR-143-145-R1	ECCC	Wildlife and Wildlife Habitat	Section 9.3.3.3, Baseline Studies IR-143 and 145 Responses from Denison	**Context:** Information presented on boreal caribou in the study areas in the Proponent's response is insufficient to: • characterize and determine the risk of Project impacts, • and • calculate the appropriate level of offsetting required. Information on important habitat features and how caribou are using the landscape is required to complete an assessment of the Project impacts. Although the Proponent provided a map showing telemetry points (provided by the Province of Saskatchewan), the map lacked sufficient detail to assess habitat use and important biophysical features of the Project area. The IR-145 response states: "Available habitat was determined as the ecosites in which caribou / caribou sign were detected most frequently during the baseline studies, and the EIS used a precautionary approach by assuming caribou use of these areas during all seasons and life stages." As a part of the analysis, calving areas are particularly important to delineate if information is available as a key part of all life stages. In the draft EIS, the habitat types that are considered non-habitat for caribou are open bogs (BS20), leatherleaf shrubby fens (BS22), graminoid fens (BS24), open fens (BS25), rush sandy shorelines (BS26), sedge sandy shorelines (BS27) and waterbodies. **Rationale:** Woodland caribou are known to use treed bog and open fen (Section 9.3.3.3.1 of the draft EIS), however open fens and bogs are excluded from the identified available Woodland Caribou habitat, based on not detecting presence or not detecting presence as frequently. Mapping of important caribou habitat features is required to assess important potential impacts to caribou. In the absence of telemetry data, mapping of habitat quality, based on a combination of known ecosites and known important biophysical features will provide a reasonable alternative where known important caribou habitat features cannot be mapped.	1. Provide maps at the Project Development Area (PDA)/Local Study Area (LSA)/Regional Study Area (RSA) scale showing caribou habitat quality. 2. Provide maps at the PDA/LSA/RSA scale showing areas with the appropriate biophysical attributes for calving and other life stages, such as important wintering habitats and movement corridors. Indicate the source of telemetry data (i.e., University of Saskatchewan and/or the Province of Saskatchewan).		Accepted
IR-146	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3.1, Woodland Caribou, Scientific Literature Review - Predation	**Context and Rationale:** The information on impacts of predation and apparent competition for caribou in relation to the proposed Project are insufficient. In the section on caribou predators (9.3.3.3.1), the Proponent provided details on densities of wolves and their overlap with caribou and speaks of apparent competition. The Proponent did not examine other predators, such as black bear. The analysis on impacts of predation and apparent competition is insufficient since	Provide further information and analyses on all potential predators of caribou, including impacts from apparent competition.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					known predators have been omitted without explanation from the assessment of effects. ECCC is not able to verify the Proponent's effects assessment since important species have not been considered in the assessment.			
IR-147	-	ECCC	SAR – Boreal Caribou	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** The process of in-situ recovery mining will likely create changes to the surface topography and potential ground subsidence as well as changes to groundwater elevations. These changes can affect the plant communities and ecosite types. In Section 9.3.4.2.1 the Proponent states that: "Following decommissioning and reclamation, wildlife habitat is expected to recover to baseline conditions." A more thorough explanation regarding post-decommissioning landscape is required to assess Project impacts.	1. Provide further rationale and/or analysis regarding the return of wildlife habitat to baseline conditions post-decommissioning. Incorporate other environmental impacts including: • Ground subsidence and impacts on wildlife habitat • Changes to aquifers and impacts on wildlife habitat 2. Describe reclamation activities/measures, including temporal information that will be implemented to help in the recovery to baseline conditions.		Accepted
IR-148	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** ECCC analyzes disturbance for caribou at the range level, in this case within the SK1 range. However, the Proponent did not provide an adequate assessment of total disturbance at the range level. The draft EIS (Section 9.3.4.2.1 p. 9-211) reads: "The SK1 Boreal Shield Woodland Caribou Management Unit has relatively low levels of anthropogenic disturbance and was exposed to large fire disturbances in the past 40 years (ECCC 2019). Environment and Climate Change Canada (2019) identified this caribou population as being self-sustaining at a threshold of 40% undisturbed habitat with the total anthropogenic disturbance not exceeding 5% of their habitat. The current anthropogenic disturbance levels (without areas burnt by past forest fires) for the study areas are below this threshold (with the exception of the already disturbed Project Area) and are estimated as: 24.8 ha (14.6%) for the Project Area, 168 ha (3.5%) for the Wildlife LSA, and 599 ha (1.5%) for the Terrestrial RSA." Analysis of habitat disturbance should be calculated at the range level in order to assess impacts and determine significance. Analysis should be consistent with the methodology described in the document Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) [1]. [1]https://publications.gc.ca/site/eng/401605/publication.html, p. 28/41	Provide the following in order to support analysis of habitat disturbance: 1. Calculation of total disturbance including natural and anthropogenic disturbance at the range level. 2. Description of effects on existing habitat at the scale of the range (for < 40% undisturbed habitat in the SK1). Include: • an account (and GIS file if available) of existing habitat affected, using the following formula: (Project footprint + 500m buffer) – overlapping (permanent alteration(s) + 500m buffer) 3. A map of the SK1 range showing all disturbed and undisturbed habitat, including predicted disturbance (direct and indirect) resulting from the Project. 4. Description of whether the Project is expected to compromise the ability of the range to be restored to the undisturbed habitat threshold, and provide a rationale for the conclusion. See also related: IR-154.		Accepted
IR-149	-	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.5.2, Additional Wildlife-specific Mitigation Measures	**Context:** The EIS describes that ongoing research is performed to inform the development of a Woodland Caribou Management Plan. This includes studies on the effectiveness of linear disruption features on predator/prey movements, and a field program for long-term reclamation planning. Moreover, it is stated that the Plan will include a detailed assessment of the need for habitat offsets. The draft EIS Section 9.3.5.2 states: "A wildlife monitoring plan and a Woodland Caribou Management Plan will be developed to address wildlife-specific mitigation measures based on proven and accepted mitigation following standard industry guidelines and	Provide the Woodland Caribou Management Plan, to demonstrate effective mitigation of potential project effects, along with wildlife-specific mitigation measures for review. The Plan should be informed by and consistent with the Boreal Caribou Recovery Strategy and demonstrate that avoidance and minimization measures will be applied to mitigate for predicted Project effects to boreal caribou and its critical habitat prior to considering offsetting measures. That is, the	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided. See also AD-83 and AD-85 in the Advice to Proponent table.	

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					BMPs. The plans will provide guidance to avoid or minimize potential adverse effects of the Project on wildlife and wildlife habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered." **Rationale**: The draft EIS does not present sufficient species-specific mitigation measures for boreal caribou. ECCC is not able to assess potential residual impacts to caribou without specific mitigations. Since the Woodland Caribou Management Plan is still under development, it is difficult to judge whether the measures will be adequate to mitigate and/or offset potential project effects on Woodland caribou and its critical habitat.	Plan should follow the mitigation hierarchy and information should be provided as outlined below: 1. AVOID: Describe all measures that will be taken to avoid effects to boreal caribou and avoid the destruction or alteration boreal caribou critical habitat. 2. MINIMIZE: Describe all measures that will be taken to minimize the effects to boreal caribou and minimize the destruction of boreal caribou critical habitat. 3. RESTORE ON-SITE: describe the measures that will be taken to restore disturbed areas of the Project, related to construction, operation and maintenance, on boreal caribou critical habitat, remaining after considering the avoidance and minimization measures. 4. Characterize the risk of the adverse effects that are likely to result from the Project on boreal caribou and its critical habitat after avoidance minimization, and onsite restoration measures have been considered. 5. OFFSET: Describe the measures that will be implemented outside the Designated Project area to mitigate adverse effects, destruction or alteration of boreal caribou critical habitat by the Designated Project during construction and operation. 6. Characterize the risk of the adverse effects that are likely to result from the Project on boreal caribou and its critical habitat after avoidance, minimization, onsite restoration, and offset measures have been considered. Describe all relevant uncertainties on the effectiveness of the measures to address adverse effects on boreal caribou and the rationale for the selected measure, in light of the mitigation hierarchy. See also related IRs: IR-157.		
IR-149	IR-149-R1A	ECCC	Wildlife and Wildlife Habitat	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149 IR-149 Response by Denison	**Context:** Much of the information presented in the Conceptual Caribou Management Plan is qualitative in nature and does not present specific details regarding a quantitative assessment of impacts following measures to avoid, minimize, and restore on-site and then assess residual effects and determine the offset required to counterbalance the remaining impacts. This is required to understand if offsetting is sufficient to address impacts to caribou. The Proponent also does not provide details on methods that will be used for pre- disturbance wildlife clearance surveys. ECCC is aware that that the Proponent will be participating in restoration trials as part of the 'Developing Eco-restoration Together' program.	1. Provide a quantitative assessment of impacts following measures to avoid, minimize and restore on-site and then assess residual effects and determine the offset required to counterbalance the remaining impacts. 2. Provide details on methods to be used for pre-disturbance wildlife clearance surveys. 3. Provide details on the Proponent's role in the Developing Eco-restoration Together program and how that work may	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided. See also AD-82 and AD-85 in the Advice to Proponent table.	

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: ECCC requires the quantitative details on the assessment of impacts to be included within the Conceptual Caribou Management Plan to adequately assess how the Proponent has applied the mitigation hierarchy. Details on the methods that will be used for pre- disturbance wildlife clearance surveys will also be required to verify that the Proponent has adequately considered how they have avoided, mitigated, or restored impacts to caribou. While ECCC understands that the Proponent will be participating in restoration trials as part of the 'Developing Eco-restoration Together' program, however, more clarity on the Proponent's role in the program and the scope of the program is required. Details such as how the outcomes of these programs will result in mitigation measures and offsetting requirements and additional clarity on the scope of the program should also be provided so that ECCC can understand the objectives and deliverables of the program.	be used in offsetting requirements. 4. Provide the scope (i.e., quantitative habitat amount) of the Eco-restoration Together program.		
IR-149	IR-149-R1B	ECCC	Wildlife and Wildlife Habitat	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149 IR-149 Response by Denison	**Context:** Section 4.2.2 of the Conceptual Caribou Mitigation plan states: "locating excessive noise generating activities such as the concrete batching operation as far away from sensitive wildlife locations as possible;". However, no specific mitigation measures are mentioned for impacts to caribou due to noise generated from the Project air strip. **Rationale:** Noise from the air traffic using the air strip will also generate excessive noise that can impact caribou. Additional information on the timing and frequency of air traffic, as well as specific mitigations related to impacts from air traffic, including mitigations related to frequency and timing of flights, will be necessary to evaluate impacts to caribou due to air strip noise.	1. Provide additional information on the timing and frequency of air traffic using the Project air strip. 2. Provide specific mitigations related to impacts from air traffic, including mitigations related to frequency and timing of flights.	Following the supplementary submission provided on July 8th, 2024, as well as the commitment (ID 9-36) provided in version 2 of the Commitments Register (July 17, 2024), this IR is accepted for the purposes of the EA review. However, the following must be corrected in the final EIS submission package: • Update the caribou management framework (EIS Appendix 9-E) to reflect the additional information and proposed mitigation measures, in the final EIS submission package. See also AD-78 and AD-85 in the Advice to Proponent table.	Accepted
IR-150	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.5.2.1, Best Management Practices for working in Boreal Woodland Caribou Range in Saskatchewan	**Context and Rationale:** In the draft EIS Section 9.3.5.2.1, the Proponent states: "Denison proactively initiated research to provide field-based findings on the effectiveness of linear disruption features on predator/prey movements." "Results will help the development of proactive and meaningful restoration strategies as an ongoing part of the overall Project (Omnia 2022). Additionally, the 2023 field program will support a program that uses the results from the 2021/2022 Caribou Trail Study in long-term reclamation planning. The program will be led by the University of Saskatchewan and is funded by Denison, an Indigenous-owned environmental company, the Northwest Communities Environmental Services (Métis owned), Mitacs, and the Natural Science and Engineering Research Council of Canada through an alliance grant. The Caribou Trail Study and the reclamation plan will culminate with the development of a Woodland Caribou Management Plan." ECCC is available to support the Proponent through review of study programs should those programs be made available during the review process. ECCC requests to see the 2021/2022 study to further our review of caribou use in the Project area.	Provide the report for 2021/2022 Caribou Trail study for long-term reclamation planning for ECCC review.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-151	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4	**Context and Rationale:** In the analysis of residual and cumulative effects for woodland caribou, information and analyses on impacts to connectivity and movement across the landscape is lacking.	1. Using available reports and data, provide an analysis of impacts to landscape connectivity for woodland caribou at the LSA and Range scales. 2. Determine whether the Project is expected to result in a reduction of connectivity within or between the ranges and provide a rationale for the conclusion. Describe how movement corridor(s) may be affected by Project activities and infrastructure.		Accepted
IR-152	-	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4, Appendix 9-B	**Context:** Baseline studies for Woodland caribou include: • Winter Track Count Survey to assess presence, abundance, feeding activity, and ecosite affiliation; • Pellet Group/Browse Availability Survey to detect presence and abundance of caribou, and frequency of occurrence and abundance of lichen; • Covert Camera Survey to determine presence and use of linear features (roads, trails, and hand-cut lines). The Saskatchewan Conservation Strategy for Boreal Woodland caribou [1] states that caribou are very susceptible to predation during the calf-rearing period, and populations are extremely sensitive to even minor changes in mortality rates. **Rationale:** It is unclear if, or how, any data on seasonal and spatial use of habitat was considered in the residual effect analysis, for example summer/winter home ranges, sensitive life stages including calving (e.g., location of calving sites). It should be noted that the English River First Nation have identified caribou calving areas in the vicinity of the Project footprint. **Reference**: [1] Saskatchewan Ministry of Environment. 2013. Conservation Strategy For Boreal Woodland Caribou (Rangifer tarandus caribou) in Saskatchewan. Saskatchewan Ministry of Environment. Fish and Wildlife Technical Report 2014.	Please provide a summary of available baseline data on habitat use during all seasons and life stages, in particular sensitive stages such as calving, and how habitat use during all seasons and life stages was considered in the residual effect analysis. See also IR-145 and IR-143.	See also AD-82 in the Advice to Proponent table.	Accepted
IR-153	-	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4.1	**Context:** According to ECCC (2020), forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g., through loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and other food sources, although they may make limited use of burned areas to feed on new growth. The residual effects evaluation of alteration and/or habitat loss lists ecosites BS3 and BS7 (regenerating forest types) as available habitat in Table 9.3-22, which represent 43.5% of the Regional Study Area. **Rationale:** It is unclear whether the ecosites BS3 and BS7 (regenerating forest types) represent suitable habitat for Woodland caribou year-round. More information is	1.Please provide further information on the suitability of ecosites BS3 and BS7 for Woodland caribou in different life stages. 2. Please provide the results of a residual effect analysis not including ecosites BS3 and BS7 for conservatism. 3. If 2 leads to habitat fragmentation, consider connectivity of habitat patches in the residual effect analysis.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					required on the habitat quality (e.g., time since last forest fire) and suitability for different life stages of caribou. For conservatism, it is recommended to perform a second residual effect analysis not including regenerating forest ecosites.			
IR-154	-	CNSC	Woodland Caribou Alteration and/or Loss of Habitat	Section 9.3.6.4.1	**Context:** Lichen, the primary food source for Woodland caribou (up to 70% of the year-round diet), can be exposed to airborne contaminants and dust deposition at distances of 1–40 km (e.g., increased metal concentrations or dust were detected in lichen at distances of 1–40 km from a mine site [1, 2]). **Rationale:** Further information is requested on how the potential for contamination of the food source "lichen" is reflected in the applied buffers of direct and indirect disturbance for woodland caribou. **References**: [1] Watkinson et al. (2021). Effects of dust deposition from diamond mining on subarctic plant communities and barren-ground caribou forage. Journal of Environmental Quality 50(4): 990-1003. Doi: 10.1002/jeq2.20251. [2] Chen et al. (2017). Does dust from arctic mines affect caribou forage? Journal of Environmental Protection 8(3): 258-276. Doi: 10.4236/jep.2017.83020.	1. Please provide additional justification for how the potential for contamination of the food source "lichen" is reflected in the applied buffers for sensory disturbance. See also related IRs: IR-137, IR-148 and IR-156. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • COPC in Lichen monitoring is recommended in transects from the Project site to assess COPC concentrations and confirm whether the chosen buffer is conservative.		Accepted
IR-155	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1, Alteration and/or Loss of Habitat	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent presents figure 9.3-14 and table 9.3-22, which "depicts available woodland caribou habitat in the Project study areas" and provide a summary of available Woodland Caribou Habitat in the Project Area, Wildlife Local Study Area, and the Terrestrial Regional Study Area. The Proponent does not provide a biologically relevant explanation on the ecosites that are considered available woodland caribou habitat. According to the amended recovery strategy for Caribou, all habitat within SK1 range has been designated as critical habitat. To align with best current knowledge and the amended recovery strategy, the map and table should show the biophysical attributes, as outlined in Appendix H of the recovery strategy.	1. Provide a biologically relevant explanation about how available caribou habitat was determined or determine available habitat based on new data from the province of Saskatchewan (See IR-145). 2. Consider referencing Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 to define important biophysical features.		Accepted
IR-156	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1 Section 9.3.7.3.1	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent identified that 142 ha of available caribou habitat within the Project footprint will be directly impacted or lost, while an additional 1,165 ha will be indirectly impacted by Project activities such as sensory disturbance. They assessed the residual and cumulative effect of alteration to habitat for woodland caribou as not significant: "The residual effect of alteration and/or loss of available woodland caribou habitat is not expected to result in a change that will alter caribou habitat integrity to the point where it would not be able to sustain the regional woodland caribou population. Therefore, the effect is assessed as not significant." Section 9.3.7.3.1 of the draft EIS states: "It is not expected that the cumulative effects of alteration and/or loss of habitat will alter the integrity of woodland caribou habitat	Provide a revised assessment of residual and cumulative effects, taking into consideration that the disturbance within the SK1 range is above the disturbance management threshold required for survival and recovery of the species. See also related IRs: IR-137 and IR-154.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions. Therefore, the cumulative effects resulting from the Project's residual effect interacting with residual effects from other projects and activities is predicted to be not significant." For the residual effect of alteration and/or loss of available caribou habitat (Section 9.3.6.4.1, Table 9.3-24), the Proponent assessed the magnitude as low, the geographic extent as local, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high and the likelihood as likely. The rationale provided by the Proponent is insufficient to determine the accuracy of these assessments, given the lack of data and the small size of the assessment area. ECCC does not support the residual effects assessment of low magnitude, given the uncertainties related to seasonal use by caribou in the Project area and the current level of disturbance in the SK1 range. For the cumulative effect of alteration and/or loss of available caribou habitat (Section 9.3.7.3.3 , Table 9.3-30), the Proponent assessed the magnitude as moderate, the geographic extent as beyond the RSA, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high, the likelihood as likely, the significance as not significant and the level of confidence as moderate. The rationale provided by the Proponent is insufficient to determine the accuracy of these assessments, given the lack to data presented for caribou and the small size of the RSA, compared to the SK1 region. ECCC does not support the conclusion of the cumulative effects assessments or for the level of confidence. The Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 states that the range is currently at the 60% disturbance management threshold. Therefore, any activity likely to result in the alteration or destruction of critical habitat may impact on the species survival and recovery. In addition, the Proponent's assessment was based on information that was lacking data on calving, wintering and rutting areas, and connectivity and caribou movements. The absence of considerations of the regional context of disturbance does not provide a conclusion based on best available information.			
IR-157	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.9 Ungulates, Furbearer and Woodland Caribou Summary	**Context and Rationale:** The Proponent has committed to developing a Woodland Caribou Management Plan, which will include a "detailed assessment for the need for habitat offsets." The Woodland Caribou Management Plan will support ECCC's review of the Proponent's assessment of residual effects following mitigation and offsetting. This plan should consider ECCC's Operational Framework for Use of Conservation Allowances (ECCC, 2012). ECCC is available to assist the Proponent in the determination of appropriate offsets that would balance against Project adverse effects after the application of measures to avoid, minimize and restore on-site are adopted. Based on the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020, anthropogenic impacts to local caribou populations experience a lag effect, which occurs over extended periods. This lag effect	Provide the Woodland Caribou Management Plan for review. The plan should clearly demonstrate efforts to avoid and minimize any Project effects and restore on-site any disturbed areas prior to the consideration of offsetting. Details on how severity of disturbance and vulnerability of the species were considered should be explained. See also related: IR-149. **Suggestions for mitigation and follow-up measures:** ECCC notes that the Woodland Caribou Management Plan should clearly explain efforts to address Project effects, including any contribution to cumulative adverse effects, after it has been	A path to resolution is still under discussion for this IR. Further guidance to Denison is forthcoming, and this table will be amended and posted to the Canadian Impact Assessment Registry, once provided. See also AD-85 in the Advice to Proponent table.	

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					needs to be adequately considered when proposing offsets. ECCC is available to assist the Proponent in understanding how critical habitat is described in the Recovery Strategy and the determination of appropriate offsets that would balance against Project effects based on the predicted impacts to caribou habitat.	determined that all options in the previous steps of the mitigation hierarchy (i.e., avoidance, and minimization,) have been fully considered and applied. In the Woodland Caribou Management Plan, provide details on how the factors outlined in the Operational Framework for Use of Conservation Allowances (ECCC, 2012) were considered in determining the offsetting amounts, including the severity of disturbance and vulnerability of the caribou population. Important factors including time lag (the amount of time from restoration work to when the habitat would be considered caribou habitat) would also need to be considered. ECCC typically recommends a minimum offset multiplier of 4:1 (offset outcome: area disturbed). This is a benchmark ratio applied to a project that is in the lower end of the risk spectrum, such as one with a low severity impact adversely affecting a low vulnerability ecological component. In general, the minimum 4:1 multiplier accounts for time-lags to restoration, uncertainty in outcomes, a precautionary approach, and the adverse impact itself in its specific context. Offset multipliers are variable and determined by project-specific circumstances and associated risks and uncertainties.		
IR-158	-	ECCC	Migratory birds	Section 9.4.1.2, Key Indicators and Measurable Parameters	**Context and Rationale:** In Section 9.4.1.2 the Proponent outlined key indicators for “Migratory Breeding Birds” which includes Waterbirds and Waterfowl, Upland Game Birds and Migratory Songbirds. These are broad categories, which do not allow for assessment of the variation in habitat requirements or ecology of individual species or guilds. **Updated Rationale:** The Proponent should identify additional focal species that can serve as indicator species by representing anticipated impacts to a broader guild of species. Indicator species should be demonstrably sensitive to the potential effect of interest, and suitable for inferring effects on other species. Species may be grouped into guilds for assessment based on similarities in ecology or vulnerability to Project effects, such as species at elevated risk of collision with vehicle traffic. By identifying focal species or guilds for each key indicator species within the Migratory Breeding Birds Valued Components (VCs), ECCC would be able to accurately review the Proponent’s assessment of impacts and mitigation measures in order to assess the accuracy of the Proponent’s conclusions and provide expert advice on the mitigation measures.	Identify focal species/guilds for each key indicator species within the Migratory Breeding Birds valued components. Provide an updated analysis of Project effects on migratory birds.	See also AD-79 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-159	-	ECCC	Migratory birds	9.4.3.2.3 Baseline Studies – Migratory Songbirds Appendix 9-B, Section 2.10.2, Results	**Context and Rationale:** Information presented in the draft EIS is insufficient to accurately predict Project impacts to breeding birds. The Proponent collected a single year of breeding songbird point counts and aerial waterfowl surveys (including avian species at risk). A single year of surveys in which birds may be unusually scarce or abundant could severely compromise interpretation of post-construction monitoring data. Additionally, data presented in the draft EIS is from 2017 and ECCC advises that more recent data is needed for a comprehensive baseline to verify Project impacts. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal avian Modelling project contain information on avian densities and avian species at risk that could supplement field data. The national standard for major projects recommends a minimum of two years of field surveys to be provided, so that temporal variability can be considered when comparing post-construction against baseline records and other available data. **Updated Rationale:** ECCC recommends that for major projects, a minimum of two years of field surveys should be provided so that temporal variability can be considered when comparing post-construction against baseline records and other available data. More recent data is needed due to landscape changes that may have occurred since 2017 as well as cumulative effects that have occurred in that time. Additionally, if there was an unusually high population density of birds in 2017 due to extraneous circumstances, Project effects may be attributed to a non-existent decline in the population when the discrepancy can be due to natural variability. A more recent baseline will account for interannual variation and any regional effects and will allow for a more accurate review of mitigation and follow-up measures. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal Avian Modelling project contain information on avian densities and avian species at risk that could supplement field data.	Supplement breeding bird point count data and aerial waterfowl data collected during 2017 with additional pre-construction field data or existing post-2017 data/modelling to provide a comprehensive baseline that can be used to verify Project impacts during construction and operational phases.	See also AD-80 in the Advice to Proponent table.	Accepted
IR-160	-	ECCC	Migratory birds	Section 9.4.3.2.3 Baseline Studies – Migratory Songbirds	**Context and Rationale:** ECCC advises that the results of the field studies need to be interpreted/analyzed in the context of the study area. The Proponent presents results on areas with highest richness and diversity but does not make a link to habitat that will be lost or experience indirect effects. **Updated Rationale:** Results regarding the effects of the Project, including a discussion on habitat types that will be lost or indirectly impacted during the life of the Project, and a discussion on the overall impact on the avian community including results from baseline studies as well as other supplemental information as per IR-159 are required to assess the validity of the Proponent's conclusions and should be used in effects assessment.	Provide results interpreted in the context of Project direct and indirect effects. Include discussion on the habitat types that will be lost or indirectly impacted during the Project and the overall impact on the avian community, using results from the analysis of baseline studies and other supplemental data (as per IR-159). Discussion should support the conclusions of the effects assessment. See also related IRs: IR-161 and IR-162.		Accepted
IR-161	-	CNSC	Bird Species at Risk	Section 9.4.3.3	**Context:** For the assessment of effects on Bird Species at Risk (SAR), in the EIS it was decided to use representative species for certain SAR birds:	1. Please provide additional information to justify the selection of surrogate species for Barn Swallow and Horned Grebe in the		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Appendix 10-A (ERA)	• Olive-sided Flycatcher and Common Nighthawk were selected to represent Barn Swallow. • Yellow Rail and Rusty Blackbird were selected as substitutes for Horned Grebe. No further rationale is provided to demonstrate that the identified surrogate species are representative of the Barn Swallow and Horned Grebe in the EIS. For example, do they share a common diet? Moreover, in the residual effects assessment, limited discussion is provided on the conservatism of chosen suitable habitat types for both surrogate and represented species, in the calculation of habitat loss and alteration, as well as change in mortality. For example, how does habitat for Common Nighthawk and Barn Swallow overlap (do they use identical habitat types?) and how does this affect the calculation of habitat loss and alteration used to evaluate the magnitude of residual effect? Finally, in the ERA, Lesser Scaup is the surrogate for Horned Grebe. Yellow Rail is also represented by Lesser Scaup but Rusty Blackbird is represented by Olive-sided Flycatcher. **Rationale:** It is unclear what criteria were applied to select surrogate species for Barn Swallow and Horned Grebe, and how the chosen surrogates relate to Barn Swallow and Horned Grebe in terms of habitat type and range, nesting, and feeding requirements etc. There is also inconsistency with respect to the use of surrogate species for the Horned Grebe between the EIS and ERA supporting document.	EIS. This should include a description of the similarity of SAR and associated surrogate species and any relevant uncertainties. 2. Please provide conservative estimates of habitat loss and alteration for the represented and not directly assessed species (Barn Swallow, Horned Grebe). 3. Please provide clarity as to why different surrogate species are used for Horned Grebe between the EIS and ERA. See also related IRs: IR-160 and IR-162.		
IR-162	-	ECCC	Migratory birds	Section 9.4.3.3, Bird Species at Risk	**Context and Rationale:** Not all avian species at risk present in the study area were included as Key Indicators in the avian species at risk (SAR) valued component (VC). Barn swallow and horned grebe were recorded in the study area, but not included as VCs. Additionally, bank swallow may inhabit the Project area. Impacts to Species at Risk Act Schedule 1 listed species need to be identified, avoided, lessened and monitored. In Section 9.4.3.3. the Proponent states: "It is acknowledged that the listed Barn Swallow (Hirundo rustica) and Horned Grebe (Podiceps auratus) could potentially occur in the Terrestrial RSA. Incidental observations occurred during the baseline studies (Appendix 9-B). To focus the effects assessment on a few key species (described in the following) it was decided to use Olive-sided Flycatcher and Common Nighthawk to represent Barn Swallow as well, and to use Yellow Rail and Rusty Blackbird as a substitute for Horned Grebe. Unlike Horned Grebe, Yellow Rail and Rusty Blackbird are also listed provincially." Barn swallow, bank swallow and horned grebe may have different nesting habitat requirements than the representative species discussed in the draft EIS. An explanation of how differing species are representative of one another is required, or if an explanation cannot be provided, the species should be assessed individually. **Updated Rationale:** The management plans for these three species demonstrate the	1. Explain how nesting habitat requirements of barn swallow is represented by common nighthawk and olive-sided flycatcher as a VC or assess individually each SAR that overlaps with the Project and is likely to be affected. 2. Explain how nesting habitat requirements of horned grebe are represented by yellow rail and rusty blackbird as a VC, or assess individually each SAR that overlaps with the Project and is likely to be affected. 3. Assess individually each SAR that overlaps with the Project and is likely to be affected. See also related IRs: IR-160 and IR-161.		Accepted

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					variability in their habitat selection. The Management Plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada (Environment Canada, 2013) states "Yellow Rails inhabit shallow wetlands and other wet areas with grass-like vegetation. They breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes (Bookhout 1995, Alvo and Robert 1999, COSEWIC 2009), shallow prairie wetlands, and wet montane meadows (Peabody 1922, Sherrington 1994, Popper and Stern 2000). " The Management Plan for the Rusty blackbird (*Euphagus carolinus*) in Canada (Environment Canada 2015), states: "Rusty Blackbirds tend to select breeding sites with a combination of freshwater bodies with shallow water and emergent vegetation for foraging that are adjacent to wetlands with conifers or tall shrubs with cover for nesting (Matsuoka et al. 2010a, Matsuoka et al. 2010b, Greenberg et al. 2011)." The Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada (ECCC, 2022) states: "The Horned Grebe breeds in small (generally 0.5 to 2 ha, but ranging from 0.24 to 18.2 ha), shallow (at least 20 cm deep, but on average 40 cm), and usually fishless, perennial wetlands, but they can also nest on larger lakes with shallow edges and sufficient emergent vegetation. Breeding sites usually contain at least 40% open water with beds of emergent vegetation, such as sedges (Carex spp.), rushes (Juncus spp.) and cattails (Typha spp.) (Faaborg 1976, Kuczynski et al. 2012, Routhier 2012, Stedman 2018)." Due to differing habitat selection and use, ECCC recommends that each selected VC is given an individual assessment with specific mitigation measures. This will allow for a more accurate review of the chosen mitigation measures.			
IR-163	-	ECCC	Migratory birds	Section 9.4.3.3.3, Baseline Studies – Avian species at risk VCs	**Context and Rationale:** The baseline studies and data analysis for species at risk (SAR) birds is insufficient to accurately predict Project effects. ECCC recommends the use of predictive modeling in relation to survey data and habitat attributes to produce distribution and density maps. Sites within the study area that support particularly high densities or diversity of an individual species, based on direct observation and, where appropriate, distribution or occupancy models, would greatly improve confidence in Project impact predictions. Additional information on specific habitat use or models of habitat used by SAR would facilitate a more complete analysis of Project effects.	Provide additional information, including mapping/modelling of specific habitat requirements for each avian species at risk or provide a justification of models used in the draft EIS.		Accepted
IR-164	-	ECCC	Migratory birds	Section 9.4.4.2.1, Alteration and/or Loss of Habitat – Migratory Breeding Birds	**Context and Rationale:** The discussion on impacts to migratory songbirds presented by the Proponent is not sufficient to understand the impacts on various guilds of birds (e.g., aerial insectivores, forest birds, wetland birds, habitat specialists). As per IR-158, focal representative species/guilds should be used as key indicators (KI) in the Migratory Breeding Birds Valued Component. A greater level of detail on Project impacts to migratory songbirds with differing habitat requirements is needed for a fulsome assessment of effects.	1. Provide further discussion on impacts to different focal species/guilds within the Migratory Breeding Birds Valued Component. 2. Provide mapping of important features or habitat types that will be lost due to the Project for different guilds of migratory birds.		Accepted

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					Updated Rationale: A greater level of detail, including a discussion on impacts to different focal species and/or guilds within the Migratory Breeding Birds Valued Component, is required for a more fulsome assessment of effects and identification of mitigation measures. Additionally, mapping detailing important features or habitat types that will be lost due to the Project for different guilds of migratory birds will be required to assess Project effects. This information will be required in order for the Proponent to apply adaptive management, and for ECCC to review the adequacy of these management plans.			
IR-165	-	CNSC ECCC	Birds (all species)	Section 9.4.4.2.2 Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment Appendix 10-A (ERA)	**Context:** On p. 9-364 of the EIS, it is stated that exposure to hazardous materials through contact with contaminated waste ponds could affect avian health and contribute to mortality. However, the ERA places the avian receptors only in waterbodies and locations outside of the Project area (see Figure 5-2 in the ERA), i.e., Whitefish Lake, McGowan Lake, the inlet to Russell Lake, and Kratchkowsky Lake. Further, there are insufficient details on the potential effects of the water quality in the water management and treatment facilities on birds, species at risk, and other wildlife, including the risk of bioaccumulation of contaminants. The Proponent should assess potential effects of water quality from these areas using applicable CCME guidelines. **Rationale:** It is unclear whether the ecological risk assessment based on the chosen exposure locations is protective and conservative for avian species potentially exposed to contaminated waste ponds on the Project site. While mitigation measures such as physical, visual, and/or auditory deterrents are proposed in Section 9.4.5.2.4, the possibility of avian species coming into contact with waste ponds cannot be excluded based on the available information in the EIS. The possibility of birds, species at risk, and other wildlife accessing the water management and treatment facilities for drinking water or other purposes is not discussed in the draft EIS.	Please perform an ecological risk assessment with avian receptors located at the contaminated waste ponds, including: 1. Describe and analyze the possibility of birds, species at risk and other wildlife using the water or waste management facilities and provide an analysis to determine if there is a risk to wildlife that may access these areas. 2. Identify the potential toxicity of water management ponds to aquatic migratory birds and species at risk (SAR). 3. Describe what measures will be taken if the waters are found to be toxic to migratory birds and SAR. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison ensure adequate mitigation measures are implemented to minimize the potential for avian exposure to pond waters.		Accepted
IR-166	-	ECCC	Migratory birds	Section 9.4.5.2 Additional Avian Species-specific Mitigation Measures	**Context and Rationale:** Avian species-specific mitigation measures are not presented in the draft EIS. The Proponent has committed to providing a variety of environmental management plans. Section 9.4.5.2 reads: "Additional mitigation measures specific to the Raptors, Migratory Breeding Birds, and Bird Species at Risk VCs, in accordance with the Migratory Birds Convention Act, and tailored to Project features will be incorporated into various Project management and monitoring plans such as the, erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring, and Waste Management Plan." Migratory birds, the nests of migratory birds and/or their eggs can be inadvertently	Provide details on species-specific mitigations for species at risk (SAR) and other avian species that will include: • details on what activity restrictions will be implemented for migratory birds and SAR and when they will be applied; • details on mitigations used during regular maintenance activities such as vegetation management (e.g., mowing), access road repair (e.g., aggregate stockpiles), and infrastructure repair; • details on methods used to detect species listed on Schedule 1 of the *Migratory Birds Convention Act* (e.g., Pileated Woodpecker) and mitigations/setback distances and timing to reduce risk to these species.		Accepted

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					harmed or disturbed as a result of many activities, including but not limited to clearing trees and other vegetation, draining or flooding land, or using fishing gear; this is known as incidental take. This inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs is prohibited under the MBCA. Incidental take, in addition to harming individual birds, nests or eggs, can have long-term consequences for migratory bird populations in Canada, especially through the cumulative effects of many different incidents. For further details, please refer to the Avoiding Harm to Migratory Birds website at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds.html In order to assess the effectiveness of species-specific mitigations and need for additional mitigations ECCC requires details on the species-specific mitigation measures proposed, and the monitoring plans.			
IR-167	-	ECCC	Migratory birds	Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance	**Context and Rationale:** The Proponent has stated that when it is not practicable to clear outside of the breeding bird window, they will conduct pre-clearing surveys. Section 9.4.5.2.1 states: “Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting season, pre-clearing nest surveys will be conducted at that location within the Project Area.” ECCC does not recommend the use of nest searches or pre-clearing surveys for active bird nests during the breeding season as a mitigation, given the difficulty associated with finding nests reliably and the high likelihood of disturbing nesting birds when searching. Instead, ECCC recommends that clearing and grubbing activities not be conducted during the breeding bird season. The Migratory Birds Regulations 2022 (MBR 2022) brings new scenarios that need to be considered: 1. Most migratory birds: - Nests are protected only when they are in use or when live eggs or chicks are present. 2. Migratory birds listed in MBR 2022 Schedule 1: - For the 18 species of migratory birds identified on Schedule 1, the MBR 2022 provide year-round nest protection until they can be deemed abandoned. 3. Migratory birds listed under SARA: - For some SARA listed migratory birds, the residence prohibition (s.33) will protect nests that are not active, but are re-used in subsequent years, and the critical habitat prohibition (s.58) will protect nests that are part of the critical habitat identification. Those prohibitions apply everywhere in Canada and at all times of the year. In these cases, a SARA permit will be required.	Provide the following information: • details on how vegetation clearing related to site development will be conducted to minimize risk to migratory birds and species at risk (SAR). • the timing window that will be used for vegetation removal to reduce risk to migratory birds and SAR	Response is accepted, but also see AD-57 in the Advice to Proponent table and follow-up IR-142-159-167-R1.	Accepted
IR-168	-	ECCC	Migratory birds	Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment	**Context and Rationale:** The Proponent mentions that avian deterrents will be used on power transmission lines, buildings and other Project infrastructure. However, the Proponent does not mention any deterrents that will be used for deterring birds from the water or waste management facilities.	Provide information on avian deterrents to be used to prevent birds or other wildlife entering water or waste management ponds. 2. Explain how proposed timing of use of deterrents will reduce risk of migratory birds making contact with treatment		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Details on deterrents for all Project components should be identified to assess residual and cumulative impacts to migratory birds.	waters outside of the nesting season (i.e., during migration and stop overuse). 3. Explain which deterrents will be used, which deterrents were considered, and what alternative, adaptive measures will be considered if deterrents are unsuccessful for any Project components.		
IR-169	-	ECCC	Migratory birds	Section 9.4.6.3, Residual Effects Evaluation for Migratory Birds, Table 9.4-15 and Map 9.4-11	**Context and Rationale:** The analysis of available habitat types for migratory songbirds appears incorrect. In their interpreted ecosite mapping, the Proponent identified 25 different ecosite types. In their table 9.4-15 and map 9.4-11, the Proponent only lists 8 ecosite types that are available migratory songbird habitat. Section 9.4.6 Residual Effects Evaluation for Migratory Songbirds reads: "Considering the baseline data (Appendix 9-B), migratory songbird habitat is described in the following text without species-specific differentiation and referred to as available habitat for migratory songbirds. Based on the baseline study results, 66.8%, 52.2%, and 50.7% of the Project Area, Wildlife LSA, and Terrestrial RSA, respectively, are assumed to provide available habitat for migratory songbirds (Table 9.4-15)." All Project areas, except some anthropogenic features and open water, would be considered available habitat for migratory songbirds. Although some ecosite types may have lower density and diversity, it is expected that all ecosites provide migratory songbird habitat.	1. Explain how information in Table 9.4-15 and map 9.4-11 were derived. 2. Explain why other habitat types were not considered as available habitat for migratory songbirds.		Accepted
IR-170	-	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation for Bird SAR, Table 9.4-19	**Context and Rationale:** The table and map presented by the Proponent do not appear representative of all available habitat for common nighthawk (CONI). Although CONI do preferentially use open areas such as gravel (often an anthropogenic disturbance) and regenerating forest, as identified in the draft EIS, they also use rock outcrops that can be within forested areas. As this area lies within the pre- Cambrian shield, there are likely rock outcrops that are also available habitat. As aerial insectivores, CONI select nesting areas in close proximity to wetlands or lakes where there is abundant forage. **Rationale:** Habitat requirements and preferences for all species at risk is required for developing effective mitigations and adaptive management.	1. Provide an updated table and map that considers all available habitat for common nighthawk. 2. Additionally, as part of environmental management plans the Proponent should include species-specific mitigations that are biologically relevant to all the species at risk for all Project phases and components.	Following the supplementary information provided by Denison on July 8th, CNSC staff determined that Denison has not provided the requested information on species-specific mitigation measures for each SAR. It is not adequate to group SAR together (e.g., all birds) due to the unique life history and habitat requirements of each individual SAR. Denison is expected to provide species-specific mitigation measures for each SAR separately. In order to resolve this IR, Denison are expected to: • Provide species-specific mitigation measures for each individual SAR. Denison may provide this information through revision of Section 3.3 and Table 4.1 in EIS Appendix 9-D. See also AD-77 in the Advice to Proponent table.	Not Accepted
IR-171	-	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation	**Context and Rationale:** Section 9.4.6.4 Residual Effects Evaluation for Bird SAR – Common Nighthawk reads: "Progressive reclamation is anticipated to begin during Construction. However, a conservative approach is used, with Common Nighthawk (CONI) habitat in the Project Area considered to be unavailable for the duration of the Project, only becoming available as habitat following Post-Decommissioning (i.e., during the regeneration of vegetation following Decommissioning)."	Develop mitigation plans appropriate for avoiding collisions of common nighthawks with vehicles, when and where nighthawks are observed foraging near or roosting on gravel roads. Demonstrate how the planned mitigation activities will result in reduced residual effects from this pathway.		Accepted

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					CONI may nest on the roadsides of access roads within the Project area. As such, the Project area should still be considered available habitat for the duration of the Project and appropriate mitigations and adaptive management should be discussed for this species.			
IR-172	-	CNSC	Birds (all species)	Section 9.4.6.4.2	**Context:** Populations of listed species may be less resilient to changes in mortality. CSA N288.6:22 Clause 7.2.4.3 states that effects on a few individuals of endangered, threatened, or vulnerable species would not be acceptable. The residual effects assessment for "Change in Mortality" for bird species at risk states that Project mitigation measures identified in Section 9.4.5 are expected to limit interactions between bird species at risk and potential sources of direct and indirect mortality. However, the mitigation measures are not discussed with respect to their effectiveness to limit interactions, specifically for bird species at risk. **Rationale:** It is unclear if the proposed mitigation measures are effective in preventing mortality in bird species at risk for which even only a few deaths could negatively impact the population.	Please provide a discussion on mitigation measures with respect to their effectiveness in minimizing mortality for bird species at risk, for which effects on a few individuals would not be acceptable.		Accepted
IR-173	-	ECCC	Migratory birds	Section 9.4.8 Monitoring and Follow-up	**Context and Rationale:** Monitoring and follow up programs are part of adaptive management and implementation of additional mitigations. In Section 9.4.8 the Proponent states: "Considering the Project planning, baseline survey results, and proposed mitigation measures, no follow-up programs are considered to be warranted at this time." Project impacts related to mortality of birds, such as collisions with the transmission line, mortality along roads and use of waste and water management facilities should be monitored during all phases of the Project and adaptively managed.	Provide details on the follow-up program to monitor impacts to avian mortality. The follow-up plan should include: • Monitoring of avian use of waste and water facilities • Monitoring of mortality along access roads • Monitoring of mortality related to transmission lines • Monitoring of effectiveness of avian deterrents.		Accepted
IR-174	-	ECCC	SAR – Bats	Appendix 9-B, Denison Mines Corporation Wheeler River Project, Terrestrial Environment, Wildlife and Vegetation Baseline Inventory, Section 2.1.4 Acoustic Bat Surveys	**Context:** The Proponent conducted acoustic surveys for bats and confirmed presence of two Species at Risk Act (SARA) schedule 1 listed bat species in the Project area, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis). However, the Proponent did not do an effects assessment of either of these bat species. **Rationale:** Although bats are present in the study area, no work was done to identify hibernaculum or maternal roosting sites. All species at risk that are expected to be present in the Project area should be assessed and species-specific mitigations detailed.	1. Conduct an effects assessment for little brown myotis and northern myotis, including the likelihood that tree clearing during the bat roosting period, is likely to 'kill', 'harm', or 'harass' Little Brown Myotis and Northern Myotis and its ability to carry out its life processes. 2. Describe and map locations of suitable myotis hibernacula and/or maternal roost habitat within the Local Study Area and Regional Study Area and explain how these habitats may be affected by Project activities. 3. Describe what mitigation measures will be taken to avoid the breeding period for bats.	Added November 20th, 2024 – draft response provided to Denison in October 2024: Following the supplementary information provided by Denison on July 5th, CNSC staff determined that it is unclear from the proponent's response whether Denison will perform both pre-disturbance surveys and additional baseline surveys for bat SAR. **<u>In order to resolve this IR, Denison are expected to:</u>** 1. Revise Figure 2-9 to re-label frequency as number of detections by time. Clarify regarding the turquoise dots if species data is uncertain in all cases or were detections for some identifiable? 2. Revise Figure IR-174 Round 3-1 and Figure IR-174 Round 3-2 to depict habitat potential for different life stages of the species for different bats. 3. Provide the proposed methods for the additional bat SAR baseline surveys including a description of the statistical approaches to be used. The methods must	

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						4. Describe any pre-construction/pre- clearing surveys will be conducted to identify any hibernaculum and maternal roosting sites. Describe how monitoring will support adaptive management.	demonstrate how the baseline data will be of sufficient sample size and duration to obtain a basic understanding of within-year and between-year variation. 4. Provide a commitment to conduct additional bat SAR baseline surveys in their commitments register	
IR-175	-	CNSC	Provincially Listed Species	Appendix 9-B; section 2.2.2	**Context:** Vegetation and wildlife habitat characterization field surveys were completed in 2017, based on which ecosite factsheets were prepared. The factsheets list observations of two provincially listed plant species with a rank of S3 (vulnerable/rare to uncommon; Table 2.4-2) according to the Saskatchewan Conservation Data Centre, which are not discussed in the main EIS document: • Angle-leaved sundew (Drosera anglica) observed in ecosites BS19, BS20, BS22, BS25 • Neat Spike-rush (Eleocharis nitida) observed in ecosite BS25 Table 9.2-12 in section 9.2.6.2.1 of the EIS indicates that there may be indirect disturbance to some of these ecosites (BS19, BS20, BS25). In section 9.2.6.3.1 it is discussed that listed plant species are not likely to return once lost from a specific location. **Rationale:** Given that not all areas in the revised Project footprint were surveyed for listed plant species in baseline studies, there is uncertainty as to whether any species were missed, in particular those that have been observed in ecosites present in the LSA/RSA (e.g., Drosera anglica and Eleocharis nitida, see also Appendix 2 Table of Appendix 9-B). It should also be noted that rare plant surveys were completed in summer 2017 only (section 2.4.2 of Appendix 9-B), which may underestimate annual rare species that may be dormant in the seed bank in some years due to specific seed emergence requirements. It is acknowledged that the Proponent committed to pre-construction listed plant surveys targeted on ecosites encountered in the Project Area but not previously surveyed, as well as ecosites within the Project Area with high potential to support listed plants. More information is requested on the potential indirect effects on rare plant species as well as the planned pre-construction surveys.	1. Please provide a discussion on the potential risks from indirect effects on ecosites with observed rare plant species 2. Please provide additional information on the ecosites included in the planned pre-construction listed plant surveys **Suggestions for mitigation and follow-up measures:** CNSC recommends focusing monitoring on ecosites that have known observations of listed plant species outside of the Project Area (e.g., BS19, BS20, BS22, BS25).		Accepted
IR-176	-	CNSC	Human Health with respect to radiation exposure	Section 10.1.4.2.1 Section 10.1.6.1.4 Appendix 10-A (ERA)	**Context:** In section 10.1.4.2.1, the Proponent provides an evaluation of air quality constituents of potential concern to human health. It states: "A screening value for radon gas of 200 becquerels per cubic metre (Bq/m3) was available from Health Canada, which applies to total radon including background sources (Health Canada 2009). The radon concentrations which were predicted are incremental concentrations (i.e., above background) and were therefore compared to the applicable incremental screening value of 60 Bq/m3 for indoor air established by the Canadian Nuclear Safety Commission (CNSC) (Health Canada 2010a; Radiation Protection Regulations. SOR/2000-203)." The 60 Bq/m3 radon concentration value also appears in section 7.1.2 of Appendix 10-A (ERA).	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit. 2. Reporting the assessment results as the total dose, from all radionuclides combined including radon progeny, and by comparing this annual effective dose to the effective dose limit. Provide a summary of the conservative assumptions that have been included in the dose calculations.		Accepted

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					Further in section 10.1.6.1.4, it is stated: "Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 Bq/m3." The Radiation Protection Regulations do not stipulate a limit for radon above background for sites Licensed by the CNSC. The effective dose limits for Nuclear Energy Workers (NEWs) and persons that are not NEWs are listed in section 13 of these regulations, and in subsection 1(3) of these regulations for the general public. The annual effective dose from all sources associated with the Licensed activities and within the scope of the Nuclear Safety Control Act and Regulations must be compared to the applicable effective dose limit. For members of the public this limit is 1 mSv per calendar year. In Section 4.2.5.3 of Appendix 10-A (ERA), there appears to be no reference mentioned for the radon equilibrium factors. These factors are a significant input into the dose calculations for radon. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations.	Provide a reference that shows how the radon equilibrium factors were determined.		
IR-177	-	HC	Change to an environmental component due to radiological contaminants	Section 10.1.4.2.1 (p. 10-22) Appendix 10-A (ERA) : Appendix B Table B.9, Ref. 19-2638 Section 6, Table 6.1-1 (p. 6-7)	**Context:** Section 10.1.4.2.1 states that, "Screening values for radionuclide concentrations in ambient air were not available. All relevant radionuclides were assessed in the HHRA in terms of their contribution to the total radiological dose to human and ecological receptors" (p. 10-22). Section 10 Appendix 10-A (ERA) states that, "No formal screening was conducted for radionuclides. However, since radiation dose to human receptors is of public and regulatory interest, the radionuclides in the uranium-238 decay series are carried forward as COPCs for further assessment" (Appendix 10-A (ERA): Appendix B Ref. 19-2638). Table 6.1-1 lists radionuclides as a key indicator for air quality, but only uranium and radon are considered in Section 6, and Section 10 Table B.9 does not include doses from uranium progeny in air. **Rationale:** Health Canada recommends using screening values that are available for radionuclides if they are appropriate for the dose and if the screening values have listed assumptions (such as particulate size and worker exposure time that can be adapted to in Denison's models). Two examples are ICRP 96, which CNSC uses in their regulatory reports to derive reference air quality values for Pb-210, Ra-226, and Th-230 (CNSC: Regulatory Oversight Report for Uranium Mines and Mills in Canada 2019); and Health Canada's Guidelines for Management of NORM (Health Canada: Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials, 2011).	1. Assess predicted radionuclides in Section 10 Appendix 10-A (ERA) using appropriate available screening values. Alternatively, provide a justification for why a screening wasn't conducted for radionuclides despite the availability of screening values (e.g., ICRP 96 and NORM Guidelines, 2011). 2. Clarify if uranium progenies in air are considered in the atmospheric transport and air quality modelling and are simply not reported, or if they are not included in the models because no screening criteria are available.	Response is accepted, but also see AD-55 in the Advice to Proponent table.	Accepted
IR-178	-	HC	Change to an environmental	Section 10.1.4.2.1 (p. 10-22)	The Baseline + Project scenario was not provided for radon levels.	1. Provide further information on whether and how baseline radon concentrations in air were determined.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			component due to hazardous contaminants	Section 6.1.4.2, Potential Project Related Effects (p. 6-31)	**Context:** Section 6.1.4.2 states that the predicted levels for radon were not added to the respective baseline air quality levels (p. 6-31), and further explains that "In all modelled phases of the Project, annual average radon concentrations at receptors beyond the Property Boundary are expected to be indiscernible from background levels." In Section 10.1.6.1.4, a different approach to evaluating predicted radon levels is mentioned: "the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3"(p. 10-44). **Rationale:** Without a rationale as to why baseline levels of radon were not included in the assessment, HC cannot fully evaluate the appropriateness of the air quality assessment. While Health Canada is of the opinion that using background radon levels as a screening value is appropriate in this case from a health perspective, different approaches to screening predicted radon levels in different sections appear to be used (i.e., background radon levels vs. CNSC incremental concentration).	2. Include baseline radon concentrations in the predicted total concentrations when comparing to existing guidelines; alternatively, provide a rationale for why baseline concentrations of radon were not included. 3. Discuss the potential health implications of the project-only increment-over-baseline radon levels		
IR-179	-	CNSC	Groundwater quality decommissioning objectives.	Section 10.1.4.2.2, Release of Treated Effluent to Whitefish Lake During Decommissioning	**Context:** It is stated that "This process would continue until the recovered water meets acceptable groundwater quality decommissioning objectives". **Rationale:** The information provided does not include groundwater quality decommissioning objectives nor a reference to these objectives.	Please provide groundwater quality decommissioning objectives or a reference to the information.		Accepted
IR-180	-	CNSC	Human health with respect to hazardous contaminants	Section 10.1.6.1.1, Human Receptors Selection and Characterization	**Context:** Within the Human Health assessment, offsite receptors during the operation period are only considered downstream of Whitefish Lake. The only identified concern was for Se to the Fisher/Trapper located at Russel Lake. This section cites Indigenous Knowledge as informing the receptor selection and location. **Rationale:** While the assessment is fairly conservative in the assumptions made on intake and receptor habits, it stands to reason that if the trapper receptor was located closer to the operation, such as at McGowan or Whitefish Lakes, this exceedance of Se could be more pronounced. In terms of maintaining a conservative assessment, if the most vulnerable receptor can be shown to be protected at the point of highest expected COPC concentration, it can be concluded that this receptor would be protected further away from the Project. Considering this, why was the hunter/trapper receptor not also assessed at Whitefish or McGowan Lake? Was Indigenous Knowledge specific in mentioning Whitefish or McGowan Lakes were not used for the activities carried out by identified receptors?	Please provide justification for excluding a receptor from occupancy at lakes closer to the Project during operation (McGowan, Whitefish). Alternatively, conduct a risk assessment to a receptor at these lakes during operation to determine if there is a predicted risk that may require monitoring or mitigation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Assessment of a receptor located closer to the point of effluent release may need to be considered to ensure there are negligible risks • If Se is expected to exceed hazard quotients further upstream, selenium removal technology may be required as part of the effluent treatment process as a mitigation measure. Other COPC's exceeding an HQ of 1 may also be identified under this process that could require specific monitoring or mitigation measures.	Response is accepted, but also see AD-59 in the Advice to Proponent table.	Accepted
IR-181	-	CNSC	Human Health with respect to radiation exposure	Section 10.1.6.1.4	**Context:** In section 10.1.6.1.4, it is stated: "The maximum incremental radon concentration at the camp worker site during Operation was predicted to be 12.4 Bq/m3, which is below the CNSC limit of 60 Bq/m3 for incremental radon." As per IR-176, there is no such CNSC limit for incremental radon. The camp worker would be considered a person who is not a nuclear energy worker	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit for incremental radon. 2. Revising all references to the 'public dose limit' applied to camp workers (non-NEWs) to align with		Accepted

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					(NEW) and subject to the dose limits of section 13 and 14 of the Radiation Protection Regulations, not the dose limit for the general public as per subsection 1(3) of the Radiation Protection Regulations. The CNSC has regulatory requirements for the ascertainment and recording of doses of radiation as per section 5 of the Radiation Protection Regulations. Every Licensee must ascertain and record the magnitude of exposure to radon progeny, the effective dose and equivalent dose received by and committed to a person who performs duties in connection with any activity that is authorized by the Nuclear Safety and Control Act or is present at a place where that activity is carried on. The camp worker performs duties in connection with the Licensed activity and is present at the location where the activity is carried out. Hence, they are not considered to be a member of the general public (who has no connection with the activity) Further, the Proponent indicates that the maximum incremental radon dose to the camp worker was estimated to be 0.13 mSv/year during Operation. The assessment assumes that the camp worker spends 100% of the time indoors. Table 10.1-11 shows the maximum total incremental dose for the camp worker to be 0.02 mSv/year. This appears to be a discrepancy. Table 5.2 in Appendix 10-C provides internal annual dose from radon inhalation. The radon doses to some NEW workers (9.44E-02 mSv/a Driller 1 and 1.03E-01 mSv/a Wellfield Operator 1, 2) here appear less than the radon dose (0.13 mSv/year from section 10.1.6.1.4) to the camp worker, who is a non-nuclear energy worker. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations and the environmental impact statement.	section 13 and 14 of the Radiation Protection Regulations. The Proponent should explain why the radon dose for the camp worker appears as 0.13 mSv/year in one instance and 0.02 mSv/year in another. The Proponent is also asked to provide the rationale as to why a non-NEW has a higher radon dose than a NEW.		
IR-182	-	HC	Change to an environmental component due to radiological contaminants	Section 10.1.6.1.4, (p. 10-44)	**Context:** Section 10.1.6.1.4 states, "The limit is incremental and is exclusive of natural background, such as natural levels of radon and medical exposures. A dose constraint of 0.3mSv/yr was established for the public from all radionuclides and all pathways for the Project, as recommended by Health Canada (2010a). The dose constraint represents a dose lower than the public dose limit that ensures the combined dose from multiple sources does not result in exceedance of the public dose limit. Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3" (p. 10-44). **Rationale:** Calculating radon separately from all radionuclides may underestimate the health risks by not considering combined doses from multiple sources when comparing to the public dose limit constraint of 0.3 mSv/yr recommended by Health Canada (2010a).	1. Provide clarification on how combined doses from all sources would be accounted for in respecting the public dose limit of 0.3 mSV/yr if radon concentrations are being calculated separately.	Response is accepted, but also see AD-65 in the Advice to Proponent table.	Accepted
IR-183	-	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C	**Context:** Exposure scenarios for workers have been identified and high-level summaries of the assumptions and resultant dose estimates have been provided. However, the detailed dose calculations have not been provided.	Provide the dose calculations for deriving the dose estimates for workers in all exposure scenarios, for at least the most dose significant scenarios.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: The method used to estimate effective, equivalent and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data, for at least the most dose significant scenarios.			
IR-184	-	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C, 2.0	**Context:** It is stated in Appendix 10-C, section 2.0 that: "In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers." As per section 14 of the Radiation Protection Regulations, the equivalent dose limit for the lens of an eye for nuclear energy workers (NEWs), effective January 1, 2021, is 50 mSv in a one-year dosimetry period. **Rationale:** The reason of the requested change is to ensure consistency with the Radiation Protection Regulations.	The EIS and Appendix 10-C should be aligned with the Radiation Protection Regulations regarding the equivalent dose limit for the lens of an eye for NEWs.		Accepted
IR-185	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2 Appendix 10-C Table 3.10-3.12	**Context:** The Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in various locations were provided in tables 3.10-3.12 in appendix 10-C. The doses from those scenarios were omitted. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	The Proponent is asked to provide all the necessary information and assumptions required to perform the MicroShield calculations independently and to list the resulting calculated values from the listed scenarios.		Accepted
IR-186	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Section 10.2.4 Appendix 10-C, Section 3.2	**Context:** In sections 10.2.3.2.4 and 10.2.3.2.6, as well as section 3.2 of Appendix 10-C, the Proponent has stated that workers in the drying and packaging areas of the processing plant will be required to wear powered air purifying respirators (PAPR) to reduce/eliminate inhalation exposure. Further in section 10.2.4, which elaborates mitigation measures, it is stated: "For the drying and packaging/loading areas of the ISR plant, use of PAPR has been assumed. It will be needed in these areas, and it has been planned in these areas to substantially reduce doses from inhalation of uranium dust. Dust levels in these areas will be monitored and kept ALARA." The use of respirators appears to be in contradiction of the requirements of section 13 of the Uranium Mines and Mills Regulations, which states: *No Licensee shall rely on the use of a respirator to comply with the Radiation Protection Regulations unless the use of the respirator (a) is for a temporary or unforeseen situation; and (b) is permitted by the code of practice referred to in the licence.* The Proponent is also reminded that respirators should not be the first choice for dose reduction in workplaces. They should only be used when the hierarchy of control (elimination, substitution, engineering, or administrative controls) is not possible. **Rationale:** At this stage of the Project, the Proponent is expected to identify design	Provide the rationale for mandating the use of respirators by workers in the drying and packaging areas of the processing plant. Include the demonstration of the application of the hierarchy of control for radiological protection within the design of these areas of the processing plant. Justify that this approach complies with section 13 of the Uranium Mines and Mills Regulations.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*			
IR-187	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Appendix 10-C, Section 3.3, 6.0	**Context:** The exposure scenarios and assumptions for the workers in the drying area and the packaging/loading area of the processing plant include the wearing of PAPRs, which is assumed to provide a 1000-fold reduction in dust exposure. Further to reference IR-186, the use of a respirator as well as in worker dose predictions for the Project, appears to contravene section 13 of the Uranium Mines and Mills Regulations, and does not follow the hierarchy of controls for radiological protection of workers as described in REGDOC-2.7.1, Radiation Protection. **Rationale:** At this stage of the Project, the Proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*	Modify the exposure scenarios and assumptions (i.e., remove the use of a respirator) for the workers in the drying area and the packaging/loading area of the processing facility. Assess the resultant exposures against CNSC regulatory dose limits and the ALARA principle. Identify mitigation measures as per the hierarchy of control for radiological protection.		Accepted
IR-188	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.4	**Context:** The following is stated in section 10.2.4: “Dust inhalation is also a potentially substantial component of worker dose at the core shack. At this location, PAPR will not be required; however, N95 masks will be used, and dust levels will be monitored here…It may be possible to increase air exchange in the core shack, above the planned six exchanges per hour, should this be necessary. This would also reduce radon exposure in the core shack.” If it is possible to increase air exchanges in the core shack, it is not clear why this was not assessed and incorporated in the design of the core shack. **Rationale:** It appears that a control measure (e.g., air exchange protocols in the core shack) to reduce the exposure to workers has been identified. However, it is not certain if it has been formally documented to ensure that it is incorporated in the engineered design of the core shack.	Provide details on how the control measures to reduce the exposure to both workers through the air exchange protocols in the core shack have been formally documented to ensure that it is incorporated in the engineered design of the core shack.		Accepted
IR-189	-	CNSC	Woodland Caribou Ecological Model	Appendix 10-A (ERA)	**Context:** In the ERA (p. C.12, section 2.3.6 Woodland Caribou) it is stated: “For the ecological model a diet comprised of 50% browse, 20% lichen and 30% macrophytes is assumed for the woodland caribou.” In the EIS, section 9.3.3.3.1, it is stated: “Research has shown that up to 70% of the year-round diet of caribou may consist of ground and arboreal lichens.” **Rationale:** It is unclear whether the assumptions in the ecological model in the ERA regarding Woodland caribou diet are conservative, given only 20% lichen intake in the model. Lichen is known to accumulate COPC such as metals and dust from the atmosphere.	Please provide additional evidence to support that those Woodland Caribou who may have higher consumption rates of lichen as part of their diet, will remain protected. This can be provided through including a second model that assumes 70% lichen in the diet. See also related: IR-138.		Accepted

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IR-190	-	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-8 (p. 3.31) and Table 3-9 (p. 3.36) Appendix 6, Table 5 (p. 16)	NO2 criteria is not being consistently compared. **Context**: Provincial and federal air quality criteria/screening values for NO2 have been used inconsistently. Table 3-9 in Appendix 10-A (ERA) uses the 2015 Saskatchewan Ambient Air Quality Standards (SAAQS) value of 300 µg/m3 to compare the maximum concentrations of NO2 at receptor locations for the 1-hour average period, while Table 5 of Appendix 6 uses the 2025 Canadian Ambient Air Quality Standards (CAAQS) of 79µg/m3 for the same average period time. **Rationale**: By utilizing the SAAQS screening value for NO2, the maximum concentrations at receptor locations exceed the 1-hour threshold solely during the decommissioning stage (Table 3-9). However, if the 2025 CAAQS are applied, the screening values would be exceeded at receptor locations for all project phases. It is best practice to use the more protective air quality standards to evaluate potential human health risks associated with project activities.	1. Compare the predicted maximum concentrations to the most protective applicable air quality standards available. Alternatively, provide a rationale as to why the SAAQS for NO2 were used rather than the more protective 2025 CAAQS to determine potential exceedances and screen for the need for additional mitigation measures. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the standards from the 2025 CAAQS for NO2 in future mitigation and follow-up plans.	Following the supplementary submission by Denison on July 5th, 2024, one minor correction remains outstanding. There is an error in Section 3.2.1.3.1 Nitrogen Dioxide (updated text in the ERA in Appendix 10-A): The results reported in the paragraph under the Summary of Exceedances at Human/Ecological Locations sub-heading (0.3% of the year for approximately 28 hours per year) is associated with the operation phase and not the decommissioning phase. This editorial error must be corrected in the final EIS submission package. This IR is accepted for the purposes of the EA review. *The following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1) In their documents to support their licence application, the proponent will have to describe mitigation measures to minimize releases of NO2. If this information is not described, CNSC staff will request the proponent to provide the information. 2) 1-hour threshold for NO2: Denison should not rely on a single study (Hesterberg et al., 2009) to support a 1-hour threshold for NO2. Denison is expected to consult more than one study. Denison will be required in their environmental risk assessment submitted as part of licensing to demonstrate that there will be no unreasonable to the environment and to the health of people as a result of NO2. World Health Organization (WHO), 2021. WHO global air quality guidelines. Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. 273 p. Available online at: https://apps.who.int/iris/handle/10665/345329	Accepted
IR-190	IR-190-R1	HC	Change to an environmental component due to hazardous contaminants	Section 6.1.3.2.2 (p. 6-21) Table 6.1-8 (p. 6-22); and, Table 6.1-9 (p. 6-22) Section 6.1.8 (p.6-44) IR-190 Response from Denison	Limitations with the proposed use of passive NO_2 monitoring would not allow comparison of measurement results to the 2025 CAAQS for 1-hour NO_2. **Context:** In response to IR-190, there was agreement to using the 2025 CAAQS for NO_2 in future mitigation and follow-up plans, which Health Canada supports. However, the proposed air quality monitoring and follow-up plans (Chapter 6.1.8) anticipate continued use passive NO_2 samplers, which do not measure hourly (1-hour) concentrations. Section 6.1.3.2.2 indicates that the assessment makes use of passive samplers to measure NO_2 at two sampling locations. The results from those samplers are presented in tables 6.1-8 and 6.1-9, for a ~30-day sampling period (i.e., a total concentrations for NO_2 in ambient air over ~30 days). While passive samplers provide measurement data for comparison to the annual 2025 CAAQS for NO_2, measurement data for the 1-hour NO_2 standard commonly requires use of an active sampler.	1.Provide additional details on proposed air quality monitoring for NO_2 that will allow for comparisons to both the 1-hour and annual 2025 CAAQS and how that will be used to support mitigation and follow-up plans. Distinguish between comparisons with measured and modelled monitoring data, as well as use of passive and active samplers. 2. If multiple approaches will be used to monitor NO_2 (e.g., use of passive and/or active samplers, modifications due to differences between project phases, etc.), describe their intended contribution to the monitoring objectives and outcomes (e.g., determine the accuracy of predictions; assist with implementing or modifying mitigation measures).	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Please provide the following information: 1. Clarify the conditions under which a switch from passive to continuous monitoring would be warranted (e.g., if the 30-d measured NO_2 concentration, after conversion to a 1-h concentration, approaches or exceeds the 1-h CAAQS value).	Accepted

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					Rationale: Health Canada encourages the monitoring of air contaminants when exceedances or near-exceedances of air quality criteria, standards and/or guidance values are predicted or reported, to: • determine the accuracy of predictions; • help verify whether standards are being met; and, • assist with implementing or modifying mitigation measures.			
IR-191	-	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-9 (p. 3.36) and Table 3-10 (p. 3.46) Section 6.1.8 (p. 6-44)	Non-threshold substances are not included in screening and monitoring plans. **Context:** Fine particulate matter (PM2.5) is not being considered further in secondary air quality screening for short and long-term exposure at human and ecological receptors because it is not predicted to exceed the screening values of the Ontario Ambient Air Quality Criteria (OAAQC) or the Canadian Ambient Air Quality Standards (CAAQS) for both annual and 24-hour average periods (Tables 3-9 and 3-10). Furthermore, it is not compared against the baseline for analysis. Table 3-9 indicates that coarse PM (PM10) is predicted to exceed the 24-hour CAAQS during all phases of the Project. However, Appendix 10-A p. 3.46 states that, "There were no exceedances of PM2.5 which is generally considered to be a more reliable indicator of potential health effects. However, health effects would be infrequent and reversible, subsiding after exposure; therefore, PM10 was not considered for further quantitative assessment in the ERA." PM10 and PM2.5 were not included in the air quality monitoring plan (Section 6.1.8). **Rationale:** Particulate matter and NO2 are considered non- threshold pollutants, meaning that health effects can occur at any level of exposure, The CAAQS for PM2.5 PM.10, and NO2 recognize that there is no population health threshold for human health effects; therefore, any increase in exposure will result in an incremental population risk (Environment Canada and Health Canada, 2012; CCME, 2000). The CAAQS values should not be construed as limits to which polluting up to is allowed. In addition, based on the principles of keeping clean areas clean and continuous improvement, proposed mitigation measures should not be confined to meeting the standards but should also be targeted towards reducing population exposure to CACs associated with the proposed project. Furthermore, although health risks associated with PM2.5 are higher than those associated with PM10, both fractions are considered non- threshold pollutants and identified by IARC (2013) as causes of cancer. **Reference**: [1] International Agency for Research on Cancer (IARC). 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. Lyon: International Agency for Research on Cancer.	1. Include PM2.5 and PM10 in the secondary air quality screening for short and long- term exposure at human receptors. 2. Include PM10 and PM2.5 in the air quality monitoring plan as they are non- threshold substances. 3. Provide a discussion of the significance of predicted exceedances of health- based standards. 4. Identify additional mitigation measures to reduce concentrations of non- threshold air contaminants associated with the Project. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the 2025 CAAQS Management Levels to develop mitigation measures that reduce project contributions of non-threshold pollutants (e.g., PM2.5, NO2).		Accepted

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IR-192	-	CNSC	Human Health with respect to radiation exposure	Appendix 10-A (ERA), Section 3.1.1.2, including Tables 3-1 and 3-2	**Context:** Section 3.1.1.2 in Appendix 10-A (ERA) provides the method of how select constituents including cadmium, chromium, selenium and lead-210 were determined. This section does not mention how the other constituents as listed in Tables 3-1 and 3-2 are determined. The values for Th-230 and U-238 in Table 3-1 are unexpected. Typically, these values should be at equilibrium. **Rationale:** The technical basis for the selection of constituents of concern is required as part of the environmental and human health risk assessments.	1. Provide the methodology of how all listed constituents are determined. 2. Provide the rationale as to why Th-230 and U-238 are not in equilibrium.		Accepted
IR-193	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.1.2 Section 8.2.4.2.3	**Context:** Appendix 10-A (ERA) Table 3-1 'Screening of Effluent Quality against Surface Water Quality Guidelines for the Wheeler River ERA' does not include acute water quality thresholds for all COPCs compared against predicted effluent quality. For example, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the CCME water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. All water quality thresholds should be derived from receiving environment parameters, and there are discrepancies between the values used in Appendix 10-A (ERA) Table 3-1 and the values presented in Tables 8.2-8 and 8.2-10 in Section 8.2.4.2.3 of the draft EIS. No selected screening value for TSS has been calculated from baseline conditions. Un-ionized ammonia, which is a regulated Schedule 4 substance under the MDMER, has not been included. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment.	1. Provide acute and chronic water quality thresholds for all required COPCs with monitoring required under the MDMER. 2. Ensure all water quality thresholds are derived from receiving environment baseline parameters and that these thresholds are consistently applied throughout the draft EIS.	In Denison's July 2nd, 2024, supplementary submission, it is unclear what value Denison is applying as the screening criteria for un-ionized ammonia. The screening value provided in other tables (ex. Tables 8.2-2, 8.2-8, 8.2-10, 8.2-13, 8.2-14) all list the SEQG/CCME water quality guideline of 0.019 mg/L as the screening criteria. The recommendations for phosphorus and inclusion of the HC values in Table 3-1 are editorial and have no influence on the assessment results, therefore can be addressed in licensing. This IR is accepted for the purposes of the EA review, but Denison are expected to correct the remaining errors in Table 3-1 of the ERA in the final EIS submission package: 1. Un-ionized ammonia - The screening value of 0.0156 mg/L for un-ionized ammonia provided in Table 3-1 differs from what has been provided in other tables (ex. 0.019 mg/L in Tables 8.2-2 8.2-8, 8.2-10, 8.2-13, 8.2-14). Denison should confirm what screening criteria is used for un-ionized ammonia and which source it is referenced from. 2. Zinc – The screening value of 0.007 mg/L for zinc provided in Table 3-1 differs from what has been provided in other tables (ex. 0.013 mg/L in Tables 8.2-8, 8.2-10, 8.2-13, 8.2-14). Denison should confirm what screening criteria is used for zinc and which source it is referenced from. 3. Manganese – The CCME value of 0.26 mg/L for zinc provided in Table 3-1 differs from what has been provided in other tables (ex. 0.21 mg/L in Tables 8.2-8, 8.2-10, 8.2-13, 8.2-14). While a minor difference, the 0.21 mg/L value appears to be the correct value calculated using site-specific hardness and pH. Denison should verify which value is correct. 4. Molybdenum – the screening criteria used for the EcoRA is the SEQG of 31 mg/L. This is significantly higher the CCME guideline of 0.073 mg/L. The CCME guideline is outdated, however the SEQG guideline does not have a safety factor applied to it, and is significantly higher than other guidelines for Molybdenum. The BC WQG of 7.6 mg/L is both up-to-date and has a safety factor applied. Use of this guideline aligns with the principles of the Precautionary Approach and does not lead to any changes in risk conclusions in ERA (i.e. Molybdenum is still not screened into EcoRA assessment as the predicted effluent concentration is 2.5 mg/L and does not exceed screening criteria). It is recommended that in alignment with CSA N288.6 and the	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							Precautionary Approach that Denison update the screening criteria for molybdenum for the EcoRa to utilize the BC WQG of 7.6 mg/L.	
IR-194	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.1.1.2 and Section 3.1.2.3	**Context:** In the ERA, COPCs should be selected for further assessment based upon the following factors: 1. COPC concentrations in effluent that exceed selected water quality guidelines for the protection of aquatic biota, and 2. Baseline COPC concentrations in the LSA that exceed selected surface water and sediment quality guidelines for the protection of aquatic biota. However, only COPCs that had concentrations in effluent that exceeded guidelines were assessed further. Baseline concentrations of COPCs in sediment were not considered. In addition to this, not all COPCs that require monitoring under the MDMER had predicted effluent concentrations. From Section 8.2.3.3 Table 8.2-2 of the Aquatic Environment Report, it appears Aluminum in McGowan Lake and Whitefish Lake South and North, and pH in Whitefish Lake North exceed water quality guidelines. Predicted effluent concentrations or near-field surface water concentrations for Aluminum and pH are not provided. **Rationale:** It is not possible to determine if there is risk from effluent to the receiving environment and aquatic receptors based on the current information provided.	1. As noted in IR-114, provide the information on predicted effluent quality for COPCs with required monitoring under the MDMER. 2. Provide the information on predicted maximum receiving environment surface water concentrations for COPCs with required monitoring under the MDMER in IR-114. 3. Update the ERA to assess the risk of any additional MDMER COPC concentrations in effluent that exceed water quality guidelines. 4. Update the ERA to assess the risk of COPCs that had elevated baseline water and sediment quality concentrations in the receiving environment.	There are multiple elements of this IR outstanding. This IR is being conditionally accepted, but these issues will need to be resolved during the licensing process. It is expected that a fully revised ERA that both incorporates revisions following closure of EA related IRs and addresses outstanding issues that will be further assessed during the licensing review. *This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Item one of the IR has been met. However additional information is required for items two, three, and four. Similar to ECCC's rationale provided for IR-124, "the ERA primarily relies on modelling results to identify the maximum predicted levels of COPCs in the receiving environment." However, due to the upper bound discharge rates being the only model input evaluated, it is unclear whether the model considered scenarios where maximum COPCs might occur as the exclusion of other environmental variables may have resulted in inaccurate maximum environmental concentrations of the COPCs. The Proponent's responses regarding baseline exceedances of COPC thresholds in the receiving waterbodies requires additional information. The modeling of surface water and sediment COPC's described in Appendix 10-A, Figures 6-1 and 6-2 respectively, show results for the receiving waterbodies. However, it is unclear if these modeled values are based on the worst-case scenarios that account for environmental variables such as seasonal changes in hydrology and chemistry, or if they have only accounted for changes in operational effluent discharge scenarios to consider the upper bound discharge rates. Including the upper bounds of operational effluent discharges regardless of the variability of the receiving environmental conditions is important factor for determining whether the baseline data and risk assessment fully considered the effects of the operations of the proposed mine, including environmental concentrations of the COPCs, on water quality. The Proponent should provide baseline data and a risk assessment that includes consideration of maximum COPC scenarios for the receiving water bodies, including seasonal variability and sediment depositional areas. The Proponent should provide supplemental information to identify if the environmental model has considered environmental variability such as seasonal changes in water levels, flows and sedimentation. The Proponent should also demonstrate that the model has considered a reasonable expected worst case scenario, such as a 100 year return.	Accepted
IR-195	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.1	**Context:** Figure 3-2 depicts modelled concentrations of COPCs in the receiving environment surface water during all Project phases. Effluent discharge rates during Operations and Decommissioning are not anticipated to differ significantly. However, COPC concentrations seem to decrease rapidly after the end of the operations period despite effluent releases continuing into the decommissioning phase.	1. Provide further information on modelled maximum COPC concentrations for each individual Project phase with estimated timing for peak concentrations to appear in the receiving environment.	Following Denison's July 2nd, 2024 supplementary submission, this IR is Accepted.	Accepted

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					Rationale: There has been no information provided on predicted changes in effluent COPC concentrations and discharge rates during the decommissioning phase. It remains unclear how COPC concentrations would decrease so quickly following the end of operations.	2. Provide further information on predicted effluent quality during the Project decommissioning phase. 3. Update ERA figures and conclusions as needed.		
IR-196	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.3	**Context:** Table 3-6 provides predicted maximum sediment concentrations of COPCs compared to sediment quality guidelines. Several selected sediment screening values are not the most stringent sediment quality guidelines, with no justification provided. Additionally, copper and lead appear to be missing guidelines that are available from the Burnett-Seidel and Liber (2013) study. **Rationale:** The most stringent guidelines should be used for the sediment quality risk assessment in the ERA. Use of the most stringent guidelines will allow the most protective assessment to analyze risks to the receiving environment, aquatic and terrestrial biota.	1. Provide further information and justification for the selection of less stringent thresholds. 2. Update the ERA as needed.		Accepted
IR-197	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.2	**Context:** It remains unclear if atmospheric deposition from Project related emissions has been incorporated into modelling for the ERA and surface water and sediment quality assessments. **Rationale:** While expected Project air emissions are unlikely to have direct impacts on the aquatic receiving environment and aquatic biota, this Project effect pathway may have indirect effects through accumulation of COPCs over time or deposition of contaminants that are not expected in effluent, which should be evaluated with predicted emissions data incorporated into water quality modelling predictions.	Incorporate atmospheric deposition from Project-related emissions into water quality modelling and assess any Project related effects to aquatic receptors from this pathway.	In Denison's July 5th, 2024 supplementary submission, items one, two, and three were addressed. However, the sample calculation was not added to Section 2.2 of Appendix A, which would support the February 2024 statement that atmospheric deposition is negligible. This IR is accepted for the purposes of the EA review, but Denison is expected to add this sample calculation in the final EIS Submission package.	Accepted
IR-198	-	HC	Change to an environmental component due to radiological contaminants	Appendix 10-A (ERA) Appendix B, Tables B.7 and B.8 Ref. 19-2638 Appendix 10-A (ERA), Table 4-3 Ref. 19-2638 (p. 4.17)	**Context:** Section 10 Appendix 10-A (ERA) contains Table 4-3 (p. 4.17), which lists ingestion rates for traditional foods and includes the category "organs" for Mammals. Tables B.7 and Table B.8 in Section 10 Appendix 10-A (ERA) Ref. 19-2638 provide the predicted concentrations of radionuclides for ecological receptors during the Project phases and during future centuries, respectively. They list the concentrations of radionuclides in moose and in moose organs, which is presented as a single cumulative organ value. Other terrestrial and aquatic animals (such as the black bear and woodland caribou) that are a part of the traditional diet of nearby Indigenous communities have higher concentrations of radionuclides than moose, yet concentrations are not provided for organs of these species. **Rationale:** While Health Canada is not aware of transfer factors to individual organs, or to organs in animals that are not ruminants, it would be beneficial to have a better understanding of radionuclide concentrations in the organs of other animals that may be consumed by local Indigenous communities.	1. Provide more clarification on how the mammalian organ ingestion rates are calculated (which animals and relative contribution percentages). 2. Provide a rationale for why concentrations of radionuclides were not assessed in organs of animals (other than moose) that are consumed as country foods by Indigenous people harvesting in the area.	*This IR is accepted for the purpose of the EA review, but the following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence:* 1. It is stated that the transfer factor (TF) for moose organs was scaled based on the beef organs transfer factor. What was this scaling value and was it similarly done for the caribou organs? (TF's for beef, moose, and caribou are presented in Table 2). 2. In Table 2, Denison used the feed-to-animal TFs for "Beef-liver" provided in Table G.3 of N288.1-20 for each of their listed RNs. Nowhere in Table G.3 is a TF for Lead-210 provided. Denison is requested to provide the reference for this TF value for Lead-210. 3. CNSC staff are interested in the worked calculations for one of the estimated tissue concentrations presented in Table 3.	Accepted
IR-198	IR-198-R1	HC	Change to an environmental component due to	Annex 1 Response to Information Requests (Denison	*Environmental Risk Assessment for Wheeler River* (September 9, 2022) does not include an assessment of radionuclides based on their mass concentrations in country foods (the assessment is only based on radionuclide concentrations).	1. Provide a rationale on why radionuclide mass concentrations were not assessed for their impact to human health.	Version 2 of the Commitment Register (July 17, 2024) included a commitment (ID 8-44) related to monitoring mercury in country foods. The wording of this commitment is specific to methylmercury. It was identified that the draft text provided to Denison by	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			radiological contaminants	Mining) – August 18, 2023 IR-198 Response from Denison – COPC Concentrations in Organs (*Pages 74, and 354-357 of 419*) Appendix 10-A (ERA)	**Context:** As part of the response to IR-198 estimated Pb-210 concentrations in moose organ and caribou organ of 7.15 and 49.4 mg/kg (ww) are reported, respectively. However, Appendix 10-A: *Environmental Risk Assessment for Wheeler River* (September 9, 2022) does not include an assessment of lead among the non-radionuclide COPCs. Using the organ meat consumption figure from the Patuanak community (16.2 g/day), exposure to Pb-210 from caribou organ meat is estimated at over 11 ug/kg bw per day (based on the response to IR-198) which would be close to 10 times greater than the 95th percentile dietary lead exposure estimates for the general Canadian population consuming retail foods. **Rationale:** While the abundance of radionuclides may pose a health risk with respect to radioactivity, their presence as chemical contaminants may also have an impact on health. This is demonstrated by the case of Pb-210 described above. Due to their potential toxicological significance to human health, Health Canada recommends assessing arsenic, cadmium, lead and mercury as part of country food assessment, regardless of the method employed to determine COPCs.	2. Provide an assessment of Lead (Pb) as a chemical contaminant (non-radionuclide) COPC to better understand potential health risks and inform management, mitigation, monitoring and/or follow-up planning.	CNSC in the May version of the IR review that the request for commitment was missing the following details: "…monitoring lead and mercury in country foods, as well as including **arsenic, cadmium,** lead, and mercury in any further assessment conducted to determine their potential risk to human health from consumption of country foods". The wording for Commitment 8-44 should be revised to fully capture these other COPCs. As well, CNSC staff noted that in their responses to IR-212-R2 and IR-100-R3, Denison has proposed a conceptual trigger-response mechanism framework. It is unclear to CNSC staff if this is referring to the monitoring detailed under Commitment 8-44, or if it is separate. If the latter, this conceptual trigger-response framework should be submitted to CNSC for review before it is finalized for implementation, for review as part of the licensing process. This IR is accepted for the purposes of the EA review, and the following must be corrected in the final EIS submission package: 1. Revise the wording for Commitment 8-44 to fully capture the other COPCs that Denison intends to include in their country foods monitoring. 2. Clarify if Commitment 8-44 will also include Denison's proposed conceptual trigger-response framework. *The following elements of this commitment will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1. Establishing/confirming baseline concentrations of Hg in water, sediment, and fish tissues before construction; 2. Regular monitoring during construction, operation and post-closure; and, 3. Undertaking an HHRA should monitoring results exceed established/confirmed baseline levels, to inform decisions on adaptive management and mitigation measures	
IR-199	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Sections 3.2.1 and 3.3.1, Wheeler River Project IMPACT Model	**Context:** Model calibrated concentrations of selenium, uranium, and lead- 210 are under-predicted compared to measured baseline concentrations for water quality in the IMPACT modelling based on Figure 3-2. Calibrated concentrations of cobalt are under-predicted and there is poor agreement between model calibrated and measured concentrations of arsenic, lead-210, polonium-210, and radium-226 for sediment quality in Figure 3-3. **Rationale:** It is unclear how poor agreement between model calibrated and measured baseline concentrations of COPCs impacts the near-field and far-field modelling predictions of COPCs during all Project phases. It is also unclear why measured concentrations of COPCS could not be used directly as model inputs when there was poor agreement.	1. Provide justification as to why model calibrated concentration inputs of COPCs were preferable for use in predictive modelling of water and sediment quality over measured baseline concentrations. 2. Provide a rationale detailing how under- or over-predicted model calibrated COPC concentration inputs influence IMPACT model predictions and uncertainty for water and sediment quality. Provide specific details on how this may impact the risk analysis for parameters that have been highlighted as having poor agreement between calibrated and measured concentrations (i.e., arsenic, selenium, uranium, lead-210, polonium-210, and radium-226).	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent has not fully responded to either item for this IR. In the response for item one, the table provided in the response supports the statement added to Section 3.2.1 of Appendix A from Appendix 10-A, that there is little difference between the geometric and arithmetic means for parameter concentrations in water. It is important to clarify if this is also the case for sediment. Apart from arsenic and radionuclides, all modelled sediment concentrations are at or below geometric mean for sediment. Given that geometric means are typically lower than arithmetic means (and at most equal) this might indicate a consistent underestimation by the model for parameter concentrations in sediment. The proponent indicates that the geometric mean is more representative of the central value	Accepted

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							of the data distribution. ECCC does not support this view because a median or mode would be used to find a central value, depending on what was meant. The geometric mean may have been used because it is less influenced by outlier values, but these should be analyzed and removed if necessary before calculating the mean, as described in Section 6.3.3.6 of CSA N288.6:22. The only reference to geometric means in CSA N288.6:22 is for calculating means of literature values. Otherwise, when considering field data, an arithmetic mean is referred to. Typically, parameter concentration statistics are calculated individually for each site to highlight differences and help identify more sensitive sites. Differences between sites are expected because of differences in lake size, catchment area and other environmental factors. Pooling data from all sites smooths out high and low values, which compounds the smoothing done by using a geometric mean. This reduction in precision causes unreliability when evaluating model predictions, since the range of parameter concentrations at baseline is not well characterized. To address the lack of clarity, the Proponent should provide a table comparing arithmetic and geometric means for parameter concentrations in sediment, as they have done for water concentrations. If differences are significant, then modify graphs in Figure 3-3 of Appendix A from Appendix 10-A to compare arithmetic means of baseline data with modelled results. For parameters with sufficient data to calculate meaningful statistics, the Proponent should demonstrate that concentrations in Russell Lake are not significantly different than those in McGowan and Whitefish Lakes. If water quality is significantly different between lakes, then the Proponent should modify graphs in Figure 3-2 of Appendix A from Appendix 10-A to compare lake-specific baseline and modelled concentrations. In the response to item two, the statement "*it is not appropriate to calibrate the model to baseline conditions as we are most interested in impacted conditions*" is incorrect, because the point of calibration is to demonstrate the model correctly simulates site conditions to predict concentrations. Inaccurate model predictions during baseline indicate the site and its system of interactions is not well understood, and the model would not be able to produce accurate predictions during operations either. Section 7.3.6 of CSA N288.6:22 states "*The models may be calibrated to give the best possible agreement with available monitoring data so that risk assessors can have confidence in model-predicted concentrations for areas and media that are poorly represented in monitoring programs.*" The monitoring data is insufficient to characterize baseline concentrations for most of the parameters in water since there are often less than 50% of samples with concentrations above the detection limits. This limits the parameters that can be used to evaluate the model to concentrations in water of chloride, sulphate and arsenic, as well as concentrations in sediment. The Proponent should demonstrate the accuracy of the model by comparing model outputs with measured concentrations for those parameters where there is sufficient data to calculate meaningful averages, quantify model uncertainty, and discuss the influence of uncertainty on risk assessment conclusions. Denison is expected to:	

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							1. Calculate the model to baseline conditions, compare arithmetic and geometric means for parameter concentrations in sediment; 2. Calibrate model to baseline conditions; 3. Calculate parameter concentration statistics individually for each site; and 4. Modify graphs as needed if significant differences are observed.	
IR-200	-	HC	Indigenous Peoples' health / Socio- economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19)	Indigenous consultation should be included in the Country Foods analysis. **Context**: The Proponent obtained country food consumption data through engagement with a single local fisher/trapper and from a dietary survey administered by CanNorth to the English River First Nations (ERFN) in 2017. However, the potential health risks to consumers of traditional food were only assessed using the data obtained from the CanNorth dietary survey. Section 10 of the EIS *states the following:* *"*The diet assumptions for the fisher/trapper are conservative and are based on engagement with a local fisher/trapper. The diet of the fisher/trapper is representative of one person, who consumes a unique composition and quantity of traditional foods (e.g., ingestion rate of 175 kg/yr of caribou, equivalent to approximately 2 to 3 servings per day). Most people fishing, hunting, and trapping in the Local Study Area and Regional Study Area would consume traditional foods more consistent with the average traditional foods consumer diet which was developed from the ERFN country foods study. In comparison, the ERFN country foods study in Section 10 Appendix 10-A (ERA) Table 4- 4 indicates a caribou ingestion rate of 2.6 kg/yr (1 to 2 servings per month) and a total game ingestion rate of 21.3 kg/yr*"* *(p. 4.10).* **Rationale:** Health Canada is in general agreement that the dietary habits of the local fisher/trapper may be an outlier and not necessarily representative of most of the local population. However, a rationale has not been provided to demonstrate whether and how the 2017 ERFN dietary survey results are representative of consumption patterns of local Indigenous communities. Also, it is unclear whether or how the ERFN dietary survey results account for the consumption patterns of vulnerable or more sensitive subgroups (e.g., heavy consumers, children and women of child-bearing age)	1. Evaluate the suitability of using the 2017 EFRN survey results and consider surveying additional community members (such as local hunters/trappers) to obtain more representative country food consumption rates for use in the traditional foods risk assessment, and for communicating the results to the communities. 2. Additionally, consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately. **Suggestions for mitigation and follow-up measures:** Health Canada recommends providing the community with the opportunity to validate the ERFN 2017 survey results.		Accepted
IR-200	IR-200-R1	HC	Indigenous People'' health / Socio- economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19) IR-200 Response from Denison	The traditional foods risk assessment should be updated to include an "Intense Land User" scenario and consider all relevant sub-groups. **Context:** See 'Rationale for Status' in IR-200 **Rationale:** Health Canada notes that the response to IR-1 confirms that the use, diet and consumption rates used to assess the "Trapper" receptor are representative of "intensive land users" from the ERFN and possibly others. This change in the assumption is significant and should be integrated into the traditional foods risk assessment. Suggestions and follow-up measures have been provided to assist in responding to this information request, which benefits from the clarity provided in response to IR-1. Health Canada also notes that the response to IR-200 did not consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately.	1. Update assumptions used in the risk assessment to reflect the new information provided in response to IR-1. (e.g., the *ERFN Trapper's use of the area as **representative** of current and future land users*). 2. Update the risk assessment in the EIS and ERA for the "Trapper" receptor (i.e., Intensive Land Users) to account for the **representative** nature of their described diet (i.e., consumption rates and composition). 3. Update the rationale and decisions related to management, mitigation, monitoring and follow-up. Include a specific discussion for those COPCs that contribute to elevated health risks among "intensive land users" and those raised by Indigenous communities (i.e., selenium, mercury & cadmium).		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
						4. Revise receptor's descriptor/title from "Trapper" to "Intensive land users" throughout the EIS and ERA to be consistent with proposed revisions made in response to IR-1. Consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately. Alternatively, provide a fulsome rationale to justify their exclusion.		
IR-201	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 5.0	**Context:** For the ERA methodology the Proponent followed CSA N288.6-12 for the assessment of risk to aquatic biota from radionuclide and non-radionuclide COPCs. This is the 2012 version, and a more recent 2022 version was publicly released. **Rationale:** The Proponent should review the most up-to-date version of the standard to ensure no changes to the methodology of the COPC exposure assessment are required for the ERA.	Update the COPC exposure assessment methodology in the ERA using the most recent CSA N288.6-22 standard, as needed.		Accepted
IR-202	-	CNSC	QA/QC	Appendix 10-A (ERA), Section 6.0-Quality Assurance	**Context:** This section provides only Quality Assurance (QA) of the ERA, including planning and preparation of the ERA. **Rational:** The Quality Control (QC) aspects are not included. Both QA and QC aspects provide confidence that ERA results are defensible and fit for use in decision-making. The N288.6 (Clause 10.2) requires that "Appropriate QA/QC requirements shall exist for all aspects of the ERA and should be specified prior to conducting the ERA".	Please include appropriate QC aspects, as per a Clause 10.2 of the N288.6.		Accepted
IR-203	-	CNSC	Sediment Quality and Benthic Invertebrates	Appendix 10-A (ERA), Section 6.2 Future Centuries Sensitivity Analysis	**Context:** This section of the ERA states "If treated effluent was released at the maximum upper bound discharge rate, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines." It appears from Figure 6-2: "Comparison of maximum concentrations of COPCs in sediment at expected and upper bound discharge rate" that cadmium and vanadium would be over their sediment quality guidelines indicated if maximum upper bound discharge rates are used. **Rationale:** It is not clear which is correct; the statement that no exceedances of sediment quality guidelines when considering the maximum upper limit effluent release, or the figures indicating there could be exceedances for cadmium and vanadium. This discrepancy in the ERA should be explained and corrected.	Please provide clarity on if cadmium and vanadium are expected to be over the sediment quality guidelines for the maximum upper bound discharge rate scenario.		Accepted
IR-204	-	CNSC	Human health with respect to hazardous contaminants	Appendix 10-A (ERA), 7.1.1, Non-radiological Human Health Risk Assessment	**Context:** In the human health risk assessment of the non-radiological COPCs, it was determined that the Project incremental HQ was predicted to remain below 0.2 for all non-carcinogens and all pathways during all phases of the Project, except for selenium for the fisher/trapper at Russell Lake from the fish ingestion pathway. **Rationale:** Given that the fisher/trapper receptor will likely be exposed to higher concentrations of selenium from the consumption of fish at Russell Lake, there is an elevated risk of selenosis in exposed individuals. This potential for selenosis would be	Please provide a discussion of measures that could be applied to mitigate the risk of selenosis in exposed individuals who consume fish from Russell Lake and other waterbodies closer to the mining operation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following:		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					further exacerbated in individuals who consume fish taken from other lakes closer to the mining operation. There is, however, no discussion of mitigation of these risks to exposed individuals.	• Selenium abatement technologies may be considered to eliminate or reduce selenium in effluent entering the lake system. • If HQs continue to exceed 0.2, then it may be necessary to post fish consumption advisories, in consultation with the Medical Officer of Health for the jurisdiction where the Project is located.		
IR-205	-	CNSC	Geology and Groundwater	Section 7, appendix H	**Context:** In this appendix the analytical concentration of various groundwater samples taken from monitoring wells is reported. **Rationale:** There is one sample labeled as "Tracer Tank" with no definition available in the current report. It is difficult to judge whether the results presented are relevant to the EIS and how it may impact the findings therein.	Please clarify the definition of "tracer tank".		Accepted
IR-206	-	CNSC	Current use of lands and resources for traditional purposes	Section 11 Section 12 Section 15 Section 16	**Context:** Impacts to Lands and Resources Use have been identified by Indigenous Nations and communities. **Rationale:** Additional information is required to demonstrate whether Indigenous Nations and communities were engaged directly by Denison regarding the cumulative effects assessment, significance determination and residual effects, and thus the overall conclusions on potential adverse impacts of the Project on the potential or established Indigenous and/or treaty rights and effects of changes to the environment on Indigenous peoples, pursuant to paragraph 5(1)(c) of the CEAA 2012.	Please describe any outstanding or residual issues or concerns raised by Indigenous Nations and communities that Denison was unable to address. In addition, outline any plans to find solutions or continue discussions with the potentially impacted Indigenous Nations and communities.		Accepted
IR-207	-	CNSC	Current use of lands and resources for traditional purposes	Section 11, Perceived Risks to Lands and Resources	**Context:** The EIS states: "Resource users may also experience changes in their perception of the quality of resources for consumption such as the palatability of fish or wildlife or have apprehensions about the safety of resources for consumption. These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning. The ERFN refer to this indicator as a "psycho-social' effect, meaning that even if people know their fears are "*perceived fears, the fear … is real and has real impacts on ERFN members' perception of their overall health and well-being*" (ERFN and SVS 2022a)." (p. 11-11) Resource harvesters may experience Project-related disturbances and, depending on how these changes are perceived, it may cause some resource harvesters to avoid the Project Area. Reductions in harvests may occur based on fear or uncertainty about the ongoing quality of country foods. For example, "*People stopped picking berries in this area when Key Lake mine was established because of concerns about health impacts*" (ERFN and SVS 2022b). **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS will document specific suggestions raised by Indigenous groups for mitigating the effects of changes to the environment on Indigenous peoples (section 5(1)(c) of CEAA 2012). For the mitigation measures intended to address the effects of changes to the environment	How does Denison plan to work directly with Indigenous Nations and communities who currently use the potentially impacted areas, including the RSA, to mitigate and monitor the perceived risks and/changes to the RSA? Has Denison had discussions with the potential impacted Indigenous Nations and communities on how fear and avoidance behaviors and related impacts on traditional land use will be mitigated, especially within the RSA? Additional information is needed to determine if Denison has engaged directly with the Indigenous Nations and communities to develop potential mitigation measures to address fear and avoidance impacts, such as a community monitoring program, which could help to reduce the perceived risk to lands and resource use through education, collaboration, and long-term monitoring with Indigenous Nations, in order to build trust. **Suggestions for mitigation and follow-up measures:** It is recommended that Denison consider engaging with potentially impacted Indigenous Nations and communities on the collaborative development and implementation of a	Response is accepted, but also see AD-60 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					for Indigenous peoples, the Proponent must discuss the residual effects with the Indigenous groups prior to submitting the EIS." These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning.	monitoring program to help address concerns about potential impacts on lands and resources as a result of the Project. The program(s) could help to monitor changes over time related the potential perceived risk of contamination of the land from Project activities and subsequent effects on the quality of fish, vegetation, and wildlife resources, which in turn could affect the safety of traditional foods and human health, and impacts on culture practices, and overall community well-being that travel to region yearly.		
IR-208	-	CNSC	Indigenous physical and cultural heritage	Tables 11.1-3, 11.1-4 and 11.1-5 Section 11.1.3.2.6	**Context:** Black bear is listed as a species hunted by several Indigenous nations, including Pinehouse residents. CNSC participated in an in-person engagement with Pinehouse residents in October 2022 and bears eating waste was identified as a concern for hunting and consumption. **Rationale:** Perceived risk of eating animals that are contaminated by hazardous or radiological wastes could deter community members from harvesting animals that are normally part of their traditional diet. Fencing for waste was specified as a deterrent for human trespassers, not animals.	Please specify measures that Denison will take to ensure bears and other animals do not scavenge from waste facilities.		Accepted
IR-209	-	CNSC	Indigenous Peoples' health / Socio-economic conditions	Section 12.1.4.2.1 (p. 12-22) Section 12.1.5 Section 12.1.6.2	**Context:** KML indicates that working at a mine camp could inhibit community members from participating in cultural activities and sharing them with family and community members, resulting in a loss of cultural knowledge and language, thus impact knowledge transmission (p. 12-22). **Rationale:** Denison addresses this by briefly identifying culturally sensitive policies which would eliminate residual effects (p. 12-30)	Please provide detailed proposed mitigation measure for KML's concerns related to loss of cultural knowledge and language should they work for Denison.		Accepted
IR-210	-	CNSC	Current use of lands and resources for traditional purposes	Section 12.1.4.2.2, Potential Effect 2: Change in Traditional Diet, Perceived Suitability of Country Foods (p. 12-26)	**Context:** The EIS states: "Project activities could change the perceived suitability of country foods. An ecological risk assessment (ERA) was conducted to consider both radiological and toxicological risks to ecological receptors such as terrestrial and aquatic invertebrates, terrestrial and aquatic vegetation, fish, and terrestrial and aquatic mammals and birds. Results for the radiological assessment predicted no exceedances of the radiation dose benchmark for the ecological receptors. For non-radiological COPCs, no exceedances were predicted except for selenium in fish from Russell Lake, based on a conversative dietary assumption for one resource user. The traditional foods diet for the fisher/trapper is conservative as it assumes that their annual fish consumption (183 kg of fish per year) would be obtained from Russell Lake, meaning the exceedance of the benchmark for selenium from fish would only occur if fish were only sourced from this one lake. This one exceedance could potentially change the perceived safety of country foods for community members and make country foods a less desirable part of a traditional diet. <u>Experience from other uranium operations in northern Saskatchewan suggests that resource use will continue despite the potential selenium exceedance. An examination of members of the Hatchet Lake Denesųłiné First Nation who live in Wollaston Lake near the Rabbit Lake operation found that over years of being active on the landscape both</u>	Given concerns with psycho-social impacts and the influence of perception discussed by ERFN earlier on in the EIS, does Denison have information on the perspectives from Indigenous Nations and communities to validate this conclusion is applicable?		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					<u>with and without the presence of the uranium industry, members had developed their own culturally appropriate practice of risk assessment and management based on their relationship with the land. Hatchet Lake Denesųłiné First Nation members appear to be more concerned with the direct effects of uranium mining on the local environment and less concerned about uranium mining's effects on their health through consumption of plants and animals. This is likely due to their high level of confidence in recognizing affected plants and wildlife and avoiding them (Elias et al. 1997).</u> The usage patterns of the ERFN Trapper have similarly allowed for continued use and access to areas proximal to other uranium operations. The ERFN Trapper had a positive relationship with other uranium operations in the ILRU LSA. He also continued to trap (i.e., used his trapline in Fur Block N-18), fish, and opportunistically pick berries, and consumed those resources during operations (KPI Program 2021). Good relationships between Denison and a new trapper who eventually takes over the trapline from the ERFN Trapper would promote continued use." (p. 12-26) **Rationale**: The underlined reference suggests that negative perceptions may not prevent traditional resource users from continuing to consume, due to adaptation to potential risks in the environment.			
IR-211	-	CNSC	Accidents and Malfunctions	Section 14.6.1, Bounding Scenario 1, Vehicle Accident and Aquatic Release of Radioactivity	**Context:** Scenario 1 describes a spill of uranium concentrate into the lake. It's not clear how the ecological risk assessment was performed. It is stated that sediment concentrations in post-remediation conditions are expected to exceed the benthic invertebrate benchmark and that these results indicate that a spill of uranium concentrate could potentially affect benthic invertebrate populations following a spill, but the spatial extent would be limited. For water, it is stated that when evaluating the potential effect, a comparison was made between the results of the estimated short-term water quality 1,892 µg/L (1.892 mg/kg) and the guideline (33 µg/L). This indicates that there may be some aquatic species that could be affected, but the effects are expected to be transient as the water concertation quickly drops to a long-term level of 0.19 µg/L. However, when looking at dose to other receptors, the results of the ecological risk assessment indicated short-term ingestion of contaminated water resulting from an accident would not result in potential risks to grouse, vole, or deer, however rationale for how these receptors were chosen is not provided. **Rationale:** It's not clear from the EIS, why the receptors grouse, vole, and deer were chosen to evaluate ecological effects from a potential spill, and why they differ from receptors in the ERA. It is also not clear if the pathway from sediment ingestion/contact was considered for semi-aquatic receptors as they could be exposed to the increased concentrations post-spill. It is also not clear if SARA species exposure to sediment and water post-spill was considered.	Please clarify why grouse, vole, and deer were chosen as receptors for the ecological risk assessment performed for accidents and malfunctions scenario 1 and clarify if the sediment pathway to receptors post-spill was considered, as well as if SARA species were considered.		Accepted
IR-212	-	HC	Human health with respect to hazardous contaminants	Section 14 (p. 14-3) Appendix 16-C (p. 14 & 15)	The follow-up plan does not sufficiently describe how various parties will be engaged in the design, implementation, and review of monitoring programs. **Context:** Section 14 of the EIS states that "The overarching fear of contamination from	1. Provide details of how local, provincial and federal authorities, and Indigenous Nations and communities will be engaged in developing the follow-up and monitoring program, including the information-sharing program.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					the mine is woven in to almost every other concern noted by participants in the TK study. It is worth acknowledging this concern separately given the potential for mental health impacts related to people's experiences of fear and anxiety" (p. 14- 3). The commitment regarding monitoring and follow-up activities appears limited to *"shar[ing] information in a transparent manner with the General Public, and specifically those Communities of Interest and Nearby Land Users with whom Denison is regularly engaging about the Project. Such an information-sharing program would consider the involvement of the Regulators to make sure the information available addresses the issues identified as concerns"* (p. 14). **Rationale:** Country food safety is not regulated federally unless foods are sold commercially. Certain aspects of country food safety and availability may be covered by provincial regulators. It is unclear whether and how various levels of government and potentially affected communities would be involved in the development of the follow-up and monitoring program. It is also unclear what the information sharing program entails and how it would inform any adaptive management if monitoring results deviated from the prediction	2. Describe the steps that will be taken if there are any exceedances of established benchmarks or deviation from predictions. **Suggestions for mitigation and follow-up measures**: Health Canada recommends that the Proponent's plan for communicating follow-up results (environmental and country foods) aims at, among other things, responding to community concerns regarding country foods to minimize avoidance of this resource. This goes beyond a passive dissemination of information and developing a strategy based on dialogue and the direct involvement of communities in monitoring, surveillance, and risk communication activities.		
IR-213	-	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A	**Context:** The Proponent states that the assessment of accidents and malfunctions began with the initial identification of hazard scenarios. Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. The hazard identification was conducted to identify a comprehensive list of potential project-related accident and malfunction scenarios associated with the key project components and activities with further details provided in Appendix 14-A. The initial hazards were then screened qualitatively based on likelihood and consequence to determine overall risk level using a risk matrix approach. Bounding scenarios were then selected from this initial list of hazard scenarios. The results of numerical analyses (RESPEC, 2021) of detailed strip model suggest that the deformation imposed on the cemented steel casing from downward movement of the rock mass may exceed the assumed casing-strain yield limits and the failure limit locally after extracting the uranium ore. However, this potential hazard is not identified in the hazard identification. **Rationale:** Exceedance of steel casing yield limits and failure limit would either compromise the steel casing integrity or damage the steel casing and result in the leakage of injected solution, which could impact on mine operation and contaminate the surrounding groundwater.	Please include the hazard of steel casing yield or damage in the table of hazard identification evaluation and conduct an initial risk screening and further detailed assessment as required.		Accepted
IR-214	-	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A, section 3.2.3	**Context:** Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. Details for how each of these project components and activities are considered in the initial hazard scenario identification process are provided in the accidents and malfunctions TSD (see Appendix 14-A; Ecometrix 2022).	Please clarify or correct all inconsistent and/or inaccurate information in Tables 3-1 to 3-14 in Appendix A of Appendix 14-A.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					However, in Table 3-1 to Table 3-14 in Appendix A of Appendix 14-A, the following inconsistencies were identified: i. consequences for the hazards ID# 1.1, 1.5, 1.7, 14.2 include occupational major injuries; however, the severity (S) is denoted as number 2 that appears to be inconsistent with consequence rating number in Figure 14.5-2 ii. Hazard ID# 1.5 has a L=2, but it is described as a highly unlikely event, which is inconsistent with the term in Figure 14.5-2 iii. Hazards ID# 3.6 and 3.7 have a L=1, but they are described as low probability event that is inconsistent with the term in Figure 14.5-2 iv. Hazards ID# 8.2, 8.3, 9.1, 10.1 to 10.5, 11.1, 11.5 have a L=1, but they are described as unlikely events, which are inconsistent with the term in Figure 14.5-2. Rationale needs to be provided how stockpile erosion is considered to have a L=1 v. Hazard ID# 12.1 has a L=2 and S=3, but it's risk ranking is moderate, which is inconsistent with the term in Figure 14.5-2 vi. Hazard ID# 13.3 has a L=2. Based on the operation experience in the similar projects in the northern Saskatchewan, ponds lining failure and leakage is a very likely event. Rationale needs to be provided to support L=2 or change the number for L. **Rationale:** Inconsistent or inaccurate/incorrect information was included in Accidents and Malfunctions assessment.			
IR-215	-	CNSC	Human health with respect to hazardous contaminants	Section 14.6	**Context:** One of the potential risks of a uranium mine and mill is a spill of untreated effluent. **Rationale:** In the EIS, it doesn't appear that the scenario of a spill of untreated effluent to the environment has been considered. A failure of the piping containing the untreated effluent could result in an uncontrolled release to the environment and could affect the groundwater, soil quality, and terrestrial biota.	Please evaluate and provide the results for a bounding scenario of a spill of untreated effluent or provide justification for its exclusion.		Accepted
IR-216	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.1 Section 14.6.7 Appendix 14-A	**Context:** Radiological doses to human receptors, including workers (i.e., driver(s) of the vehicles), from the Bounding Scenarios 1 (Vehicle Accident Including Rollover, Collision, Run Off Road) and 7 (Vehicle Accident Including Rollover, Collision, Run Off Road) have not been assessed. **Rationale:** An estimate of the effective doses to human receptors, including workers, are required to determine whether the expected doses meet the dose limits set out in the Radiation Protection Regulations.	Provide estimates (including calculations) of the potential radiological doses to human receptors, including workers, resulting from Bounding Scenarios 1 and 7.		Accepted
IR-217	-	CNSC	Accidents and Malfunctions	Sections 14.6.1 and 14.6.2	**Context:** Highway 914 crosses the Wheeler River 10 km southwest of the access road junction. A vehicle accident, including a rollover, collision, or run off road, at or near the bridge could potentially result in a release of uranium concentrate and release of fuels and chemicals into the surface water at this location. Denison believes that a release of uranium concentrate and a release of fuels and chemicals at this location would bound	Please provide information on all water crossings along the transportation corridor and justification why bounding scenarios 1 and 2 would bound the effects of the accidental releases of uranium concentrate and fuels and chemicals at these crossings.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					the releases at any other water crossing along the transportation corridor. However, no information on what other water crossings along the transportation corridor exist and how bounding scenarios 1 and 2 would bound the risk of releasing uranium concentrate and fuels and chemicals at other crossings. **Rationale:** The release of uranium concentrate and fuels and chemicals at water crossings would contaminate the water body at the crossings and pose a risk to the environment and public health.			
IR-218	-	CNSC	Accidents and Malfunctions	Sections 14.6.1.1 and 14.6.1.4	**Context:** Table 14.6-1 indicates that the average flow of Wheeler River south of Russel Lake is 17,340 L/s or 17.34 m3/s. This rate is used for uranium dissolution rate calculation. However, in section 14.6.1.4, it states that the average annual flow is 24.3 m3/s. In Table 14.6-3, the last two rows appear to be added wrongly. It also states that sediment quality results are shown in Table 14.6-5 for post-remediation conditions. During minimum flow conditions, the affected volume is expected to be smaller, resulting in a higher sediment concentration. In comparison, higher flow conditions are expected to result in a greater footprint and lower concentrations. However, in Table 14.6-5, the average sediments concentration and porewater concentration appear to be incorrect and switched between average flow and maximum flow. **Rationale:** Inconsistent/inaccurate information provided in the EIS.	Please clarify and correct the inconsistent information on average flow rate of Wheeler River at the crossing and incorrect information in Table 14.6-3, and average sediment concentration and porewater concentration under average and maximum flow conditions in Table 14.6-5.		Accepted
IR-219	-	CNSC	Accidents and Malfunctions	Sections 14.6.1.1.1 and 14.6.1.4.1; Sections 5.1.1 and 8.1 of Appendix 14-A	**Context:** When assessing the release characterization of Bounding Scenario 1, the Proponent assumed that 95% of the released uranium concentrate can be recovered from the release location without sufficient justification, and that different water column depths, i.e., 10 cm and 5 cm, and average water depth of 1.2 m at the release location were used without explanation. **Rationale:** As the recovery rate of the uranium concentrate would have an impact on the assessment of its potential effects, it is necessary to understand how the recovery rate and water level were selected for assessing this bounding scenario.	Provide further rationale for assuming 95% recovery rate and for using different water column depths for uranium concentrate release characterization.		Accepted
IR-220	-	CNSC	Accidents and Malfunctions	Section 14.6.1.1.1 Appendix 14-A, Section 5.1.1	**Context:** The Proponent states that based on drum deformations performed in a previous analysis (McSweeney et al. 2004), if a drum experienced a crush force of 100,000 lbs., then the deformation of the drum would cause the lid to detach from the drum. Using this drum failure mechanism, and assuming the drums weigh 450 kg and are arranged four across in the truck, at a speed of 48 km/h, the front 25% of the drums would fail, at 60 km/h to 97 km/h 55% would fail, at 145 km/h 75% would fail, and at ≥193 km/h all would fail. Given that the speed of the truck is likely between 60 km/h to 97 km/h, it was concluded that less than 55% of the drums would fail upon a traffic accident scenario. It is assumed to be 40 drums per shipment, so some stacking or rows of drums should be expected in this scenario. The drums stacked above could be at greater risk of deformation in a traffic accident. It is not clear whether drums stacking was considered	Please provide information and/or rationale as to whether drum stacking would impact drum failure at different speeds and confirm whether 55% drum fail for such an accident is still valid.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					in the previous study cited by the Proponent and whether less than 55% fail is still an adequate percentage of drum failures in such traffic accident scenarios if drums stacking is needed. **Rationale:** Drum failure percentage will impact the release quantity of uranium in such an accident scenario and then impact the consequence assessment. Therefore, the drum failure should be adequately assessed and supported with sufficient information and justification.			
IR-221	-	CNSC	Accidents and Malfunctions	Section 14.6.1.3, Appendix 14-A, Section 7.1	**Context:** It is projected that there would be about 100 drums packaged per mill operating day. One trip per day for 330 days per year is assumed for the probability evaluation. This means 100 drums per trip, which is inconsistent with description in section 14.6.1.1.1 where assuming 40 drums in one shipment per day. **Rationale:** Shipments per day will impact the probability evaluation, and number of drums per trip will impact the release of uranium during an accident.	Please clarify the number of shipments per day and number of drums per shipment that are expected and re-calculate the probability as necessary.		Accepted
IR-222	-	CNSC	Accidents and Malfunctions	Section 14.6.2.4	**Context:** Bounding Scenario 2 consists of the aquatic release of fuel and hazardous chemicals due to traffic accidents. The EIS states that amongst the fuels considered for this scenario, the consequences of the release of gasoline and solvents are bounded by the consequences associated with the release of diesel. Both gasoline and solvents are lighter with higher vapour pressure; therefore, they have a shorter half-life in the aquatic environment and a lesser tendency for adsorption to sediments and suspended solids in the water column. There is no other justification provided to show that the release of diesel can bound other chemicals such as sulfuric acid and sodium hydroxide that are heavier than diesel. **Rationale:** The release of either sulfuric acid or sodium hydroxide during accident could change the water PH significantly at the releasing location, which would post a negative impact on the local environment.	Please provide further justification that the consequences of the release of sulfuric acid and sodium hydroxide can be bounded by the consequences associated with the release of diesel.		Accepted
IR-223	-	CNSC	Accidents and Malfunctions	Section 14.6.4.1 Appendix 7-A, Appendix K	**Context:** The EIS states that the 3D strip numerical model predicted that stresses and displacements did not show instability in the altered sandstone or basement rock at the location where a freeze wall would be placed around the Phoenix Deposit boundary (RESPEC 2021). The potential damage to the freeze wall due to mine-induced stresses and displacements under this scenario is excluded. **Rationale:** One outer section of the freeze wall (i.e., north-east freeze wall of the phase 4 mining area) and some internal cross walls are located in the desilicified zone. The RESPEC 2021 report (i.e., Appendix K of Appendix 7-A) appears not to have included the desilicified zone in the geomechnical modeling, nor is provided the stresses and the displacements/deformation of the area northeast of the phase 4 ore body where a significant extent of the desilicified zone exists.	Please provide information on the stresses and displacements/deformation of the area northeast of the phase 4 ore body from the geomechanical studies to demonstrate the resulted stresses and displacements will not impact on the freeze wall integrity after IRs for geomechanical studies for ore extraction are addressed. **Technical Discussion Required**: Yes		Accepted
IR-224	-	CNSC	Human Health with respect to	Section 14.6.5.4 Appendix 14-A	**Context:** For the Bounding Scenario 5 (Process System and Piping Failure), doses to receptors at distances of 100 and 500 metres (0.25 and 0.01 mSv respectively) are predicted. The assessment also indicated that the dose to the unprotected worker	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 5 (Process System and Piping Failure).		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			radiation exposure		staying inside the processing plant during the spill could exceed the 50 mSv dose limit specified by CNSC if workers did not leave the area quickly after the spill. The Proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.			
IR-225	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** With the Bounding Scenario 5 (Process System and Piping Failure), the Proponent states that Denison ensures that the process is designed to include control measures to reduce the exposure to both workers and members of the public as low as achievable. The measures would ensure that the processing plant is adequately ventilated, and that spills or leaks are detected by loss of system pressure, observation, or flow imbalance. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 5, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 5, have been formally documented and incorporated in the engineered design of the processing facility.		Accepted
IR-226	-	CNSC	Accidents and Malfunctions	Sections 14.6.6.1 and 14.6.6.4	**Context:** It is stated that in the case of the accident and for a release amount of 1 kg inside the processing plant, the dose to offsite receptors at 200 m from the Project site was calculated to be less than the CNSC public dose limit of 1 mSv. The analysis also indicated that the dose to a worker in a full-face-piece powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. **Rationale:** Section 14.6.6.1 indicates that 2 kg of uranium concentrate could be released in case of the accident. No rationale is provided why 1 kg rather than 2 kg uranium concentrate is used for dose calculation. If 2 kg is used as the source term, the dose to offsite receptors at 200m and workers in the area would be higher.	Please provide the rationale for using a source term of 1 kg rather than 2 kg of uranium concentrate for the dose calculation to offsite receptors and workers. If sufficient rationale cannot be provided, the doses to offsite receptors and workers should be recalculated using 2 kg uranium concentrate, and the results provide.		Accepted
IR-227	-	CNSC	Accidents and Malfunctions	Section 14.6.6.1.1	**Context:** Bounding Scenario 6 involves a fire and/or explosion within the processing plant, resulting in the release of a large amount uranium to the atmosphere. The airborne source term for this scenario is estimated with equation developed by the United States Department of Energy (USDOE), where the respirable faction is assumed to only include particles of 10 mm and smaller. **Rationale:** No rationale was provided to support the consideration of only 10 mm and smaller particles. As provided in Table 14.6-3, the particle size of uranium <15 mm is less than 20%. Majority of the uranium particle size is larger than 10 mm. The airborne source term is an important factor for the effects assessment and should be calculated with transparent and justified information/data.	Provide rationale for only considering 10 mm and smaller particles for the respirable fraction.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-228	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** For the Bounding Scenario 6 (Facility Fire and/or Explosion), the predicted dose is less than 1 mSv to a member of the public 200 metres away from the Project site. The analysis also indicated that the dose to a worker in a full-face powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. The Proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 6 (Facility Fire and/or Explosion).		Accepted
IR-229	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** With the Bounding Scenario 6 (Facility Fire and/or Explosion), the Proponent states that Denison would ensure that the design of the plant includes control measures to reduce the exposure to both workers and members of the public to levels that are as low as achievable. The measures would ensure that the processing plant is adequately ventilated. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 6, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 6, have been formally documented and incorporated in the engineered design of the processing facility.		Accepted
IR-230	-	CNSC	Accidents and Malfunctions	Section 14.6.7.4	**Context:** It is stated that a conservative penetration time of 15 min was applied in the assessment. Based on this assumption, the maximum depth of contamination could be 90 cm (for penetration rate of 0.1 cm/s). It is not clear why the penetration time of 15 minutes is considered conservative as the penetration time would depend on the time needed for the emergency response team to respond. It is also stated that the wide range of the calculated velocities is a result of variation of soil conditions and the slope of the surface. The distance that the groundwater can travel under these extreme (i.e., conservative) conditions ranges from 0.15 m to 100 m. It is not clear how the groundwater travel distance of 0.15m and 100m is calculated. **Rationale:** The penetration time will influence the penetration depth of the released materials, which in turn, considering the groundwater travel distance, will impact the potential areas and volumes of contaminated soils and shallow groundwater.	Please provide justification for applying 15 minutes of penetration time, and why it is considered conservative. In addition, please provide information on how the groundwater travel distance of 0.15 m and 100 m was obtained.		Accepted
IR-231	-	CNSC	Accidents and Malfunctions	Sections 14.6.6.4 and 14.6.6.5	**Context:** The EIS states that in the unlikely event of an unmitigated accidental release of uranium due to a dryer explosion, doses to the workers are expected to have a moderate effect, while doses to members of the public are expected to have a minor effect. Based on this evaluation, the severity of the consequences of this accident and	Please re-evaluate the consequence and the risk of Bounding Scenario 6 by considering the potential worker fatality resulted from an explosion.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					malfunction scenario is predicted to be moderate. In consideration of both probability and consequences, the overall risk related to Bounding Scenario 6 is predicted to be low. **Rationale:** When there is an explosion within the process plant, it is likely there will have worker fatality. The severity of the consequences of an explosion would be catastrophic and the risk of Bounding Scenario 6 would be higher.			
IR-232	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 14-A, Table 3-7, ID# 7.1 Appendix 14-A, Table 5-5	**Context:** The Proponent indicates in Appendix 14-A, Table 3-7 that a release of sulfuric acid is a low consequence event therefore would not require further assessment. However, according to a Safety Datasheet on high concentrated sulfuric acid (ICSC–0362 - SULFURIC ACID, concentrated (> 51% and < 100%) (ilo.org)), the substance is incompatible with certain materials and can give off toxic fumes. Furthermore, it reacts with various metals to produce hydrogen gas, which is explosive. The Proponent provides estimates of chemicals, including sulfuric acid, to be transported to site in Appendix 14-A, Table 5-5. The annual consumption of sulfuric acid is estimated at 15,417 m3, in 617 trucks per year, but the concentration is not stated. **Rationale**: Given the high reactivity and inherent corrosive nature of sulfuric acid combined with the volume and concentration that may be stored on site, ECCC requests that the Proponent provide a detailed risk assessment related to a terrestrial spill of sulfuric acid, specifically at the processing plant.	1. Provide the volume and the concentration of sulfuric acid that will be stored on site. 2. Provide a detailed risk assessment of the fate and behavior of sulfuric acid during a release into the environment.		Accepted
IR-233	-	HC	Human health with respect to hazardous contaminants	Appendix 14-A, Section 8.7 (p. 8.10)	An effects assessment for a transportation accident scenario involving radioactive materials was not included. **Context:** The Proponent provided an effects assessment relating to a diesel spill on the ground (Section 14 Appendix 14-A, Section 8.7). However, no information was provided regarding the potential human health effects of a uranium concentrate release at the two locations considered (Section 14 Appendix 14-A p. 8.10). **Rationale:** An accident involving radioactive material may have an impact on human receptors, based on the proximity of receptors and the proposed response protocols.	1. Assess and describe the potential health effects (chemical and radiological) of a transportation accident involving a uranium concentrate spill at the following locations: a) km 160 of Hwy 914, which is the location of a cultural camp that has been established by the ERFN. b) km 67 of Hwy 914, which is a gathering location for the Kineepik Métis Local associated with the Northern Village of Pinehouse. c) All other potential sites of importance for the public and Indigenous peoples.		Accepted
IR-234		CNSC	Effect of Environment	Section 15.2.2	**Context:** Effects of seismic events on the uranium extraction and post decommissioning are not assessed. **Rationale:** Seismic events could further exacerbate the stability of the voids induced by the uranium extraction, which will result in extra stresses and displacements/deformation in the overlying rock formations. These extra stresses and displacements/deformation could impact on the mine operation and post decommissioning groundwater flow and contaminant transport.	Please provide an assessment of seismic events on the mine-induced voids stability and the resulted effects on the mine operation and post decommissioning. **Technical Discussion Required**: Yes		Accepted
IR-235	-	ECCC CNSC	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** In this section it is stated that: "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit, following the RPC4.5 and RCP8.5 scenarios, respectively, as indicated by the Climate Atlas (PCC 2019)."	1. Provide the source of the data displayed in Max 1-Day Precipitation (mm) category in Tables 15.5.1 and 15.5-2.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					RCP4.5 represents predicted climate conditions of a moderate carbon future. RCP8.5 represents predicted climate conditions under a high carbon future. The values shown in Tables 15.5-1 and 15.5-2 show averages of 25.9 and 26.7 mm for RCP4.5 and 25.9/27.5 mm for RCP8.5. These values do not correspond to the source indicated by the Proponent. **Rationale:** Based on the Proponent's description we would expect to find the same values for "Max 1-Day Precipitation (mm)"in the Climate Atlas for RCP4.5 and RCP8.5 scenarios. ECCC was unable to duplicate the results. ECCC queried the Climate Atlas for Tomblin Lake and returned a result of "Region Geikie River." https://climateatlas.ca/find-local-data ECCC then queried the Climate Atlas for Max 1 Day Precipitation (mm). https://climateatlas.ca/data/grid/782/maxdaypr_2030_85/line https://climateatlas.ca/data/grid/782/maxdaypr_2030_45/line The results displayed an array of values ranging from 83.6 mm (2050) to 87.3mm (2092) for a Regional Concentration Pathway RCP8.5 scenario and values ranging from 48.9mm (2050) to 89.5 mm (2083) for an RCP4.5 scenario. These values do not match the averages shown in Tables 15.5-1 and 15.5-2.	2. Provide detailed calculations for the following average values: • 25.9 mm 26.7 mm in Table 15.5-1: Predicted Climate Conditions of a RCP4.5 Moderate Carbon Future • 25.9 mm 27.5 mm in Table 15.5-2: Predicted Climate Conditions of a RCP8.5 High Carbon Future 3. Explain how the data shown in Tables 15.5.1 and 15.5.2 were used in the precipitation risk assessment. 4. Denote the differences between "mean", "value/max value", and "fluctuation", in the calculation of extreme event risk. 5. Compare model derived data against: 1. Natural variability of the observed data. 2. Variability in the statistics generated via observation based time series. **Technical Discussion Required**: Yes		
IR 236	-	ECCC ERAD	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** It is stated that, "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit…" As per the Proponent's description, Tomblin Lake was chosen as representative location for Wheeler when Climate Atlas was used as data source. **Rationale:** In those two tables, for the "Max 1-Day Precipitation (mm)" the historical average is given as 24.1mm. Local time series analysis for the climatic region in which Wheeler Project is located provide averages (for 1-day max precipitation) of approximately 30+ mm. It is the Proponent's responsibility to keep the required database current and up to date, because the length of the time series influences all derived statistics. Statistical analysis of extreme events is highly dependent of the mean with extreme values reaching values 3 to 4 times higher than the mean.	1. Provide a clear explanation on how the historical mean for 1-Day Max Precipitation was calculated. 2. Compare the values obtained via various means (ex: copied from the internet, modeled via some online algorithm, derived from specialty literature), against time series analysis based on observations. **Technical Discussion Required**: Yes		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status

IR-237		CNSC	EA follow-up and monitoring program	Appendix 16-C throughout, including Table 1.5-1: Wheeler River Monitoring and Follow-up Program Summary (p. 8-15)	**Context:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS should provide discussion on the follow-up program's requirements, and include:
					• objectives and structure of the follow-up program and the VCs targeted by the program
					• tabular summary and explanatory text of the main components of the program including:
					  ○ a description of each monitoring activity under that component
					  ○ which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures)
					  ○ the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects)
					  ○ the specific monitoring objective for that activity
					  ○ planned schedule
					• roles and responsibilities to be played by the Proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the program results
					• possible involvement of independent researchers
					• program funding sources
					• information management and reporting (reporting frequency, methods and format)
					• possible opportunities for the Proponent to include the participation of the public and Indigenous groups, during the development and implementation of the program
					
					The follow-up program plan should be sufficiently described in the EIS to allow independent judgment as to the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures." (Section 11)
					
					Rationale: The Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information, and while some of the aspects detailed in the Generic EIS Guidelines are included, the aspects underlined are missing or appear incomplete.
					
					Further, all information from throughout the EIS should be incorporated into this Summary. For example, the EIS notes that: "Groundwater samples will be collected at least monthly and semi-annually in the wells within the freeze wall and on the freeze wall perimeter, respectively" (p. 7-109) and that "At least five to seven multi-well clusters are proposed across the mined area (Figure 7.8-2). Sampling will include KI parameters or the full suite of COPC at different times in the remediation process" (p. 7-111).
					
					These details (only examples) are not included in Appendix 16-C.
						It is recognized that this document will evolve over the planning process and be finalized prior to the EA Decision; however, as plans are developed and revised, CNSC staff expect that updates will be made to this document and provided with any future versions of the EIS.
						
						Appendix 16-C Summary of Monitoring and Follow-up Programs must include sufficient details to allow CNSC staff to determine the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures. This includes concrete monitoring plans (sampling locations, frequency, etc.).
						
						Additionally, please incorporate any relevant information included in the EIS into this Summary.
								Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-238	-	CNSC	Current use of lands and resources for traditional purposes	Various sections of the EIS, including: Section 8 Section 9 Section 10 Section 11 Section 12 Section 15 Section 16 Appendix 16-C (p. 3)	**Context:** The EIS indicates that "further detailed [follow-up and monitoring programs] will be developed as Project designs are finalized that may influence the nature, frequency, and locations of monitoring. In addition, input from regulatory agencies, the public and Indigenous Peoples will be considered." (Appendix 16-C, p.3) It is not clear in several section(s) of the EIS and the Indigenous Engagement Report, whether Denison has provided the interested Indigenous Nations and communities with the opportunity to participate in the development, implementation, and review of monitoring and mitigation measures, as per the guidance of REGDOC-3.2.2 and CNSC's Generic EIS Guidelines. **Rational:** As outlined in Section 11 of CNSC's Generic Guidelines for the Preparation of an EIS, please include roles and responsibilities to be played by the Proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the monitoring program results as well as possible opportunities for the Proponent to include the participation of the public and Indigenous Nations and communities, during the development and implementation of the program.	Please provide additional information to demonstrate whether Indigenous Nations and communities were engaged directly on the potential mitigation and monitoring measures to address the concerns raised regarding potential impacts of the Project on the potential or established Indigenous and/or treaty rights. Provide a rationale if this engagement has not been completed. As the Project develops, please provide concrete actions Denison will take in the follow-up and monitoring programs to engage Indigenous Peoples to alleviate concerns and incorporate their interests, and when this engagement is planned to take place.		Accepted

[i] **Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation**
Health Canada, Water and Air Quality Bureau, October 2022

Health Canada (2022) provides a quantitative estimate of the risk of lung cancer associated with exposure to PM2.5 in Canada. The pooled hazard ratio (HR) for lung cancer mortality in the Canadian population is 1.127 (95% CI: 1.085, 1.170) per 10 µg/m3 increase in long-term exposure to ambient PM2.5. The slope coefficient (β) for this relationship is 0.01196, as derived below:

$$e^{(\beta\times 10\ \mu g/m^3)} = pooled\ hazard\ ratio\ per\ 10\ \mu g/m^3$$
$$e^{(\beta\times 10\ \mu g/m^3)} = 1.127$$
$$\beta \times 10\ \mu g/m^3 = \ln 1.127$$
$$\beta = (\ln 1.127)/(10\ \mu g/m^3)$$
$$\beta = 0.01196$$

The additional lung cancer mortality (over the baseline rate) from PM2.5 derived from a given source can be determined using the equation below, based on the attributable fraction or (HR-1)/HR (Greco et al. 2020):

$$ALCM = \left[\left(e^{\beta\cdot Exposure} - 1\right)\Big/ e^{\beta\cdot Exposure}\right]\cdot Baseline\ rate \cdot Years$$

ALCM = additional lung cancer mortality cases per 100,000 population

β = 0.01196 (slope coefficient from meta-analysis in Health Canada (2022))

Exposure = estimated PM2.5 exposure concentration from the relevant source(s) (µg/m3) (does not include baseline PM2.5 exposure)
Baseline rate = 45.5 per 100,000 (current Canadian Age Standardized Mortality Rate (ASMR) for lung cancer from Canadian Cancer Statistics Advisory Committee 2021); the Canadian baseline rate is appropriate as the slope coefficient was derived from Canada-wide studies and an updated ASMR of Canada (if available) would be appropriate for use in the calculation

Years = years of project or project phase

Sample calculation:

Project estimates an exposure from relevant source(s) of 0.067 µg/m3 over 50 years of operation

$$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) \big/ e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$$

$$ALCM = \left[\left(e^{0.01196 \cdot 0.067} - 1\right) \big/ e^{0.01196 \cdot 0.067} \right] \cdot 45.5 \cdot 50$$

ALCM = 1.8 additional lung cancer mortality cases per 100,000

References:

[1] Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian Cancer Statistics 2021. Toronto, ON: Canadian Cancer Society; 2021. Available at: cancer.ca/Canadian-Cancer-Statistics-2021-EN
[2] Greco, S.L., MacIntyre, E., Young, S. et al. An approach to estimating the environmental burden of cancer from known and probable carcinogens: application to Ontario, Canada. BMC Public Health 20, 1017 (2020). https://doi.org/10.1186/s12889-020-08771-w
[3] Health Canada. Lung cancer and ambient PM2.5 in Canada: a systematic review and meta-analysis.
[4] Health Canada, 2022. Available online at: https://publications.gc.ca/site/eng/9.907038/publication.html

Annex 7

Federal Indigenous Review Team (FIRT) – Advice to the Proponent for the Wheeler River Environmental Impact Statement (EIS) October 2024

**The March 2023 Advice to the Proponent table and November 2023 Advice to the Proponent table with Denison's responses are available below

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent
AD-72	CNSC	Section 8.1.3.4.2 Probable Maximum Precipitation (PMP) Events Appendix 8C	In Section (List of Appendices, p. iv) of "S8_App 8-C Hydrological Effects Assessment Report Wheeler River" states ''Appendix III- Response to IR-103''. This is incorrect and refers to IR-103.	This reference should be edited to "Appendix III- Response to IR-102."
AD-73	Environment and Climate Change Canada (ECCC)	Section 2.2.3 Project Description Proponent response to IR-12-R1B	The Proponent provided maps of the proposed water management structures for the road to the airstrip and the airstrip in Attachment IR-12. However, they should commit to including them in the Final EIS. Inclusion of these maps will allow for improved understanding of site water management and transportation of non-contact water.	ECCC recommends that the Proponent Include maps of the proposed water management structures for the road to the airstrip and the air strip, provided in Attachment IR-12, in the Final EIS.
AD-74	ECCC	Section 8 (Aquatic Environment); Appendix 10-A (ERA)	The predicted effluent concentration of 42 ug/L for the proposed Project represents a very high concentration of selenium. For comparison, the Canadian Council of Ministers of the Environment (CCME) guideline is 1 ug/L (January, 2022: Proposed Approach for Coal Mining Effluent Regulations – Discussion Document (canada.ca))	Given the high selenium concentrations predicted in the discharge, ECCC recommends that the Proponent: • Identifies effective mitigation measures (including source control) to avoid effects in the receiving environment, and • Analyzes the extent to which selenium concentrations in effluent can be reduced.
AD-75	ECCC	Section 2.2.3 Project Description Proponent response to IR-12	While the Proponent did provide in Attachment IR-12 the requested proposed water management structures, for the road to airstrip and the airstrip, the information surrounding the proposed water management structures is found within multiple documents which makes it difficult for readers to understand the resulting impacts to water quality.	The proposed water management structures for the road to airstrip and the airstrip should be included in the Final EIS to allow for the effects of these structures to be more readily understandable. Additionally, the Proponent should respond to questions within a single document to reduce the complexity involved in understanding the environmental effects of the Project.
AD-76	ECCC	Section 8.4.4.2.3, Aquatic Environment IR-124-R1 Response from Denison	CSA N288.6-22 is the latest standard for the nuclear industry for the assessment of risk associated with releases from the nuclear industry to the environment. The statistical and environmental considerations required in the establishment of baseline data as well as the use of mathematical models are set our in the standard to ensure that the risk assessments are defensible.	The Proponent should apply CSA N288.6-22 to risk assessment for sediment where appropriate.
AD-77	ECCC	Section 9.3.3.3, Baseline Studies Section 9.3.5 Mitigation Measures IR 142, 159, and 167 Responses from Denison IR-142-159-167-R1 IR-170	It is unclear how conducting wildlife sweeps seven days in advance will adequately identify and mitigate for all species, especially species at risk. Similarly, uncertainty remains regarding how adaptive management mechanisms will be triggered. Note that active terrestrial nest searches for birds, including avian species at risk, are generally not recommended by ECCC or the province of Saskatchewan (Publications Centre (saskatchewan.ca)) because they are likely to cause disruption to breeding activities and are largely ineffective for passerines. However, if avian nest searches in simple habitats (as outlined in the Guidelines to avoid harm to migratory birds) are undertaken, then information should be provided on methods and timing for review. Conducting a nest search seven days in advance of works may be too far in advance	The Proponent should develop species specific mitigation measures, and provide these for review. Species specific mitigations should take into account the ecology of individual species at risk, including habitat requirements, nesting/denning or other important landscape features and timing of life stages as they relate to project construction and operation. The Proponent should conduct literature reviews to find proven mitigations for all species at risk within the project area. ECCC is available to discuss these measures with the Proponent.

[1] *Unless otherwise stated, the section noted refers to the draft EIS*

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent
			to detect all possible nests. Nest searches should be conducted as close to the clearing or construction dates as possible. Developing species specific mitigation measures based on habitat potential mapping, prior to nest searches, can reduce construction delays, as advice on these measures would be available for implementation. For certain projects or locations, additional more specialized surveys may be warranted (e.g., radar surveys, or foot-based counts of colonially nesting birds).	
AD-78	ECCC	Section 9.3.6.4 IR-149-R1B	In their IR response, the Proponent states "English River First Nation and SVS (2022) compiled an IK study documenting current and past land use, knowledge of the land, and participants' perspectives on potential Project effects, as well as cumulative effects from past mining and other developments. The report identified a wildlife corridor used by several species, including woodland caribou. The corridor runs between Cree Lake (approximately 40km southwest of the Terrestrial RSA and Russell Lake (in the southern portion of the Terrestrial RSA (Feature 1001-09; ERFN and SVS 2022). The report identified a caribou calving area: Feature 1009-07 covering large portions of the Terrestrial RSA with the exception of the most western, northern, and eastern extents. This area is also described as offering good caribou habitat year-round (ERFN and SVS 2022)." The Proponent has also provided mapping showing that there are calving areas within the RSA. Calving is an important life history function that occurs within specific biophysical attributes. It is important to mitigate these effects.	Since both the mapping provided as part of the EIS and the English River First Nation study indicates that there is calving areas within the RSA, incorporating mitigation measures related to timing of sensory disturbances during calving season into the Caribou Management Framework would enhance the caribou management plan.
AD-79	ECCC	Section 9.4.1.2, Key Indicators and Measurable Parameters IR-158	The Proponent identified key indicator species for migratory songbirds, waterbirds and upland game birds, but did not provide any justification on why these species were chosen. It is important to understand why a certain species was chosen as an indicator in order to assess whether the that species possesses similar life history characteristics.	During pre-construction, construction and operational monitoring, the Proponent should consider any trends and changes to the avian community, including the key indicator species which are representative of other species that may be more difficult to monitor for implementation of adaptive management. (see IR-159 for additional input). Appendix 9-D provides an assessment of three additional key indicator species (Barn Swallow, Bank Swallows, Horned Greme). All eight key indicators for avian species at risk should be accounted for.
AD-80	ECCC	9.4.3.2.3 Baseline Studies – Migratory Songbirds Appendix 9-B, Section 2.10.2, Results IR-159	Although the Proponent notes that the supplemental data did not result in a different conclusion in the EIS and would not require updates to the mitigation measures, it was acknowledged that the data did provide further context for the RSA. Interpreting the original baseline data as well as the supplemental data in the context of the Project (i.e. what species were at what densities in which areas/ecosites) provides a more robust baseline with which to compare construction and operational monitoring data. This is particularly important in the context of species' natural variability.	Even if the supplemental data did not change the conclusions in the EIS, the data is essential for comparison reasons. Data collected during construction and operational monitoring should be compared with baseline data to test predications on impacts from the project, and whether mitigation measures are effective.
AD-81	ECCC	Section 9.3.3.3, Baseline Studies IR-143 and 144 Responses from the Proponent	In their IR response, the Proponent notes that "the majority of these data points illustrated in Figure 2-2 and Figure 2-3 in revised draft EIS Appendix 9-F are located beyond the LSA and to the north and east of the Project Area." ECCC notes that the baseline studies done for the Project were limited in scope and scale, and the map showing telemetry data from the province of Saskatchewan shows caribou use throughout the LSA and RSA.	ECCC advises that the Caribou Management Framework should consider the entire LSA as being used by caribou for all their life functions and that mitigation measures, including offsetting, be developed with the understanding that this Project poses a medium level risk to caribou using the area.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [1]	Context and Rationale	Advice to the Proponent
			ECCC notes that trail camera, pellet, incidental and telemetry data only provide a small snapshot of actual habitat use.	
AD-82	ECCC	Section 9.3.3.3, Baseline Studies IR-149-R1A IR-152.	ECCC notes that the Proponent indicates a commitment to continuing to work with the province regarding caribou offsetting through the finalization of the Caribou Management Framework.	ECCC notes that at this time there are not enough details in the Caribou Management Framework for ECCC to provide advice on the appropriateness of the offsetting measures.
AD-83	ECCC	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149	ECCC notes that Figure 2.4 of Appendix 9-F, shows that there is suitable calving habitat in close proximity to the airstrip, including within the LSA just west of the airstrip and along the Wheeler River at the southeast end of the LSA. ECCC notes that information is not yet available on the timing and frequency of air traffic. The Proponent has provided some potential measures likely to be incorporated into operations of the airstrip. The Proponent states that they will use the most direct path, however, important areas for caribou (e.g. calving grounds) may be located along the most direct route. Figure 2.4 of Appendix 9-F, shows that there is suitable calving habitat in close proximity to the airstrip, including within the LSA just west of the airstrip and along the Wheeler River at the southeast end of the LSA.	ECCC advises that mitigation and monitoring should be developed to address sensory impacts as a result of the airstrip. The Caribou Management Framework should incorporate consideration of the proximity of air traffic to important landscape features for caribou, as well as timing of flights during important life stages (e.g. calving).
AD-84	ECCC	Section 9.3.6.4.1 Section 9.3.7.3.1	The Proponent notes that the size of the SK1 Boreal Shield range is estimated at 18,034,870 ha (ECCC 2020), resulting in an estimated additional Project-related disturbance of 0.001% at the scale of the SK1 Boreal Shield Woodland Caribou Management Unit. The Proponent concludes that the contribution of the Project to cumulative effects on woodland caribou within the SK1 conservation unit are negligible.	Although the Proponent has provided information to show that the Project has negligible impacts at range scale, this Project poses a medium risk to caribou at the local and regional scale due to the proximity of important features for caribou within the LSA and RSA. Mitigations for sensory disturbance during critical life stages such as calving should be developed and included within the Caribou Management Framework. Measures to monitor the effectiveness of implementation are also needed.
AD-85	ECCC	Section 9.3.5.2 Appendix 9-E Wheeler River Project Caribou Management Framework	Much of the information presented in the Wheeler River Project Caribou Management Framework is qualitative in nature and does not present specific details regarding a quantitative assessment of impacts following measures to avoid, minimize, restore on-site and determine the offset. This is required in order to understand if offsetting is sufficient to address impacts to caribou. The updated Wheeler River Project Caribou Management Framework indicates that the Proponent will use the SK ENV caribou offset calculator. Without information on the amount of offsetting that will be implemented, ECCC cannot advise on whether the amount is appropriate in the context of the species Recovery Strategy. Although the Proponent has provided an updated draft Caribou Management Framework, information regarding offsetting remains outstanding. The Proponent notes that SK ENV is developing a boreal caribou habitat offset calculator and that the Caribou Management Framework will be finalized using that tool as part of the provincial approvals.	Information is still lacking on the amount of habitat offset required to balance against Project effects. Therefore, the Caribou Management Framework should be updated with outstanding information. The Proponent should consider offsetting effects associated with this Project. However, ECCC is unable to specify an offsetting amount at this time as there was insufficient information provided by the Proponent. ECCC acknowledges that the Proponent has committed to working on their offset plan with the province of Saskatchewan. However, offsetting measures, outputs, and priority locations should be confirmed in draft plans and submitted for review. Without additional information on the Proponent's mitigation measures, including offsetting measures, ECCC cannot provide advice on whether project effects will be mitigated.

Federal Indigenous Review Team (FIRT) – Advice to the Proponent for the Wheeler River Environmental Impact Statement (EIS) November 2023

** The new newest Advice to Proponent table is available above

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [2]	Context and Rationale	Advice to the Proponent	Denison's Response
AD-50	ECCC	Section 2.2.1.4.2, Wellfield Operation Section 2.2.1.4.2.2, Secondary Containment of Mining Solution – Pumping	Providing a report or memo by the Proponent's consultant Newmans Geotechnique Inc. as a public record will more effectively explain the "information on the freeze wall integrity and basis for the design, which relies on site field data and lived experience from several exiting [sic] Saskatchewan mining operations", than a summary (attachment IR-10) of the material presented by Greg Newman during the meeting with the FIRT on April 19, 2023.	The response from the Proponent in IR-10 is accepted based on the meeting between ECCC, Denison and the CNSC, as well as the Proponent's consultant and the presentation by Greg Newman (Newmans Geotechnique Inc.) as well as the summary of the meeting noted in attachment IR-10. However, the Proponent should provide a public record of the consultant's memo or a report that explains the details of the freeze wall containment and monitoring that were provided during the April 19, 2023 meeting instead of the summary provided by the Proponent in attachment IR-10.	The April 19, 2023, presentation from Newmans Geotechnique Inc. to the CNSC is provided here as Attachment AD-50.
AD-51	CNSC	Section 8.3.3 and 8.5, Aquatic Environment and Fish health	Denison has committed to additional baseline data gather as part of their response to IR-107.	Also related to IR-120 and IR-125, CNSC staff recommend Russell Lake be included in this baseline collection to increase the robustness of the established baseline in the final EIS.	Acknowledged. Denison will consider this request as it develops the plans for additional baseline collections, as well as the monitoring program design documentation for aquatic environment monitoring that is planned to be part of the licensing submission. It is noted that no aquatic environment effects are predicted to accrue in Russell Lake in relation to any phase of the Project and the concentrations of all water quality constituents are predicted to remain below aquatic protection values.
AD-52	CNSC	Section 8.3.3.1, Methodology and Metrics	Denison has indicated that exposure to other pre-existing stressors could result in abnormal conditions or deformation(s) in existing population, but the extent of existing conditions should be evaluated to ascertain whether the rate is increasing as a result of proposed activities once in operation.	Related to IR-121, CNSC staff recommend that Denison add text to EIS to reflect that no gross abnormalities in fish were observed during field work.	The text of revised Draft EIS Section 8.3.3.2 has been revised as recommended to indicate that that no gross abnormalities in fish were observed during baseline field work.
AD-53	CNSC	Section 8.3.8, Monitoring and Follow-up	Section 8.3.8 of the EIS states: "Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development." Tracking changes in fish communities / populations in reference lakes over time should be conducted, as reference lakes can be used to differentiate natural temporal variation with potential project impacts. Denison has committed to inclusion of reference lakes in study designs used to assess changes in fish communities / populations over time.	Related to IR-122, CNSC staff recommend that Denison strengthen discussion of reference lakes, and their use, in EIS.	Additional text (see below) has added to the fifth paragraph of Section 8.3.8 of the revised Draft EIS regarding aquatic environment monitoring program sampling areas and "reference lakes" more specifically, as follows. "Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development conditions, as well as through contemporaneous comparison of "exposure area" versus "reference area" data. In this context an "exposure area" is an area downstream of potential mine influence and a "reference area" is an area outside of potential mine influence. Where possible, the reference area would be located in the same drainage, upstream of mine influence where conditions closely mimic those downstream as is possible and where there is no, or reduced likelihood that exposure and reference fish populations can co-mingle."

[2] *Unless otherwise stated, the section noted refers to the draft EIS*

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [2]	Context and Rationale	Advice to the Proponent	Denison's Response
AD-54	CNSC	Section 9 Various pages in section 11.1, Land and Indigenous Resource Use Section 12 Section 14	The increased road traffic (14-18 trucks per day during construction/operations) may have indirect impact on ungulates, furbearers and wood land caribou presence/absence for traditional and subsistence hunting have been raised to CNSC staff when meeting with Indigenous Nations and communities and are presented in the EIS.	Related to IR-128, Denison should have follow-up discussions with the Ministry of Saskatchewan Highways, Indigenous Nations and communities (including KML and ERFN) and stakeholders regarding adding additional pull-outs to the highway to ensure safety for northern residents.	Acknowledged. We note that the Ministry of Highways and Infrastructure is responsible for construction and maintenance of highways in the province and Denison has no power or authority to construct pull-outs. However, Denison is committed to ongoing engagement throughout the life of the project and can provide input to Ministry of Highways and Infrastructure as applicable.
AD-55	ECCC	Section 9.2.5.2.7, Waste and HazardousMaterials Management	Vehicles and equipment with engines adhering to Tier 4 emission standards should be employed where feasible in order to minimize emissions. Regardless of engine tier used, best management practices should be followed, including proper maintenance of engines and anti-idling measures.	Related to IR-139, the Proponent should commit to following best management practices regarding the use of vehicles and equipment, including proper maintenance of engines and anti-idling measures.	Section 2.8 of the EIS and the commitment register included with this submission outlines Denison's plan to regularly maintain and inspect equipment and machinery to make sure they are in good working order.
AD-56	ECCC	Section 9.3.1.3.1, Spatial Boundaries for Ungulates, Furbearers and Woodland Caribou	The EIS and the IR response did not provide sufficient information to understand how the Regional Study Area (RSA) boundaries for caribou were determined.	Related to IR-137, An assessment typically involves setting a geographic area for the assessment for the direct and indirect effects of a proposed project; this area is sometimes referred to as the Local Study Area (LSA). ECCC advises that the LSA is likely to extend beyond the Project footprint and a 500m buffer. ECCC demonstrated that the application of a 500m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale (Environment Canada, 2011). However, adverse effects of projects including predator and prey access to undisturbed areas, reduction in connectivity, and sensory disturbance to individuals of boreal caribou can vary and extend several kilometers depending on project activities and ecological context. The LSA should at the minimum capture the above-mentioned effects. A Proponent will also set a geographic area for the assessment within which the cumulative effects of the proposed Project are possible; this is sometimes referred to as the RSA. Typically the range(s) is(are) the proper scale to assess cumulative effects. However, assessing cumulative effects may require a different approach for large continuous ranges than for smaller discrete ranges. The impact of disturbance that may be concentrated in part of a large continuous range may be masked given the size of the range. For large continuous range it may be relevant to assess cumulative effects at the scale of the range but also at a smaller scale. The Proponent should consult with experts of the relevant jurisdiction in order to determine the local and regional study area, and provide a justification of the extent of the study areas in the impact statement.	The reviewer is also referred to the response to IR-137 and the response to AD-56 should be read in conjunction with it. The following is provided for reference. As per accepted environmental assessment methodology, the spatial boundaries were established to capture the extent of the expected/likely adverse effects, both direct and indirect, on the various valued components, that were expected as a result of the Project. The Project Footprint was delineated as the maximum extent of physical, direct disturbance resulting from the Project. The LSA was delineated to capture the extent of all direct, and most indirect effects of the Project on the wildlife VCs, including woodland caribou. The RSA was delineated to capture the extent of all likely Project effects, in consideration of the life-requisites and behavior of the various VCs being assessed (i.e., a habitat-based assessment) including ungulates (e.g., woodland caribou) which are known to have large home ranges. The RSA was also delineated in the context of the cumulative effects assessment, as it related to the region. Further the RSA is considered representative, as it includes habitat (ecosite types) that are found throughout the SK1 range. In particular, based on the habitat and its potential to support woodland caribou (as classified by the Saskatchewan Ministry of Environment) within the RSA is relatively consistent with the remainder of the habitat in the SK1 range (see Figure 2.1 in Appendix 9-F of the revised draft EIS). These study areas are appropriate, in that they capture the extent of the likely adverse effects of the Project on the VCs, to provide an

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					ecologically relevant determination as to the likely adverse effect on the regional population of all assessed VCs, including woodland caribou (i.e., no dilution of the effects over the entire SK1 range – although this has been provided for context). The 500 m buffer around a physical disturbance was considered in the context of the extent of sensory disturbance, to allow Denison to determine the geographical extent of an effect (i.e., limited to the LSA, limited to the RSA) to allow the appropriate characterization of the effect to inform the determination of significance. Cumulative effects occur when the adverse effects of the Project, overlap in time and space, with the adverse effects from other projects and activities. As such, the RSA is the appropriate scale to appropriately conduct a defensible cumulative effects assessment – i.e., the effects of projects that are beyond the RSA spatial extent would not likely result in residual effects that could act cumulatively with the Project's effects, and consideration of effects that do not overlap spatially or temporally, are not cumulative, by definition. The Project is likely to add another 0.4% of anthropogenic disturbance (considering the Project Area of 169.6 ha) resulting in up to 1.9% of total anthropogenic disturbance in the Terrestrial RSA. As such, the Project's contribution to the cumulative effect is 0.001% of additional disturbance in the SK1 range, which is below the accepted threshold level of anthropogenic disturbance based on the SK1 range plan (ECCC 2020). The Ministry of Environment has indicated that the current level of anthropogenic disturbance is 53% within the SK1 range, which is below the accepted threshold level of 55% for anthropogenic disturbance for the SK1 range.
AD-57	ECCC	Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance	In their response to IR-167, the Proponent states: "Site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for migratory birds and SAR (i.e., winter), where practical, to avoid disturbance during sensitive time periods. It is noted that additional information related to timing windows and species as it concerns Project activities has been provided in response to IR-134. Pre-clearing surveys will be conducted and set-back buffers implemented, as needed. The pre-clearance surveys will be completed prior to all clearing events, regardless of the time of year / season when clearing is set to occur. If nests or tree cavities should be encountered during pre-construction surveys or ongoing monitoring activities, any subsequent Project activities will be in accordance with the 2022 Migratory Birds Regulations."	Related to IR-167, provide details on how vegetation clearing related to site development will be conducted to avoid harm to migratory birds and species at risk (SAR).	The reviewer is also referred to the response to IR-167 and the response to AD-57 should be read in conjunction with it. The following is provided for reference. As noted in the August 2023 IR responses, site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for migratory birds and SAR (i.e., winter), where practical, to avoid disturbance during sensitive time periods. However, in the event that site clearing activities or other works are anticipated to occur during a sensitive timing window for migratory birds and SAR, the pre-disturbance wildlife sweeps would be conducted by qualified biologists at least 7 days prior to any scheduled vegetation/land disturbance. The biologist would search the proposed area to be cleared, plus a 100 m buffer, for sensitive

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			ECCC does not recommend the use of nest searches or pre-clearing surveys for active bird nests during the breeding season as a mitigation. Instead, ECCC recommends that clearing and grubbing activities not be conducted during the breeding bird season. ECCC does not recommend active nest searches in most cases and for most species, in part because there is a great degree of difficulty associated with reliably detecting nests and a high likelihood of disturbing or damaging active nests while searching. Exceptions to the general nesting period exist, and these include interannual variation and nest searches for certain species which may breed outside of these general periods. Under the MBCA it is prohibited to destroy a nest with a live bird or viable egg, even if this occurs outside of what might be considered a normal nesting period.		wildlife features that may be used by avian SAR (e.g., nests and/or nesting cavities), woodland caribou, and bats (e.g., roosting sites/cavities). The wildlife sweeps will not be species-specific surveys focused on species at risk per se but will be based on timing of Project related activities (i.e., will be completed in advance of site clearing activities). These surveys are intended to identify sensitive wildlife features such as hibernacula, dens, nests, cavities, mineral licks, that would require specific mitigation measures to avoid or minimize adverse effects on identified features and are not species-specific. Nevertheless, the methods associated with these pre-construction and pre-clearing sweeps will be tailored to species at risk that may potentially be using habitats at certain times of the year. For example, methods will include searching prominent topographic features such as rock outcropping or downed forest trees and debris where wolverine may establish denning sites. In the event the sweeps are conducted during the winter period, methods related to snow tracking would identify wolverine presence based on tracks and potential denning sites in the snowpack within ravines or drainages within the forested areas within the study areas (as per Resources Inventory Committee 1999). Additionally, methods will include searching for potential roost trees for bat species, as per protocols included in the Wildlife Habitat Features Field Guide (BC Ministry of Environment and Climate Change Strategy, Ecosystems Branch 2019). Depending on the results of these sweeps, appropriate mitigation measures will be developed and implemented. If sensitive wildlife features are found, they will be documented (e.g., photographs, GPS location recorded). The data collected would inform the development and implementation of appropriate mitigation measures (e.g., appropriate set-back distances for Project activities and/or consideration of timing windows as per SK MOE (2017), in consideration of applicable laws and regulations (e.g., Migratory Birds Conservation Act, Wildlife Act), as appropriate. **References:** B.C. Ministry of Environment and Climate Change Strategy Ecosystems Branch. 2019. Wildlife Habitat Features Field Guide (Kootenay Boundary Region). October 2019. Pp. 119 Resources Inventory Committee. 1999. Inventory Methods for Medium-Sized Territorial Carnivores: Coyote, Red Fox, Lynx, Bobcat, Wolverine, Fisher and Badger. Standards for Components of BC's Biodiversity No. 25. Ministry of Environment, Lands and Parks.

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					Saskatchewan Ministry of Environment (SK MOE). 2017. Saskatchewan Activity Restriction Guidelines for Sensitive Species. https://publications.saskatchewan.ca/api/v1/products/79242/formats/89555/download (accessed July 2021).
AD-58	HC	Section 10.1.4.2.1 (p. 10-22) Appendix 10-A (ERA): Appendix B Table B.9, Ref. 19-2638 Section 6, Table 6.1-1 (p. 6-7)	Section 6 of the Draft EIS contains Table 6.1-1 (p. 6-7), which lists radionuclides as a key indicator for air quality. Only uranium and radon are considered in Section 6, and Section 10 Table B.9 does not include doses from uranium progeny in air.	Related to IR-177, consider rewording Table 6.1-1 to "radon" instead of "radionuclides" to avoid confusion.	Acknowledged. The revision to Table 6.1-1 has been made as suggested.
AD-59	CNSC	Section 10.1.6.1.1, Human Receptors Selection and Characterization	Within the Human Health assessment, offsite receptors during the operation period are only considered downstream of Whitefish Lake. The only identified concern was for Se to the Fisher/Trapper located at Russel Lake. This section cites Indigenous Knowledge as informing the receptor selection and location. While the assessment is fairly conservative in the assumptions made on intake and receptor habits, it stands to reason that if the trapper receptor was located closer to the operation, such as at McGowan or Whitefish Lakes, this exceedance of Se could be more pronounced. In terms of maintaining a conservative assessment, if the most vulnerable receptor can be shown to be protected at the point of highest expected COPC concentration, it can be concluded that this receptor would be protected further away from the project. Considering this, why was the hunter/trapper receptor not also assessed at Whitefish or McGowan Lake? Was Indigenous Knowledge specific in mentioning Whitefish or McGowan Lakes were not used for the activities carried out by identified receptors?	Denison has addressed IR-180, but has not considered the suggestion for establishment of additional treatment technologies of COPCs. CNSC staff maintains that there may be the need to establish additional treatment for effluent should environmental monitoring during operation indicate COPC's are accumulating in the environment beyond what is anticipated in the EIS. This is a firm reminder that this will be evaluated as part of the licensing phase of the project, should it proceed.	Acknowledged; it is understood that consideration of treatment technologies will be part of the licensing phase of the Project.
AD-60	CNSC	Section 11, Perceived Risks to Lands and Resources	The EIS states: "Resource users may also experience changes in their perception of the quality of resources for consumption such as the palatability of fish or wildlife or have apprehensions about the safety of resources for consumption. These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning. The ERFN refer to this indicator as a "psycho-social' effect, meaning that even if people know their fears are "*perceived fears, the fear … is real and has real impacts on ERFN members' perception of their overall health and well-being*" (ERFN and SVS 2022a)." (p. 11-11)	Related to IR-207, as Denison continues to work with Indigenous Communities of Interest on community specific monitoring regimes, please provide additional information in the IER on any updates on engagement activities to date that have taken place with KML and ERFN and any other Indigenous Nations and communities who utilize the area, with respect to follow-up monitoring plans that are being developed to support the Project licensing and permitting. If Denison has made commitments with respect to this, this is information that should also be included in the commitments report.	Denison continues to work with its Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Métis Local on a community specific monitoring regime, suited to each of their interests and needs, in an agreed-upon fashion. Updated information regarding engagement activities is provided in the updated IER and updated commitments register included with the IR response package.

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			CNSC's [Generic Guidelines for the Preparation of an EIS](#) state: "The EIS will document specific suggestions raised by Indigenous groups for mitigating the effects of changes to the environment on Indigenous peoples (section 5(1)(c) of CEAA 2012). For the mitigation measures intended to address the effects of changes to the environment for Indigenous peoples, the Proponent must discuss the residual effects with the Indigenous groups prior to submitting the EIS." These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning.		
AD-61	CNSC	Various sections of the EIS, including: Section 9 Section 10 Section 11, including Section 11.1.4.3.1 (p. 11-46) Section 12 Section 16	ERFN indicated they are concerned about declining moose populations from an influx of hunters; more people may be accessing the area year after year, and worried populations may be affected by the Project (21-EN-ERFN-473.13). Further, the EIS highlights that: "Vehicle collisions are the most likely source of direct mortality for moose. Effective mitigation measures (e.g., breaks in snowbanks; speed limits; and exclusion fencing around contaminated waste pads and ponds) will be implemented to reduce moose mortality." (p. 11-46) To address potential concerns specific to Project related effects to wildlife species of interest to the Indigenous Communities of Interest, Denison has committed to collaborating with ERFN and KML on a monitoring regime suited to each of their interests and needs.	Related to IR-129, Denison needs to ensure that the proposed monitoring regime with ERFN, KML and other Indigenous Nations who utilize the area are included in the commitments table for future EIS submissions.	Denison continues to work with its Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Métis Local on a community specific monitoring regime, suited to each of their interests and needs, in an agreed-upon fashion. Updated information regarding engagement activities is provided in the updated IER and updated commitments register included with the IR response package.
AD-62	CNSC	Various sections of the EIS, including: Section 8 Section 9 Section 10 Section 11 Section 12 Section 15 Section 16 Appendix 16-C (p. 3)	IR-238 requested that Denison provide additional information to demonstrate whether Indigenous Nations and communities were engaged directly on the potential mitigation and monitoring measures to address the concerns raised regarding potential impacts of the Project on the potential or established Indigenous and/or treaty rights. As well, it requested that Denison provide a rationale if this engagement has not been completed. As the Project develops, please provide concrete actions Denison will take in the follow-up and monitoring programs to engage Indigenous Peoples to alleviate concerns and incorporate their interests, and when this engagement is planned to take place.	Related to IR-238, If Denison has made commitments with respect to engagement activities with Indigenous Nations and communities on potential , this is information that should be included in the commitments report.	Please see response to IR-238 and as noted previously Denison continues to work with its Indigenous Communities of Interest with reserves and residential communities most proximal to the Project, Denison has committed to collaborating with English River First Nation and Kineepik Métis Local on a community specific monitoring regime, suited to each of their interests and needs, in an agreed-upon fashion. Updated information regarding engagement activities is provided in the updated IER and updated commitments register included with the IR response package.
AD-63	ECCC	Appendix 6-C Climate Baseline and GHG Emissions Report	ECCC recommended that the identification of the sources of GHG emissions and quantification of these emissions be described for the post-decommissioning phase, as was done for the other phases. ECCC recommended that the Proponent discuss the potential impacts that the Project may have on Canada's ability to meet its climate-related targets, following the guidance of the Strategic Assessment of Climate Change (SACC) and the Draft Technical Guide Related to the Strategic Assessment of Climate	Related to [AD-18](#), ECCC recommends the identification of the sources of GHG emissions and quantification of these emissions be described for the post decommissioning phase. This information will be useful for future development of a net-zero plan.	The Post-Decommissioning phase consists of physical, chemical, and biological monitoring of the site that will be conducted to confirm that the site is chemically and physically stable. Post-Decommissioning extends from the end of physical decommissioning until transfer of the site into the provincial Institutional Control Program or direct release of the land back to the Crown. The Post-Decommissioning monitoring program will be

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			Change: Guidance on quantification of net GHG emissions, impact on carbon sinks, mitigation measures, net-zero plan and upstream GHG assessment.		designed and conducted in accordance with the provincial and federal regulations and licence conditions. For the purpose of the environmental assessment and the stage at which Project development currently stands, Denison believes the information provided on GHG emissions within the EIS documentation is appropriately focused on the Project phases with greatest activity which contribute to Scope 1 and 2 emissions. As noted previously in response to AD-18, in accordance with our discussions with the CNSC, Denison is committed to re-assessing the GHG and climate change components of the EIS and other elements of the SACC once more detailed, site-specific data become available (i.e., detailed feasibility and engineering studies). This is expected to include more detailed study around overall GHG emissions, carbon sinks and mitigation options, best available technologies / best environmental practices, climate resiliency, net-zero carbon planning and offsetting.
AD-64	ECCC	Appendix 6-C Climate Baseline and Greenhouse Gas Emissions Report	ECCC noted that more specific data, such as regional data from provinces, forest companies, or literature may be available. The use of Table 20 of the draft Technical Guide does not apply. ECCC recommended that the Proponent also consider biomass that are not aboveground and confirm whether soil carbon is taken into account, as well as wetlands. ECCC recommended that the Proponent provide a quantitative and qualitative description of the Project's impact on carbon sinks, following the guidance of the SACC and the draft Technical Guide.	Related to AD-19, ECCC recommends that the Proponent revisit the land use calculation provided in the draft Environmental Impact Statement as the use of Table 20 of the draft Technical Guide for the above ground mass of vegetation species is not appropriate. This table is for above-ground woody vegetation in cropland systems which does not apply in this instance. A simple site survey would determine above-ground biomass on site using basic information such as site class and species. More specific data, such as regional data from provinces, forest companies, or literature may be available, while generic national data is available (e.g., Biomass Estimates for Major Boreal Forest Species in West-Central Canada (publications.gc.ca), Canada's Forest Biomass Resources: Deriving Estimates from Canada's Forest Inventory (nrcan.gc.ca)). ECCC reiterates the advice that the Proponent provide information regarding the consideration of biomass that are not above ground, specifically whether soil carbon and wetlands are taken into account. ECCC also restates the advice that the Proponent provide a quantitative and qualitative description of the Project's impact on carbon sinks, following the guidance of the SACC and the draft Technical Guide.	It is anticipated the GHG and climate change components of the Project will be re-evaluated once more detailed, site-specific data becomes available; this will be done after the EIS process is concluded and possibly as part of sustainability reporting. This analysis is expected to include more detailed study around overall GHG emissions (including land use changes - forest/vegetative biomass, soil carbon, wetlands), carbon sinks and mitigation options, best available technologies / best environmental practices, climate resiliency, net-zero carbon planning and offsetting.
AD-65	CSNC	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	In response to IR-82, Denison highlights the importance of the S redox couple (S(2-)/S(6+)) near the ore zone.	Related to IR-82, CNSC staff recommend that Denison consider the inclusion of hydrogen sulfide test kits for in-field measurements of H2S to supplement qualitative interpretations (e.g., absence of "rotten egg" odor associated with sulfide) relating to redox conditions.	Acknowledged and Denison thanks CNSC staff for this recommendation. The recommendation will be considered within the context indicated during future planning.

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		Appendix 7-C, Section 3.5			
AD-66	ECCC	Appendix 7-C, Numerical Modelling: Post Decommissioning Evaluation,Section 2.3.1.4, Desilicified Zone	The Proponent states in both the EIS and their response that a hydraulic conductivity value of 5x10-6 m/s was uniformly assigned to the model layers representing the Desilicified Zone. They additionally state that this value is consistent with packer and pumping tests screened in this unit that have interpreted hydraulic conductivity values ranging from $1x10^{-6}$ to $3x10^{-5}$ m/s (Appendix C), with a geomean of $6.0x10^{-6}$ m/s. In their IR response, the Proponent stated that the hydraulic conductivity used as the model base case ($5x10^{-6}$ m/s) is similar enough to the geometric mean value ($6x10^{-6}$ m/s) that no consequential change to the model would occur if the geometric mean were to be used. The use of the value of $5x10^{-6}$ m/s as the model base case was not substantiated. ECCC accepts the response to Part 1 of the IR as the Proponent has stated that $5x10^{-6}$ m/s and $6x10^{-6}$ m/s are similar enough hydraulic conductivities that redoing modelling with the geometric mean is not expected to consequentially change outputs for either the PHREEQC orFEFLOW model. However, the reasoning for selecting the value of $5x10^{-6}$m/s was not clear.	Related to IR-89, while repeat modelling using the geometric mean hydraulic conductivityof $6x10^{-6}$ m/s is not required, include a statement in the EIS to indicate that the geometric mean hydraulic conductivity was not used in themodel and providing justification for using the value of $5x10^{-6}$ m/s instead.	The revised Draft EIS text (Appendix 7-C, Section 2.3.1.4 has been updated to report the geomean of the desilicified zone will be updated to $4.8x10^{-6}$ m/s. The previously reported value of $6x10^{-6}$ m/s was erroneous. "A hydraulic conductivity value of $5x10^{-6}$ m/s was uniformly assigned to the model layers representing the Desilicified Zone. This value is consistent with packer and pumping tests screened in this unit that have interpreted hydraulic conductivity values ranging from $1x10^{-6}$ to $2x10^{-5}$ m/s, with a geomean of $4.8x10^{-6}$ m/s. As within other units, the geomean value was not applied directly, but rather a rounded value slightly higher than the geomean was applied throughout the entire desilicified zone. The value applied within the desilicified zone is considered conservative as it is a factor of 1.9 higher than the most-reliable hydraulic conductivity estimates (i.e., values obtained through pumping tests measured the conductivity as $2.7x10^{-6}$ m/s) and is equivalent to the geomean value."
AD-67	Health Canada (HC)	Appendix 10-A, Section 3.2.1.3.1, p.3.43-3.44	**Inappropriate use of an outdated standard in assessing health and environmental effect(s) from short-term exposure to nitrogen dioxide (NO_2).** The Draft EIS technical supporting document (Appendix 10-A) appears to misinterpret Health Canada's 2016 Human Health Risk Assessment for Ambient Nitrogen Dioxide (NO_2) in setting its screening criteria and evaluating the health impacts from exposure to Nitrogen Dioxide. The document states: *"Health Canada published a national one-hour maximum acceptable level of 400 µg/m^3 for NO_2 in ambient air using a risk assessment approach (Health Canada, 2016b). This value considers sensitive human populations."* This statement is inaccurate. As indicated in Health Canada's 2016 publication, this value (400 µg/m^3) refers to the National Ambient Air Quality Objective (NAAQO) for NO_2, developed in the 1970s. The Canadian Ambient Air Quality Standards (CAAQS) were later developed in consideration of both human health and the environment to replace existing Canada-wide standards, including the NAAQOs, and in many cases are the most stringent Canadian air quality standard, guideline or objective.	The CAAQS are recommended as the most stringent air quality standard for assessing health and environmental effect(s) from short-term exposure to NO_2 in the project. The CAAQS are generally calculated for specific multi-year averages and for a particular statistical form so that extreme and unpredictable events do not drive risk management. However, if the data is not available for comparison to a full CAAQS timeframe, Health Canada suggests using model results for at least one calendar year to allow for a basic comparison with the CAAQS statistical form. The modelling results should be able to indicate the frequency of CAAQS exceedances, which can be used in the discussion as to whether any anticipated human health impacts are anticipated Modelled predictions within an air quality assessment's study area should be compared to the most stringent air quality standards, guidelines or objectives applicable to the region that may be affected by project activities. In this case, CAAQS are the most stringent levels and CAAQS are not restricted to applications only within the context of the [Air Quality Management System] (AQMS). Evaluation against the CAAQS may be considered in determining the nature and severity of the project's impact on air quality levels and the resulting mitigation measures that may be required to maintain good air quality levels or to prevent an exceedance of the CAAQS.	Acknowledged. The reviewer is referred to the response to IR-190 for a discussion of the use / interpretation of the CAAQs in the EIS.

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			The new CAAQS for NO2 also recognizes that there is no population health threshold for human health effects; therefore, any increase in exposure will result in an incremental population risk (Environment Canada and Health Canada, 2012; CCME, 2000). In other words, NO2 is considered to be a non-threshold substances, meaning that health effects may occur at any level of exposure. Therefore, guideline values should not be construed as limits to which polluting up to is allowed.	As health effects can occur even at levels of exposure below the limits set out in the CAAQS, they should not be viewed as "pollute-up-to" levels. It should be acknowledgeable that health risks exist below the guidelines. In addition, the principles of keeping clean areas clean and continuous improvement are operative, thus proposed mitigation measures should not be confined to meeting the standards, but should also be targeted towards reducing population exposure to CACs associated with the proposed project. This advice is also relevant to IR-190 and may be of use in responding to that request for a comparison of the predicted maximum concentrations to the most protective applicable air quality standards available (i.e., CAAQS).	
AD-68	ECCC	Appendix 16-A Summary of Residual Effects Appendix 16-B Summary of Cumulative Effects	ECCC recommended the inclusion of an assessment of potential GHG mitigation measures throughout all phases of the Project including a Best Available Technologies / Best Environmental Practices (BAT/BEP) Determination, as described in Section 3.2 of the draft Technical Guide. ECCC also recommended the development of a credible Net-Zero Plan on how to achieve the target of 0 kt CO2 eq/year, for the year 2050 and beyond, following the guidance of the SACC and the draft Technical Guide.	Related to AD-49, ECCC notes the comment provided by the Proponent stating, "Denison will consider the option of preparing a climate resiliency assessment with consideration to best available technologies / environmental practices (BAT/BEP) as well as a net-zero plan as the Project advances". ECCC continues to recommend that the Proponent align with best practices by including in the EIS a Best Available Technologies / Best Environmental Practices (BAT/BEP) Determination and a credible Net-Zero Plan on how to achieve the target of 0 kt CO2 eq/year, for the year 2050 and beyond, following the guidance of the SACC and the draft Technical Guide.	The information presented in the Draft EIS meets the requirements of CEAA 2012. Per Denison's response to AD-49 (Annex 1, page 419/419) the company will consider the option of preparing a climate resiliency assessment with consideration to best available technologies / environmental practices (BAT/BEP) as well as a net-zero plan as the Project advances but is not intending to include this information in the revised Draft or Final EIS.
AD-69	CNSC	Appendix 16-C	The EIS and the Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information. It is not clear which monitoring programs will be employed to demonstrate regulatory compliance, and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders. The CNSC's Generic Guidelines for the Preparation of an Environmental Impact Statement (EIS), also state: "The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the proponent intends to implement them and the environmental outcome the mitigation is designed to address. CNSC staff requested in the March 2023 letter to Denison (e-Doc 6991467) a Commitments Table for the Wheeler River EIS. This letter requested information of all commitments made by Denison with detailed information such as: ✓details of the commitment × which phase(s) of the project will the commitment be carried out (e.g., all phases) ✓ where the commitment is referenced (which document, table, etc. and where it can be found)	For the next draft EIS submission, the evergreen Commitments Table should be updated to include: • which phase(s) of the project will the commitment be carried out (e.g., all phases) • how this commitment will be tracked (project EA follow-up program, site-wide programs, etc.) and; • all commitments to Indigenous Nations and communities	Please refer to the commitments register included with Denison's IR response package.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [2]	Context and Rationale	Advice to the Proponent	Denison's Response
			× how this commitment will be tracked (project EA follow-up program, site-wide programs, etc.) Several commitments to Indigenous Nations and communities from the August 2023 submission appear to be missing from this table and should be included in the next submission.		
AD-70	ECCC	Appendix 16-C Summary of Monitoring & Follow-up Programs	ECCC recommended that the Proponent consider developing a GHG follow-up program to measure and compare actual GHG emissions against the EIS estimates, including reporting the Project's actual emissions and updating the emissions estimates as needed.	Related to AD-48, ECCC acknowledges that the Project will likely be required to report annually per section **46** of the **Canadian Environmental Protection Act** as the annual emissions are likely to be over 10,000 tonnes of CO2e. However, ECCC's suggestion incorporates additional components to align with the goal outlined in Appendix 16-C of the draft EIS to "assess the environmental performance of the project relative to the predictive assessment that has been completed in support of the environmental assessment process". This would involve comparing actual vs. estimated emissions following the terms of the SACC's net GHG emissions equation and evaluating the effectiveness of GHG-related mitigation measures.	Greenhouse gas emissions (GHGs) were not included as a valued component in the EIS, and as such, Denison is not proposing to add GHG monitoring to the EA follow-up monitoring to remain consistent with the methodology and scope for an EA completed under CEAA 2012. The annual GHG reporting will provide the required and relevant information to regulators per the Canadian Environmental Protection Act. Denison's ESG reporting framework will be developed as the Project advances and will be scoped beyond the components of the EIS.
AD-71	ECCC	Conceptual Caribou Management Plan	Section 4.2.1 of the Conceptual Caribou Management Plan states that "The Project components are also west of the known home range of woodland caribou (based on tracking data received by the Ministry of Environment; Figure 4-2), although the absence of data does not mean the absence of caribou and Denison has observed caribou in the area." Calculation of home range is normally based on statistical analyses of telemetry data. Home range cannot be inferred from telemetry points and incidental observations from a map	Related to IR-149, the Conceptual Caribou Management Plan should be corrected to remove the reference to caribou home range.	Acknowledged - Version 2 of the Caribou Mitigation Plan (now titled Caribou Management Framework) has been updated to re-word the sentence highlighted by ECCC. For reference and further information, it is noted that Denison continues to work collaboratively with Saskatchewan Ministry of Environment (MOE) on their requirement for an offset for adverse effects on caribou habitat. Denison has advanced the Project-related Caribou Management Framework within the context of the province's offsetting framework. The MOE has reviewed the draft framework and has provided Denison a notification of their support. Subject to finalization and provincial acceptance, the framework will provide the means to address/offset all residual adverse effects (i.e., those remaining after the application of the proposed mitigation measures) of the Project on caribou that are under provincial jurisdiction.

Federal Indigenous Review Team (FIRT) – Advice to the Proponent for the Wheeler River Environmental Impact Statement (EIS) March 2023

** The new newest Advice to Proponent table is available above

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [3]	Context and Rationale	Advice to the Proponent	Denison Response
AD-01	Canadian Nuclear Safety Commission (CNSC)	Glossary sections	There are terms used throughout the EIS that may either need defining, or inclusion in the glossary. • "Bounding", "bounding case" and "bound" are used frequently throughout the EIS to describe the scope of the assessment. For example, p. 2-6 the EIS States: "Denison has bound the environmental assessment above the deposit…" • "Laydown". P. 2-54 states: "During Construction, Denison plans to create a laydown area next to the future domestic landfill to temporarily store construction waste. Examples of materials include clean wood, plastics, metal, and concrete. The construction laydown area will not be lined, but it will have a berm surrounding the area to minimize run-on and runoff." • "Deflagration" (p. 2-22) • "Speed of sound" The EIS states: "Deflagration means the material burns slower than the speed of sound, thus no shock waves are generated. Propellant permeability enhancement methods reach injection pressures of up to 8,000 psi and are near instantaneous over periods of milli seconds…" (p. 2-22) - Explain briefly what is meant by "speed of sound" • "Dries" (p. 2-65): "the main dries will be located in the processing plant" • "Scarified" 2-84 Laydown areas will be scarified, covered with 0.5 to 1.0 m of stockpiled overburden, and vegetated with native, self-sustaining species. • "Furblock" (p. 4-29) • "Cutlines" (p. 4-101)	Add this terminology to either one of the early glossaries, or when describing the methodology, in order to help readers understand these terms (particularly non-technical readers, such as Indigenous peoples and members of the public).	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-02	CNSC	General	Mining solution and lixiviant are used interchangeably throughout the EIS. When both are used periodically, may be difficult for a member of the public to recognize that these are one in the same (mining fluid seems more often used).	Be consistent in how this is referred to, in order to ensure it's clear to readers that these are one and the same.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-03	CNSC	Throughout the Executive Summary (ES) and draft EIS	Errors in formatting and grammar were identified throughout ES and EIS. Some examples are underlined below: • "often referred to as "the final uranium product (yellowcake" (ES, p.16) • "Whitefish Lake;;" (ES, p.47)	Please correct these and any other formatting, spelling or grammatical errors.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.

[3] *Unless otherwise stated, the section noted refers to the draft EIS*

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [3]	Context and Rationale	Advice to the Proponent	Denison Response
			• "Forest fires are common throughout most of northern Saskatchewan, however, and are an important natural disturbance of northern boreal forest ecosystems" (p.72) • "Other comments that the process reminded them of fracking, which carried a negative connotation…" incomplete sentence (EIS, p. 2-3) • ".During this phase, water taking will mainly be used by the processing plant and wellfield remediation and to support the potable water plant and wash bay." (EIS, p. 8-29) • "In McGowan Lake, meanmercury concentrations in Northern Pike" (EIS, p. 8-224) • "Flows and water levels in lakes and rivers within the LSA will realize some adverse change (reduction) as a result of overprinting drainage areas reporting specifically to Whitefish Lake and water taking from this same waterbody." (8-38) • "Residual effects characteristics specific to Fish Health are defined in Table 8.5-6 with evaluation of residual effects provided in " (EIS, p. 8-242) • "Potential Project residual effects on the Fish Health VC are primarily related to c the controlled" (EIS, p. 8-249) • "…resulting in a moderate level of uncertainty. ." (EIS, p. 9-47) • "…the assessment. Error! Reference source not found. Provides a summary of unique identification numbers referenced within Section 10.1." (10-10) • "Kineepik Métis Local #9 have also note how the Project…" (EIS, p. 11-57) • "But do not compose the same volume of consumption" (EIS, p. 11-56) – should this be comprise? • " Phoenix Infrastructure. I In total, approximately 284 ha" (EIS, p. 11-156) Please note, this list is not exhaustive.		
AD-04	CNSC	Section 2.2.1 Mining (p. 2-4 to 2-5)	An arial view could be useful to help a reader understand the proposed freeze wall earlier in section 2 (e.g., The shape, whether it surrounds the deposit). This is unclear but there are good images further down in the EIS (i.e., Figure 2.3-1 on p. 2-78).	Consider adding image to Section 2.2.1, similar to or containing aspects of Figure 2.3-1.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-05	Transport Canada (TC)	Sections 2.2.3.2, 2.2.3.10, 2.2.5.1, 2.3.1.6, 8.3.4.2.2, 11.1.4.4.2,	The two water crossings over Kratchkowsky Creek and Hart Creek and the water intake and effluent discharge/intake pipeline and diffuser at Whitefish Lake may be subject to the *Canadian Navigable Waters Act* (CNWA). However, these works may be exempt from the CNWA, if they meet the requirements of the Minor Works Order.	*This advice pertains to the regulatory phase.* It is recommended that the Proponent self-assess each work using TC's Project Review Tool as follows: https://npp-submissions-demandes-ppn.tc.canada.ca/projectreview-outildexamenduprojet	Acknowledged and Denison will address this in the regulatory phase as highlighted.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [3]	Context and Rationale	Advice to the Proponent	Denison Response
				If the works do not fit the Minor Works Order, the Proponent has the option to either submit an application for approval to the NPP, or use the public resolution process, as these are all unscheduled waterways. The full text of the Minor Works Order is available here: https://laws-lois.justice.gc.ca/eng/regulations/SOR-2021-170/page-1.html. Background information on the NPP, the Minor Works Order, the application for approval process and the public resolution process are available here: https://tc.canada.ca/en/programs/navigation-protection-program/apply-npp	
AD-06	Environment and Climate Change Canada (ECCC)	Section 2.2.3.8, Project Description	In this section it is stated that: "The third step of the Industrial Wastewater Treatment Plant (IWWTP) is anticipated to further neutralize and improve the remaining water quality proposed to be achieved with further pH adjustments through agitated tanks and a clarifier with negligible solids generation expected at this stage. Several additional technologies including ion exchange are being evaluated as part of an ongoing Best Available Technology Study to be complete as part of future permitting." ECCC would be interested in reviewing this study when it becomes available. Considering that the third step of the effluent treatment process in the IWWTP is still undergoing development, ECCC cannot make final conclusions regarding the efficacy of the treatment process. When final treatment technologies have been evaluated and selected, ECCC would like to review this information to allow for release to the environment.	ECCC requests the opportunity to review the Best Available Technology Study and selected treatment technologies for the IWWTP when the report becomes available.	The BATEA information for the IWWTP will be included in Denison's application to the CNSC for a license to operate. As such, ECCC can direct their review request for review to the CNSC.
AD-07	TC	Section 2.2.5.3	With respect to the proposed airstrip, under the *Aeronautics Act*, the proposed airstrip would be considered an "aerodrome", which is defined as: "aerodrome means any area of land, water (including the frozen surface thereof) or other supporting surface used, designed, prepared, equipped or set apart for use either in whole or in part for the arrival, departure, movement or servicing of aircraft and includes any buildings, installations and equipment situated thereon or associated therewith." Aerodromes, including the one proposed by Denison, are subject to the *Aeronautics Act* and the Canadian Aviation Regulations (CARs).	*This advice pertains to the regulatory phase.* The proponent must notify the Minister of Transport of the proposed airstrip (aerodrome). This notification, being a summary report to the Minister of Transport, is required by section 307 of the CARs (CARs 307). CARs 307 also requires Denison to undertake consultation in the prescribed manner before it constructs the proposed aerodrome at the mine site. Details of the consultation are to be included in the above-mentioned summary report to the Minister of Transport. CARs 307 identifies the requirement to consult to include anyone seeking to undertake a prescribed aerodrome work at a certified or non-certified aerodrome, whether it is the creation of a new aerodrome or, at an existing aerodrome, lengthening an existing runway or making a new one. The Regulation also provides minimum expectations for how the consultation should be conducted, including timelines, who to notify and under what circumstances. The intent of the Regulation is to compel	Acknowledged and Denison will address this in the regulatory phase as highlighted.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [3]	Context and Rationale	Advice to the Proponent	Denison Response
				consultation in advance of an aerodrome work that will result in sustained and regular impact on interested parties as identified in the Regulation. As the proposed aerodrome will not be within 4 kilometres of a city or built-up area, under CARs 307, the proponent is required to consult the following interested parties: (i) the Minister of Transport, (ii) the providers of air navigation services, (iii) the operator of a certified or registered aerodrome located within a radius of 30 nautical miles from the location of the proposed aerodrome work, (iv) the authority responsible for a protected area located within a radius of 4 000 m from the location of the proposed aerodrome work, (v) any local land use authority where the proposed aerodrome work is to be carried out, and (vi) the owner of any land bordering the land on which the proposed aerodrome work is to be carried out. Proponents are encouraged to share their plans with the local land use authority before the consultation period. The local land use authority may have information about other nearby projects or developments that could impact on the proponent's plans. In summary, regarding the airstrip (aerodrome), the proponent must complete the consultation and file the summary report with the Minister of Transport, prior to commencing construction of the aerodrome. Further details can be found at: https://laws-lois.justice.gc.ca/eng/regulations/SOR-96-433/FullText.html#s-307.01. TC recommends that the proponent contact TC's Aerodromes Group at CASPNR-SACRPN@tc.gc.ca before starting the consultation, to ensure it is completed in accordance with CARs 307.	
AD-08	CNSC	Figs. 3.4-1, 4.3. 1, and where applicable throughout the EIS	Some maps in the EIS do not contain highway numbers.	Please consider including the highway numbers on the maps early in the Draft EIS when laying out the project location so the reader can become familiar with road network within northern Saskatchewan when discussions take place.	Thank you for the advice comment. This will be addressed once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-09	CNSC	Section 4, including Figures 4.3.1 and/or 4.3.2 and where	The maps included in the EIS in sections do not have any Treaty boundaries. First Nation Treaties should be included on the map. Not all First Nations reserves, and boundaries are included on the map such as Cree Lake and Slush Lake, please include on map and consider adding others from the NAD.	It is recommended that Denison update the maps in these sections to include Treaty Boundaries and community locations are included on the Project location map in Figure 4.3.2 and other maps throughout the entire EIS where applicable.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	Department	Reference to EIS, appendices, or supporting documentation [3]	Context and Rationale	Advice to the Proponent	Denison Response
		applicable throughout the EIS.			
AD-10	CNSC	Section 4	Overall, CNSC believes that Denison is abiding by the communications strategies and products identified in their PIDP, but would be interested in additional information that is available.	While CNSC staff are satisfied that the proponent meets the requirements with this EIS, further clarity and detail on the strategic planning behind these communications activities would be beneficial and would further support the overall goals of the Project's engagement activities.	Acknowledged. Further details on the Public Information Program and Public Disclosure will form part of the documentation submitted in support of the CNSC licensing for the Project.
AD-11	CNSC	Section 4 Indigenous Engagement Report (IER)	There is a summary of what engagement activities will occur moving forward. However, it is not clear which engagement activities/meetings will occur during the different stages of the EA/ project life cycle. Please provide additional details upon submission of the Final EIS.	Denison should consider clarifying in the updated IER which engagement activities will occur during each stage of the project moving forward as per Reg Doc 3.2.2 before submitting the Final EIS.	The engagement activities as outlined in the draft EIS are reflective of the iterative nature of engagement with respect to the Project. At the time of the filing of the final EIS, Denison will describe the status of engagement and future expected engagement activities to occur, which will continue to be aligned with the requirements of Reg Doc 3.2.2.
AD-12	CNSC	Section 4 IER	Information included in the EIS Section 4 and IER regarding engagement activities, communication and issues and concerns raised will need to be updated when the next version of the EIS is submitted. The EIS and IER will need to be updated to include information from Fall of 2022 until approximately two months prior to the submission date of the next EIS.	When re-submitting the EIS, ensure that the engagement log, issues and concerns tables and information about engagement activities done to date have been updated. No action needed only advice to update this section before submission with most up to date engagement activities including any that take place with other Indigenous Nations and communities not included in the Draft EIS.	Acknowledged.
AD-13	CNSC	Section 4 IER	Denison states that validation of VC selection was completed with ERFN, the Northern Village of Beauval, the Northern Village of Pinehouse Lake, and the Northern Hamlet of Patuanak (hereafter Beauval, Pinehouse, and Hamlet of Patuanak, respectively). The EIS states that this was completed through a shared online survey. The EIS also indicates that YNLR was also included in this process.	How has Denison validated VC selection with the other Indigenous Nations and communities that have showed interest and if so, by what methods (survey's, engagement, meetings, review of Draft sections etc.?) Did Indigenous Nations and communities select any VC's that were not included in the EIS and if so why not? Please elaborate and provide more details in the EIS on any other methods used including engagement sessions that were completed with Indigenous Nations and communities, through in-person community workshops, VC selection approval through early review of Draft EIS sections.	Section 4 of the draft EIS describes the approach taken related to the Indigenous and non-Indigenous Communities of Interest in relation to the Wheeler River Project. Denison has engaged with these entities regarding the validation of the VC selection. Denison has not undertaken VC validation activities with other Indigenous Nations or communities that have shown interest in the Project, owing to the systematic approach to engagement Denison has been following. This approach is consistent with the methodology presented to the CNSC by Denison in early 2020, for which confirmation was received in mid-2020 and reflected in the draft EIS. All activities undertaken in relation to engagement on VCs are currently described in the EIS; there are no additional details to add. Denison can confirm that it is unaware of additional or new VCs brought forward by other Indigenous Nations or communities that are not suitably captured within the current draft EA approach.
AD-14	CNSC	Section 4.3.1, Pg 246	On this page, Denison states that MN-S is "currently structured with a President, an Executive, a Provincial Metis Council, Regional Presidents, and Local Presidents. The wording of 'Regional	Please update all wording of "Regional President" to "Regional Director" when referring to MN-S.	Thank you for the advice comment. This will be corrected in the final EIS.

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			President' is incorrect and should be changed to say, 'Regional Director'.		
AD-15	ECCC	Sections 5.3.4 (Table 5.3-3); 8.1.3.3 Climate Change; 8.1.3.4 Climate Change Influenced Extreme Events; Table 15.4-1: Summary of Potential Effects of Short-term Extreme Weather Events on the Project and Associated Mitigation; Section 15.5 Climate Change.	The Proponent indicates that the Project's full lifetime is roughly 40 years (including the post-decommissioning phase) and that climate conditions are important design considerations for a number of sensitive aspects of the Project. Potential future climate changes and their potential effects on the Project and Valued Components (VCs) are described in various sections of the draft EIS. Notably, in Section 15.5.2, ensemble mean projections are provided for several climate variables for two future time periods and emissions scenarios (RCP 4.5 and 8.5). In Section 8.1.3.4, the Proponent describes possible future changes in short-duration precipitation extremes (based on Intensity Duration Frequency or IDF curves from the IDF_CC tool) and indicates that an increase in their frequency and magnitude may occur over the Project lifetime "… and may require consideration for greater storage and conveyance capacity for Project water management infrastructure" (p.8-41). The Proponent indicates that aspects of the Project are being designed to meet standards based on design values that appear to be derived from observed (i.e. historical) climate conditions (e.g. water management infrastructure; see Table 15.4-1). In Section 15.5.3, they indicate that an adaptive management approach will be used to address some aspects of future climate change as necessary. For example, page 15-19 of the draft EIS states that: "Denison will develop an Emergency Preparedness and Response Program for the Project to address forest fires and extreme weather that may occur. If unforeseen effects on the Project occur from longer and more severe forest fire seasons associated with climate change, or increased frequency or severity of extreme weather (e.g., ice storms, snowstorms, flooding), Denison will apply adaptive management that includes monitoring **climate factors so that they can proactively mitigate or prevent adverse climate effects on the Project**." (Emphasis added).	ECCC recommends that when considering potential future climate change and relevant effects on the Project, the Proponent consider the range of variability from the ensemble of models (not just the ensemble mean). ECCC also recommends that the Proponent consult the 2019 Canadian Standards Association Guidance on Intensity Duration Frequency for Canadian Water Resources practitioners , which provides examples of alternative methodologies to estimate future return values for design as needed. In terms of adaptive management, ECCC recommends that the Proponent clearly outline what climate factors will be monitored to mitigate or prevent adverse climate-related effects. This should include information on when and how the climate factors would be monitored and under what circumstances particular adaptive management approaches would be applied.	Please see response to IR-15, IR-103, IR-104, IR-235, and IR-236. The probable maximum precipitation (PMP) value of 493 mm selected for design of water management infrastructure, such as ponds, is similar to total annual precipitation (456 mm from Key Lake station, and 483 mm from 1981-2020 climate normals). The selected PMP is well above (>5 times higher): 1) current/measured 24-hour maximum precipitation, 2) modelled 1 in 100 year 24-hour return for current conditions, 3) modelled 1:100 year 24 hour return for a future (2020-2050) period, 4) the predicted maximum 1-day precipitation under different emissions scenarios for the future (including RCP8.5 in the 2021-2050 period). For comparison to the **design PMP of 493 mm**: - the measured maximum 24-hour precipitation from Key Lake station was **42.9 mm** and **72 mm** from 1981-2020 climate normals. - the modelled existing/current 1 in 100 year, 24 hour return using the IDF_CC Tool for the Wheeler River Project site was **79.9 mm** and at the Key Lake area was **56.4 mm**. - the modelled future (2020-2050) climate 1 in 100 year, 24 hour return using the IDF_CC Tool for the Wheeler River Project site was **88.6 mm** and at the Key Lake area was **62.0 mm**. - the predicted future climate (2021-2050) under the highest CO2e emissions scenario (RCP 8.5) shows maximum 1-day precipitation of **25.9 mm**. The PMP is much higher (> 5 times higher) than the observed and predicted 24-hour maximum precipitation and the 1:100 year 24 hour return. Completing the design using a large PMP provides confidence that the water management infrastructure will be sufficient and function under future climates as it relates to potential changes in precipitation.
AD-16	CNSC	Section 5.10 (p.70) and throughout the EIS	In section 5.10 of the ES, where the seven scenarios are listed, formatting is inconsistent. Likelihood is in quotes in some places, but not in all. **Not significant** is bolded inconsistently throughout the EIS. As well, in many cases noted as "not significant", where others note "are not expected to have a significant effect".	Suggest making formatting consistent if going to use quotes and bolding to highlight sections of the text. Also, validate that use of "not significant" and "are not expected to have a significant effect" are consistently used (where appropriate).	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.

Ref. #	**Department**	**Reference to EIS, appendices, or supporting documentation [3]**	**Context and Rationale**	**Advice to the Proponent**	**Denison Response**
AD-17	ECCC	Appendix 6-A Air Quality Technical Supporting Document A.10	Some of the off-road vehicles have an emission rating of Tier 2 but in Appendix 6-A Section A.10 the Proponent claims that "for non-road diesel combustion, Tier 4 emission factors were assumed". Choosing an engine with a lower Tier will increase emissions in NOx significantly and the Proponent should be using the best available technologies to minimize environmental impacts.	ECCC recommends that the Proponent choose engines that meet the most stringent emission standards to the extent possible, which are Tier 4 for the compression-ignition engines, during all phases of the Project.	Please see response to IR-139.
AD-18	ECCC	Appendix 6-C, Climate Baseline and GHG Emissions Report	Understanding Project emissions is important to inform analysis of a Project's potential impact on Canada's emissions targets and climate change commitments. ECCC notes that Section 4.0 and Appendix C: Greenhouse Gas Emissions Calculations of Appendix 6-C identifies the source of emissions and quantifies them in the construction, operation, and decommissioning phases of the Project, in accordance with the Draft Technical Guide Related to the SACC (Draft Technical Guide). While ECCC recognizes that the emissions will be relatively small in the post-decommissioning phase, the identification and quantification of the emissions in this phase is not found in the draft Environmental Impact Statement (EIS). The post- decommissioning phase is expected to last 15 years, likely going past 2050. The draft EIS does not discuss emission intensities of the Project, only the grid electricity. The draft EIS also does not discuss the Project's potential impacts on Canada's climate targets.	ECCC recommends that the identification of the sources of Greenhouse Gas (GHG) emissions and quantification of these emissions be described for the post-decommissioning phase, as done for the other phases. ECCC recommends the Proponent include discussion on the emission intensities of the mining of the product, following the guidance of the SACC and the Draft Technical Guide. ECCC recommends that the Proponent discuss the potential impacts that the Project may have on Canada's ability to meet its climate-related targets, following the guidance of the SACC and the Draft Technical Guide.	The Post-Decommissioning phase only includes monitoring (physical, chemical, and biological) and regulatory site inspections. These activities are not expected to generate any significant GHG releases. Notwithstanding, the calculated GHG emissions estimates for Construction, Operation and Decommissioning are expected to be sufficiently conservative to capture any incidental GHG releases during monitoring and inspection activities. The EIS anticipated an annual average production rate of approximately 4,082 metric tonnes of U_3O_8 and an annual net GHG releases of 30,702 metric tonnes CO2e over the operations phase of the project. The annualized GHG intensity during operations is estimated at 7.5 tonnes of CO2e / tonnes of U_3O_8. Section 2.5 of the EIS provides a summary of the anticipated GHG releases and a comparison to the nation- and province-wide GHG emissions. The project is expected to contribute less than 0.0043% to the nation-wide annual average. Given this very low contribution, the project is not expected to impact Canada's ability to meet its climate-related objectives and targets. Also see response for AD-19 (second paragraph).
AD-19	ECCC	Appendix 6-C, Climate Baseline and GHG Emissions Report	The draft EIS lacks information related to estimates of impact on carbon sinks and emissions from land-use changes. As land use shifts from a vegetated site prior to development, to an industrialized site, removal of vegetation and peat will have impacts on carbon sinks and construction emissions. Section 6, Appendix 6-C, 4.1.2 Land Use Change states that site-specific information of above-ground mass of vegetation was not available and default data from Table 20 of the Draft Technical Guide were applied. The default data is contained in this table is not applicable in this case, as they represent aboveground woody vegetation in cropland systems. ECCC recognizes that the usage of the median value of 0.51 for the carbon content is reasonable. From the information given in the draft EIS, it does not seem that the soil carbon was taken into account. In the absence of detailed information, the Proponent assumed that the area cleared would also be excavated (and drained in the case of wetland areas) which	Land Use Change Regarding the lack of site-specific information of above-ground mass of vegetation, an initial site survey on-site using basic information such as site class and species would assist in determining the above-ground biomass. More specific data, such as regional data from provinces, forest companies, or literature may be available, and generic national data is available (e.g., Fo148-1-2E.pdf (publications.gc.ca), 4775.pdf (nrcan.gc.ca)). ECCC recommends that the Proponent also consider biomass that are not aboveground and confirm whether soil carbon is taken into account, as well as wetlands. *Carbon Sinks* ECCC recommends that the Proponent provide a quantitative and qualitative description of the Project's impact on carbon sinks, following the guidance of the SACC and the Draft Technical Guide.	Limited site-specific data were available to characterize land use change and impacts on carbon sinks. As such, the use of default values from the SACC/IPCC in conjunction with some limited habitat/vegetation data (extracted from Chapter 9.2 Terrestrial Environment – Vegetation and Ecosystems, Listed Plant Species and Wetlands) was employed and is considered reasonable at this stage of the assessment. Please note that additional information on the land use change GHG calculations can be found in Appendix 6-C Climate Baseline and Greenhouse Gas Emissions Report. In accordance with our discussions with the CNSC, Denison is committed to re-assessing the GHG and climate change components of the EIS and other elements of the SACC once more detailed, site-specific data becomes available (i.e., detailed feasibility and engineering studies). This is expected to include more detailed study around overall GHG emissions, carbon sinks and mitigation options, best available technologies / best environmental practices, climate resiliency, net-zero carbon planning and offsetting.

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			would create significant additional emissions from soil disturbances and drainage. Section 4.1.2 also states the Project involves clearing an area of approximately 169.6 hectares. There are no estimates on the impact on carbon sinks related to the Project.		
AD-20	NRCan	Section 7.3.1, Physical Geography	Drumlins and eskers in the region trend Northeast to Southwest as opposed to northwest to southeast as written on page 7, line 18. Correct orientations are used on page 7, line 23.	NRCan recommends revising the text. Please refer to 250 000 scale Surficial Geology Lines from Quaternary mapping, CSRS NAD83 Zone 13, Saskatchewan Geological Survey 2017.	Acknowledged. The typo in the draft EIS, Section 7.3.1 will be corrected in the final EIS. In Section 7.3.1. the text will be updated to say the following: "The most important associated topographic features in the region are the northeast to southwest trending drumlins and eskers…" See also response to IR-54.
AD-21	NRCan	Section 7.3.2.3, Metacrystalline Basement Rock	Pegmatite missing from list of basement rock types.	NRCan suggests addition of pegmatite to the list of basement tock types as shown on Figure 7.3-6.	Denison will update the final EIS per NRCan's suggestion.
AD-22	NRCan	Section 7.3.3.1, Aquifer Properties, Section 7.3.2.3, Metacrystalline Basement Rock, Appendix 7A, 2.0, 2.3.1, 2.3.2	The terms "metacrystalline" and "metagranitic gneiss" are not frequently used terms in scientific literature. Gneiss is, by definition, a metamorphic rock.	NRCan suggests revision to "Crystalline Basement rocks" or "Basement metamorphic rocks", and "granitic gneiss" as used in Figure 7.3-6. Please refer to Oxford Dictionary of Earth Sciences.	Denison will update the final EIS per NRCan's suggestion.
AD-23	NRCan	Appendix 7A, 2.3.1, Metacrystalline basement rock	Orogeny is the process, orogen (or orogenic belt) is the feature produced by orogeny.	NRCan suggests replacing "Tran Hudson Orogeny" with Trans Hudson Orogen".	Denison will update the final EIS per NRCan's suggestion.
AD-24	NRCan	Appendix 7A, 2.3.1, Metacrystalline basement rock	Quartzite is by definition a metamorphic rock, and the term is used later without the meta-prefix.	NRCan suggests replacement of the term "meta-quartzite" with "quartzite".	Denison will update the final EIS per NRCan's suggestion.
AD-25	NRCan	Appendix 7A, 2.3.4, Athabasca Group Sandstones and Conglomerates	Sands are unlithified, whereas you are referring to grain sizes in this case.	In Table 2-1, NRCan suggests replacing the term "sands" with "grain sizes" under MFc and MFb descriptions.	Denison will update the final EIS per NRCan's suggestion.
AD-26	NRCan	Appendix 7A, 2.3.5, Overburden	Typo on page 2, line 7: "A grain size sample was collected in GWR-033 from approximately 9 m below ground surface, and the same consisted of 8.8% clay (less than 4 µm).	NRCan suggests revision of "same" to "sample" and clay to "clay-sized" grains.	Denison will update the final EIS per NRCan's suggestion.
AD-27	CNSC	Section 8.2.1.3 – Spatial and Temporal Boundaries	It is noted that McGowan Lake is an identified reference lake for the Key Lake Mill site. With the establishment of the Wheeler River mine, effluent would be flowing into McGowan Lake, which could potentially interfere with Key Lake's environmental monitoring program by compromising McGowan Lake's baseline conditions.	The CNSC advises Denison to communicate with Cameco to ensure they are aware of this situation. Coordination between the two companies may be necessary to ensure Key Lakes environmental monitoring program is not compromised. It is recommended to	Denison will communicate with Cameco through the Saskatchewan Mining Association to highlight the timing of the start of the Project as it may relate to Cameco's use of regional lakes for reference lake purposes. McGowan Lake will no longer be suitable as a reference lake for Cameco once the Wheeler River Project starts operating,

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			Depending on the loading of COPC's into McGowan Lake and resultant water concentrations, it may no longer be accepted as an acceptable reference lake for use by Key Lake. This would require Cameco to modify their monitoring program at the Key Lake Mill.	discuss this potential issue with Cameco ahead of time to determine the best path forward.	since it will be downstream of treated effluent release. Alpha Lake (LA-9 in Denison's aquatic baseline studies) will likely be outside of any influence from Denison's activities. Please note that Denison has previously been in communication with the Saskatchewan Ministry of Environment, Environmental Protection Branch regarding the baseline study work Denison completed as part of the Environmental Assessment process and the potential changes to McGowan lake (a Cameco's reference lake) from the proposed Wheeler Project. Reference: Email from Janna Switzer (Denison) to George Bihun (MOE) on May 12, 2020.
AD-28	ECCC	Section 8.2.4.2.3 Appendix 10-A, Section 3.1.1.2	Tables 8.2-9 and 8.2-10 in Section 8.2.4.2.3 Part II_S8 Aquatic Environment and Table 3-1 in Appendix 10-A Section 3.1.1.2 demonstrate predicted maximum effluent concentrations of Constituents of Potential Concern (COPCs) and maximum predicted receiving environment concentrations. The final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short-term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guideline, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. While uranium is not a Schedule 4 substance with prescribed concentration limits under the Metal and Diamond Mining Effluent Regulations (MDMER), the MDMER requires the characterization of uranium concentrations in effluent under Schedule 5, and requires that all mine effluent released from final discharge points be non-acutely lethal. Under Schedule 5 Section 9(d) of the MDMER, the Proponent will likely be required to conduct selenium fish tissue sampling if average annual concentrations of selenium in effluent equals or exceeds 5 ug/L.	Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non-acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.	Denison fully understands its obligations with respect to the MDMER and will comply with the MDMER end of pipe effluent discharge criteria.
AD-29	CNSC	Section 8.3.3 Figures 8.3.5 etc. 8.5-4	It does not appear that aquatic baseline sampling maps for Russell Lake have LAB 1 and 2 locations showing the baseline sampling locations within Russell Lake. (Figures 8.3.5). Please update the Figures throughout aquatic environment section to include of the baseline sampling studies/ locations within Russell Lake.	Please update maps and sections in EIS to reflect aquatic baseline studies that were completed.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-30	CNSC	EIS sections 8.4.3.2.4 Benthic Invertebrate Community and 8.4.7.6 Climate Change Considerations	ECCC EEM guidance recommends the use of multiple reference areas as it offers the greatest statistical power to detect a meaningful difference between a reference area and an exposure area and can also give an indication of variability among reference areas. It is also important to incorporate multiple reference locations into the study design to aid in designing against spatial confounding factors.	Considering climate change may change the lake conditions from baseline conditions, and that there is already natural variability between lakes that will be used as reference lakes and exposure lakes, it could become difficult to show changes to sediment/benthic invertebrates are not due to project activities, therefore there is a recommendation to ensure the current baseline	Changes in landscape influence and lake conditions are not limited to those brought about by climate change. The preparation of a study design under the MDMER EEM program strives to ensure that a single reference area or multiple reference areas are as representative of a control condition as possible. Best practice is to undertake an analysis of candidate reference areas using the existing baseline information and investigate their utility as controls

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			Section 3 of the Aquatic Environment Baseline Study Report details the similarities between benthic invertebrate communities by using the mean Bray-Curtis index between sampling locations and the median reference condition for the lake group size. It's not clear in the EIS if there are any issues expected to be able to use this data to compare project effect locations to references sites into the future, as some sampling locations are currently not very similar to the reference sites. In addition, climate change could affect the sediment and benthic communities in the future. The EIS states "the frequency and magnitude of extreme precipitation events have the potential to change water levels and flows in the RSA, which may affect sediment transport, deposition, and therefore benthic invertebrate habitat. Changes to average and upper and lower bounds of ambient temperatures may also affect aquatic habitat, which in turn may affect benthic invertebrate communities. Climate change over the life of the Project (i.e., 35 to 40 years) will be monitored as part of the Project's environmental monitoring programs, and influences on water quality, sediment quality, and benthic invertebrates will require adaptive management to mitigate any potential effects of the Project that may be exacerbated by climate-related changes on the aquatic environment". It is recommended to ensure that appropriate number/location of reference sites are sampled to enable any changes to sediment or benthic invertebrate communities that may be due to climate changes, and not project effects, are able to be assessed.	data is adequate, and to consider if additional data, and addition of additional reference stations, will be needed moving forward.	prior to project development. A preliminary EEM study can be completed that will allow for a Before-After-Control-Impact study design, that will provide the ability to monitor change not only in the exposure areas, but in the reference areas, thereby allowing for a reasonable assessment of potential mine related impacts.
AD-31	CNSC	Section 8.4.6.1, Residual Effects Characterization	The EIS states "Local Indigenous communities have expressed direct concern with respect to mercury. Mercury has not been identified as a COPC for the Project as it is currently not present in the receiving environment (i.e., background condition) at detectable concentrations and will not be produced as part of the mine process; therefore, it will not be discharged to the aquatic environment. However, it is understood that potential nutrient enrichment-related effects are possible and can be linked to increases in mercury in the environment." Based off concerns from Indigenous communities, and the fact that phosphate is a COPC in the effluent, and elevated concentrations of mercury were measured near the Kratchkowsky Lake bottom, adding methylmercury to the environment sampling plans may be beneficial.	Please consider adding methylmercury to the environment sampling plans (such as fish dorsal muscle) in order to confirm there are no unexpected effects of the project on levels, and to satisfy stakeholder concerns.	Refer to response to IR-100.
AD-32	CNSC	Section 9.1.8.3, Appendix 10-A (ERA) section 3.2.1.5	It appears there is no consistency between the assessment of soil quality in the ERA and the baseline soil sampling program presented in the EIS. The baseline program includes 10 soil permanent sampling locations (Appendix 9-B, section 2.5). Sampling at these	Please clarify how baseline measured data on COPC concentrations in soil is considered in the current and future iterations of the ERA.	Baseline measured soil data were used in the ERA to characterize the existing environment. The IMPACT model was used to predict the Project contributions for the Project phases above baseline.

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			locations is proposed to be continued during the Operation Phase, and monitoring data will be compiled and reported annually/periodically (EIS section 9.1.8.3). Conversely, the ERA estimates and predicts concentrations of COPC in soil based on atmospheric deposition. Furthermore, the location of ecological receptors in the ERA (Figure 5-2) is different from the permanent soil sampling plot locations (Appendix 9-B, Figure 2.5-1). It is unclear why measured baseline soil quality data were not discussed in the ERA and whether future monitoring data will be considered in the ERA to verify accuracy of predicted COPC concentrations		The baseline soil concentrations used in the model are provided in Section 3.5.1 and Table 3-8 of Appendix A in Appendix 10-A (ERA). The ERA will be revised according to the periodic review requirements in CSA N288.6-22 which will reflect ongoing data collected from monitoring programs.
AD-33	CNSC	Section 9.3.3.1.2	Indigenous knowledge is summarized with regard to moose, including: • Calving sites close to the Wheeler River, with lots of muskeg in the area. A moose calving area is located in the Terrestrial RSA, southwest of the Project Area. • A wildlife corridor is used by moose, running between Cree Lake (outside and to the west of the Terrestrial RSA) and Russel Lake (in the southern portion of the Terrestrial RSA). It is unclear how this information is incorporated into the residual effects assessment.	Please clarify how Indigenous knowledge on moose calving sites and corridors in the RSA is incorporated into the residual effects assessment for the key indicator "moose".	The sites identified by IK were explicitly considered in the impact assessment as indicated by their identification as overlapping with the Terrestrial RSA as noted in the question. However, the areas were not expressly discussed in the residual effects assessment because there is no anticipated spatial overlap of those areas with direct or indirect Project effects. The Indigenous Knowledge provided by ERFN and SVS (2022) identifies a moose calving site (Feature 1001-08) ~ 2 km southwest, and a wildlife corridor ~6 km south of the Project Area (as depicted in Figure 4. Map B, page 16 of ERFN and SVS 2022). Both areas are within the Terrestrial RSA but outside the Wildlife LSA. The reference to "Calving sites close to the Wheeler River…" refers to a broad area that is 45 km east of the Project Area, well beyond interactions with the Project Area. The presence of the areas identified through IK was acknowledged in Section 9.3.3.1.2 (Information from Indigenous Knowledge, Local Knowledge, and Engagement) in Part II, Sec. 9 of the Draft EIS. The assessment (Sec. 9.3.4.2) considered alteration and/or habitat loss at the LSA and RSA scale. Section 9.3.4.2.1 (pg. 9-210) summarizes the effects on moose habitat as follows: "Habitat alteration through sensory disturbance effects (such as noise, dust deposition, and artificial light) is expected to result in reduced habitat quality and effectiveness near Project components and infrastructure reaching beyond the Project Area into the Wildlife LSA…." Further, Sec. 9.3.6.2.1 (Alteration and/or Loss of Habitat, pg. 9-230) identifies that an area within a 500 m radius of the Project Area will be influenced by the Project and likely make the habitat within that area less suitable for use by moose. Therefore, the effects of the Project on moose calving have been appropriately assessed and are expected to be contained within the Wildlife LSA. That affected area

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					does not overlap with the moose calving site or the wildlife corridor identified by IK.
AD-34	CNSC	Appendix 9-B	Baseline studies for birds are restricted to short time frames in one year only, for example: • Breeding Songbird Point Count Call Survey (June 7 and 17, 2017) • Aerial Waterfowl and Raptor Stick Nest Survey (June 15 and 16, 2017) The Canadian Wildlife Service (2022) recommends: • Consider the potential effects of projects on birds throughout the year and document the distribution and abundance of birds in all seasons. Some species may be under-represented in existing data bases due to temporally restricted periods of detectability. • Explicitly target species at risk and other focal species. • Conduct at least two years of field surveys as a national standard for major projects, so that temporal variability can be considered in future comparisons to baseline data. **Reference:** Canadian Wildlife Service. 2022. Guidance Regarding Data Needed to Support Assessment of Project Effects on Birds. Environment and Climate Change Canada, Gatineau, Quebec. 80 p.	Please consider conducting surveys following CWS's recommendations or provide an explanation as to how current baseline data for birds is sufficient to characterize the existing environment.	The data collected as part of the baseline studies for birds was focused on the habitat types and areas most likely to be disturbed as a result of the Project. Conducting additional baseline surveys for waterfowl, raptors, and breeding birds is not anticipated to result in changes to the assessment outcomes and predictions made as part of the effects assessment, which was habitat-based, for avian species. The assessment methods used a conservative approach with the assumption that following the implementation of site-specific mitigation measures, the proposed Project activities would have a residual effect on these species guilds regardless of species presence on site. However, to supplement the species data that were collected as part of the baseline field program, Denison is willing to acquire additional information on species presence in the RSA from existing sources, specifically from the Saskatchewan Breeding Bird Atlas (Birds Canada). However, collection and consideration of this information is not expected to affect the findings and/or conclusions stated in the draft EIS as the assessment was habitat-based to address all species.
AD-35	CNSC	Section 10, IMPACT MODEL	Denison discusses details of the IMPACT model but has not provided scenario(s) used to facilitate review.	Please consider providing CNSC with the IMPACT model scenario file(s) in the spirit of regulatory cooperation.	The intent of Appendix A to Appendix 10-A is to provide the inputs used for the IMPACT model as well as all of the characteristics for human and ecological receptors. Where site-specific data were not used in the model it can be assumed that default values from CSA N288.1-20 were used in the IMPACT model. As such, Denison does not intend to provide the scenario files.
AD-36	English River First Nation (ERFN)	Section 10.1.3.2, Traditional Foods Diet (p. 10-15)	The EIS States: "The ERFN is comprised of seven reserve lands across Saskatchewan" (p. 10-15) While this is accurately reflecting a source document, the source document is incorrect.	Please update to "The ERFN is comprised of seven historical settlements that have now grown into 19 different reserves across Saskatchewan"	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-37	CNSC	Section 10.1.9, Human Health Summary and Appendix 10-A – 4.4.1 Risk Estimation	The Human Health section of the EIS, as well as the ERA, indicates that there is an exceedance for selenium for the fisher/trapper receptor, with the Project estimated to contribute to the majority of this exceedance (0.93 of the HQ). While the assessment is conservative by assuming an increase intake rate of fish solely sourced from Russel Lake, the precautionary principle should be considered to ensure in reality the HQ for selenium remains below 1, even under conservative assumptions.	Please conduct of effluent, water, and aquatic organism monitoring (as already suggested in EIS) to confirm HQ's are highly conservative in the EIS modelling and receptors remain protected. Should it be determined Se concentrations are increasing in the environment at such a rate as there may be in impact to the environment or human health, installation of a selenium removal circuit into the effluent treatment process should be considered. The proponent should ensure that the proposed wastewater treatment system design incorporates the capability for expansion	Denison acknowledges that a robust effluent and environmental monitoring program will be developed to confirm all EIS modelling predictions. The ERA will be revised according to the periodic review requirements in CSA N288.6-22 which will reflect ongoing data collected from monitoring programs.

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				or upgrades in alignment with the precautionary approach, pollution prevention, and continuous improvement.	
AD-38	CNSC	Appendix 10-A (ERA)	It is unclear if measured or modelled COPC concentrations in blueberry were used in the calculations of human receptor dose. Similarly, it is unclear if measured or modelled COPC concentrations in lichen and blueberry were used in the calculations of ecological receptor dose. CSA N288.6-22, Clause 7.3.6 states that “Measured concentrations of COPCs should be used, where possible, in the exposure assessment.” Please see the Clause for further information.	Please clarify if measured or modelled COPC concentrations in blueberry / lichen were used in the calculations of human and ecological receptor dose.	Measured baseline lichen data were used in the ERA to characterize the existing environment. The IMPACT model was used to predict the Project contributions for the Project phases above baseline. Measured baseline blueberry data were used for model calibration to determine if there was good agreement between measured data and modelled data. The IMPACT model was used to predict both baseline and Project contributions for blueberries. The ERA will be revised according to the periodic review requirements in CSA N288.6-22 which will reflect ongoing data collected from monitoring programs.
AD-39	CNSC	Appendix 10-A (ERA), Table 2-2	Table 2-2: Estimated Home Ranges of Selected Terrestrial Ecological Receptors Based on the reference McLoughlin et al. (2016), the Home Range for Woodland Caribou is indicated as “Expected = 80 km2” which represents the mean range sizes pooled over the two study years for calving/post-calving. The indicated Minimum (67 km2) and Maximum (267 km2), however, do not relate to the calving/post-calving stage, which is not clearly stated in Table 2-2. In contrast, these values are actually mean range size values for autumn/rut and early winter, respectively, as described in the source document on Page 83 (McLoughlin et al., 2016). It should be noted that in terms of true minimum and maximum, the source document states that individual home ranges, based on up to two years of GPS locations, varied in size from 16.2 km2 to 1363.9 km2 (Page 82 of McLoughlin et al., 2016). Reference: McLoughlin et al. 2016. Population dynamics and critical habitat of woodland caribou in the Saskatchewan Boreal Shield. Interim Project Report, 2013–2016. Department of Biology, University of Saskatchewan, Saskatoon. 162 pp. Available online at http://mcloughlinlab.ca/lab/wp-content/uploads/2019/06/2013-2016-SK-Boreal-Shield-Caribou-Project-Interim-Report-Nov-18-2016.pdf	Please provide clear details on the source of the home range values listed in Table 2-2.	Denison acknowledges the comment and will add clarification in Table 2-2 of Appendix A in Appendix 10-A that the minimum represents the autumn/rut and the maximum represents the early winter.
AD-40	CNSC	Appendix 10-A (ERA) section 3.2.1.5	Although the soil type selected in the ERA for modeling of atmospheric deposition to soil is sandy soil, organic soils have been delineated and characterized (section 9.1.3.3 of the EIS) as valued component (i.e., “Organic Matter/Peat”). It is unclear if the soil quality modeling performed in the ERA is protective for soil types other than sandy soil.	Please clarify if COPC modeling based on sandy soil is protective of organic/peaty soil and provide justification.	The majority of the soil in the Project Area and LSA is considered sandy soil. Section 9.1.3.2 of the EIS states "Mineral soils are associated with upland sites and (in all likelihood) anthropogenically disturbed land that, together, correspond with >99% of the Project Area and 91.5% of the LSA (Figure 9.1-8). The predominate mineral soils within the RSA have been classified as Sandy Dystric Brunisols (Smith et al. 2011)." Organic matter/peat was included as a VC in the EIS because of the concern regarding drying and losing biological function through groundwater interactions, and not in

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					terms of assessment of soil quality. Additionally, Section 9.1.3.3 of the EIS acknowledges that organic soils is limited in the Project Area. As such, this comment is considered not applicable.
AD-41	CNSC	Appendix 10-A (ERA), Table 5-5	Table 5-5: Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model The exposure pathway for phytoplankton is stated as “direct contact in sediment”, however, phytoplankton live suspended in the water column. It is acknowledged that in the IMPACT modelling report, phytoplankton is described with an occupancy factor of 1 in water (Table 2-5).	Please add the pathway “direct contact in water” to Table 5-5 and revise all calculations accordingly.	Table 5-5 will be revised to state “direct contact in water” for phytoplankton. No calculation changes are needed.
AD-42	CNSC	Appendix 10-A (ERA), Table B.12	Table B.12: Sample Calculation – Adult Recreational Fisher/Hunter (McGowan Lake) Dose and Risk Calculations for Selenium The source for the Terrestrial Plant Ingestion Dose for Labrador tea and blueberry is stated as “Table C.5”, however, this table could not be located.	Please provide the referred-to Table C.5 or an alternate source of information for the Terrestrial Plant Ingestion Dose for Labrador tea and blueberry.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-43	CNSC	Appendix 10-A (ERA), Environmental Risk Assessment for Wheeler River Technical Support Document	The ERA is prepared by Ecometrix and submitted to Denison Mines. It is unclear if the ERA submitted has been reviewed and accepted by the proponent (Denison Mines). CSA N286-12 clause 9.5.5 specifies that “the selected supplier’s technical documents that are required to be submitted shall be reviewed and accepted”. Meeting these CSA N286-12 requirements will ensure that the proponent has control of the purchased services as a future licensee applicant.	Provide clarifications if ERA documents have been reviewed and accepted by the proponent.	See response to IR-202 which indicates that Denison reviewed and accepted the ERA. This text will be added to Appendix 10-A.
AD-44	CNSC	Section 11	It is not clear whether all of the interested Indigenous Nations and communities were engaged on the results and findings of the Heritage Resources Impact Assessments (HHRIA) or just ERFN?	CNSC staff would appreciate an update on any engagement activities that have taken place with regards to any of the HHRIAs for the Project, or any site or thing that is of historical, archaeological, paleontological or architectural significance as requested by other Indigenous Nations and communities to date.	Denison confirms that the results of the Project-related HRIAs were discussed with ERFN, as they expressed interest in further understanding the nature of the work undertaken. The Saskatchewan Ministry of Parks, Culture and Sport, Heritage Conservation Branch (HCB) administers The Heritage Property Act. Regulatory approval as per section 63 of The Heritage Property Act (GS 80) was granted for the Project for the two separate HRIAs (HCB File No. 16-2102, December 14, 2017 and HCB File No. 19-933 February 12th, 2020). The results of the HRIAs were included and formed part of the draft EIS. Comments made by Indigenous communities on this section of the EIS will therefore be responded to accordingly by Denison, where appropriate. Additionally, as noted in Section 11.3.2, “The Heritage Resource

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					Management Plan (HRMP) was informed by engagement with ERFN, who recommended that the HRMP should include a mechanism to involve Indigenous communities where appropriate (21-EN-ERFN-591.1; 21-EN-ERFN-591.2) (see Appendix 11-B)." The mechanism to involve Indigenous communities has been included in the HRMP and allows for general notification to Indigenous communities should an artefact be found, which provides flexibility to engage all appropriate Indigenous nations accordingly.
AD-45	CNSC	Section 11.1.4.5.2. Perceived Suitability/Safe Use of Resources (p. 11-59)	The EIS States: "Section 2.6.1 in Section 2 describes the extensive review of mining methods that led to the decision to adopt the ISR mining method." (p. 11-59). This reference is not correct, as this section does not contain a review of the mining methods.	Please update this to reflect the appropriate section.	Thank you for the advice comment. This will be addressed, as possible, once the EIS is updated following the conclusion of the information requirement (IR) process.
AD-46	TC	Section 14.6.7.2	Transport Canada would like to clarify that although the proponent may use a third party to assist in developing emergency response assistance plans (ERAPs), it is the proponent's responsibility to submit the ERAP application(s) to Transport Canada, per Section 7(1) of the *Transportation of Dangerous Goods Act, 1992* as follows: Emergency response assistance plan 7 (1) No person shall import, offer for transport, handle or transport dangerous goods in a quantity or concentration that is specified by regulation — or that is within a range of quantities or concentrations that is specified by regulation — unless the person has an emergency response assistance plan that is approved under this section before (a) importing the dangerous goods; (b) offering the dangerous goods for transport; or (c) handling or transporting the dangerous goods, in the case where no other person is required to have an emergency response assistance plan under paragraph (a) or (b) in respect of that handling or transporting.	*This advice pertains to the regulatory phase.* Transport Canada notes that the sentence highlighted in yellow below is incorrect and should be revised or removed. While a contractor could assist the proponent to develop the ERAP(s), it is the responsibility of the proponent to apply to Transport Canada for approval of the plan(s). 14.6.7.2 Design and Mitigation Considerations Principal traffic risk mitigation measures include: • traffic control measures such as speed limits; • travel management plans; • spill and emergency response planning; and • driver training. Additionally, Denison considered several provisions to make sure that the effects of a terrestrial release of hazardous materials are as low as practicable. In addition to transportation mitigations listed for Scenarios 1 and 2, the following provisions were considered. • The *Transportation of Dangerous Goods Act, 1992* (Government of Canada 2019) outlines the requirements for entities that transport dangerous goods to establish emergency response assistance plans. These plans list specialized personnel and equipment that are required for responding to an incident. It is expected that a contractor responsible for the transportation of uranium concentrate, fuel, and hazardous chemicals would develop these plans.	Acknowledged. Section 14 will be updated in the final EIS to clearly state that while a contractor could assist Denison to develop the ERAP(s), it is Denison's responsibility to apply to Transport Canada for approval of the plan(s).

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AD-47	Health Canada (HC)	Appendix 14-A (p. 8-9)	**Context:** No emergency response plan has been provided within the draft EIS, which states that emergency response plans will be developed in the future (Section 14 Appendix 14-A, p.8-9). **Rationale:** For any emergency event, Health Canada considers the protection of human health as a primary consideration in the development of emergency preparedness and response plans. This includes monitoring for human health impacts and the provision of health-related guidance. Further, this will be a requirement of the licensing process. The proponent should ensure that the emergency response plans consider the protection of all relevant potential human receptors that could be impacted by an onsite or project-related off-site accident involving the release of chemical and/or radiological substances.	It is recommended that Denison develop an emergency response plan in consultation with potentially affected communities and stakeholders that includes, but is not limited to, the following: 1. All relevant contact information of the communities, especially related to km 160 of Hwy 914, which is the location of a cultural camp that has been established by the English River First Nation and km 67 of Hwy 914 that is a gathering location for the Kineepik Metis Local associated with the Northern Village of Pinehouse. 2. Description of the mechanisms for communication with communities in case of an emergency. 3. Description of the partnership with and the training of local communities and local responders (see Section 14 Appendix 14-B, p.1). 4. Description of mutual aid agreements with neighboring industries/municipalities, where appropriate.	Denison acknowledges the comment and thanks Health Canada for the recommendations as to the development of its Emergency Response Plan. As noted in the draft EIS, Denison has committed to the development of an Emergency Preparedness and Response Program as a component of its Environmental Management System (EMS). The objectives of the program are generically consistent with the recommendations that have been provided and Denison, as it has demonstrated to date, is committed to meaningful engagement with communities of interest and will solicit input and advice during all aspects of program development. For reference it is noted that as it concerns its EMS framework documentation hierarchy it is expected that three levels of documentation will be developed – Programs, Plans and Procedures. The emergency preparedness and response documentation will follow this hierarchy and input from interested parties will be solicited during all phase of program/plan/procedure development. Denison intends to develop this documentation as it advances through the licensing phase of Project realization.
AD-48	ECCC	Appendix 16-C, Summary of Monitoring and Follow-up Programs	Appendix 16-C does not include consideration of any monitoring and follow-up programs regarding GHGs.	ECCC recommends that the Proponent consider developing a GHG follow-up program to measure and compare actual GHG emissions against the draft EIS estimates, including reporting the Project's actual emissions and updating the emissions estimates as needed.	Denison anticipates being subject to ECCC's reporting requirements for emitters over 10,000 tonnes CO2e and the information is collected under section 26 of the Canadian Environmental Protection Act. This was noted in the draft EIS, Section 2.5 Greenhouse Gas Emissions.
AD-49	ECCC	Appendix 16-A Summary of Residual Effects Appendix 16-B Summary of Cumulative Effects	ECCC notes that GHG mitigation measures have not been considered for the Project. Furthermore, the Project's lifetime is expected to extend into 2050 and beyond. Consistent with the information requirements of the SACC, and aligning with Canada's commitment to achieve net-zero GHG emissions by 2050, the Proponent should provide a credible plan that describes how the Project will achieve net-zero emissions by 2050.	ECCC recommends that the draft EIS include an assessment of potential GHG mitigation measures throughout all phases of the Project. This could include a Best Available Technologies / Best Environmental Practices (BAT/BEP) Determination, as described in Section 3.2 of the Draft Technical Guide. ECCC also recommends that the Proponent provide a credible Net-Zero Plan on how to achieve the target of 0 kt CO2 eq/year, for the year 2050 and beyond, following the guidance of the SACC and the Draft Technical Guide.	GHGs were not included as a VC or KI in the draft EIS and as such, there are no specific GHG-related mitigation measures in Appendix 16. However, many of the mitigation measures for the VC Air Quality related to combustion products would also be associated with a reduction in the Project's Scope 1 emissions. As noted in the draft EIS, Section 2.5, at this stage in the Project Denison will look for opportunities to optimize energy management and improve the energy intensity of the Project where practical. Also see response for AD-19 (second paragraph). Denison will consider the option of preparing a climate resiliency assessment with consideration to best available technologies / environmental practices (BAT/BEP) as well as a net-zero plan as the Project advances. Section 2.5 of the EIS provides a summary of the anticipated GHG releases and a comparison to the nation- and province-wide GHG emissions. The project is expected to contribute less than 0.0043% to the nation-wide annual average. Given this very low contribution, the project is not expected to impact Canada's ability to meet its climate-related objectives and targets.

Wheeler River Project

November 1, 2024: On October 18, 2024, Denison Mines Corp. (Denison) re-submitted revised responses and supporting documentation for the proposed Wheeler River Project to the Canadian Nuclear Safety Commission (CNSC). CNSC staff conducted a completeness check and determined that outstanding IRs have passed completeness and supporting submissions are adequate to proceed to the EIS Technical Review. More information can be found in the October 25, 2024 letter to Denison, and completeness check table.

The next phase of technical review by CNSC Subject Matter Experts is underway, for completion by November 15th, 2024. The review includes the following documents:

- Wheeler River Project: Denison's Responses to Information Requests from the Federal and Indigenous Review Team (October 18, 2024)

- Wheeler River Project: Appendix A to Denison's Responses to Information Request (October 18, 2024)
- Wheeler River Project: Advice to Proponent Table (October 25, 2024)

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October 30, 2024

Brianne England
Regulatory Manager
Denison Mines Corp.
bengland@denisonmines.com

Subject: Outcome of CNSC Staff Completeness Check of the October 18, 2024 Responses to Federal-Indigenous Review Team Information Requests for the Wheeler River Project

Dear Ms. England,

On October 18, 2024, Denison Mines Corp. (Denison) submitted revised responses to Information Requests (IRs), including Appendix A with supporting information, and Advice to the Proponent comments for the proposed Wheeler River Project [1-2]. CNSC staff have determined that the submission has the required information to proceed with the technical review of the responses.

The technical review commenced on October 25, 2024, with an aim for completion by November 15, 2024.

Should you have any questions, please do not hesitate to contact me, directly by phone at 343-540-6213 or by email at Jessica.Way@cnsc-ccsn.cg.ca.

Sincerely,

- Original Signed By -

Jessica Way
Environmental Review Specialist
Environmental Review Division

c.c.: CNSC: N. Kwamena, P. Burton, A. Levine, R. Noakes, K. Gorzkowski, R. Froess
Denison: K. Himbeault, J. Switzer, C. Inglis-McQuay, R. Nagel

References:

[1] Letter, B. England (Denison) to J. Way (CNSC), *Denison Response to CNSC Comments-Wheeler River EA Submission #5*, October 18, 2024 (e-Doc 7386973)

[2] Email, B. England (Denison) to J. Way (CNSC), *Advice to Proponent Table-Wheeler River EA Submission #5*, October 24, 2024 (e-Doc 7395132)

Appendix A to Denison's Response to FIRT Round 4 Wheeler River Project EIS Comments

October 18, 2024

IR-12

- Department: ECCC
- Project Effects Link: Change to an environmental component due to hazardous contaminants
- Reference to EIS, appendices, or supporting documentation: Section 2.2.3, Project Description

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 9, 2024)	IR (ROUND 4, Sept.6, 2024)	Denison Response (ROUND 4, Sept. 16, 2024)
IR-12	-	Context: There is not enough information provided within the draft EIS and site water infrastructure designs to determine if the infrastructure will sufficiently contain mine site contact and noncontact water runoff. It is unclear how water management will occur during all proposed Project stages at the Project airstrip, which is located away from the main Project site. No information has been provided regarding water that may come into contact with fuels and oils from machinery on the air strip, how and where that contaminated water will be treated, and how surface runoff around the airstrip will be managed. Additionally, it is unclear if contaminants from heavy machinery on roads have been considered during runoff collection plans throughout the mine Project site. Water management at the airstrip and roads can have impacts on surface water quality and sediment quality and contaminants (e.g., Hydrocarbons) from these sources should be considered in overall site water management plans. In Section 2.2.3.1 a site drainage plan for contact and non-contact water has been provided in Figure 2.2-17, and water balances have been provided for the different Project phases in Figures 2.2-14 to 2.2- 16. In Section 2.2.3.4 a volume of 30,000m3 for the process water pond is provided, and it is stated that the process water pond has the capacity to contain Probable Maximum Precipitation (PMP) event estimated to be 483.3mm while allowing for 1.0m of freeboard. However, there are no estimates on the total volume of water that may be drained from the overall site infrastructure (i.e., the well field, processing areas, etc.) during a 24-hr PMP event. Additionally, in Figure 2.2.17 culvert locations are provided, however there is no further information on culvert designs, flow ratings and capacity for PMP events. Rationale: In order to be able to understand	1. Provide information on how contact and non-contact water from the site airstrip will be managed. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 2. Provide further information on how potential contaminants in runoff from roads have been considered in the site water management. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 3. Provide estimated volumes of water to be drained from overall site infrastructure (such as the mine terrace, airstrip, camp area etc.), during a 24-hr PMP event. 4. Provide additional information on culvert designs and conveyance capacity for PMP events.	1. and 2. Denison's approach to site water management is keep non-contact water "clean" – that is, the management approach provides that non-contact water does not come into contact with site aspects that may impart constituents/contaminants of concern and that non-contact water mingles with contact water. Contact water is water expected at the wellfield and processing plant terrace (refer to runoff collection arrows shown in draft EIS Figure 2.2-17), and also includes leachate collected from landfills. As such, runoff from the airstrip and site roads is considered non-contact water and will not be actively managed. However, should a spill occur, the spill response plan will be followed. Details of Denison's response plans will be developed to support licensing as part of the Waste Management and Emergency Management and Fire Protection programs. By following best practice and mitigation measures outlined in the EIS, Denison does not anticipate a need to continually manage water at the airstrip or along site roads as the water here will be clean, non-contact runoff. Examples of relevant mitigation measures include: • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • Fuel storage and distribution infrastructure will be constructed in accordance with applicable legislation requirements. • Fuels will be stored in approved, above-ground, double-walled storage tank(s) equipped with secondary containment in accordance with provincial regulations and standards. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. Refer to Section 14 of the draft EIS for the screening and evaluation of various accident and malfunction scenarios. Should unplanned events or conditions occur, it will be important for Denison to address and respond in an appropriate manner. Details of Denison's response plans will be developed to support licensing as part of the Waste Management and Emergency Management and Fire Protection programs. Additionally, should unexpected water pooling be observed at the airstrip or site roads during Operation, temporary water removal means such as vac trucks or sump pumps could be employed and the areas would be re-graded to minimize water accumulation. 3. As indicated in the response to IR-12, points 1 and 2 above, Denison expects contact water requiring management is at the wellfield and processing plant terrace (refer to runoff collection arrows shown in draft EIS Figure 2.2-17). For this area, the volume of water expected during a 24-hour PMP of 493 mm is approximately 37,240 m3. The wellfield runoff pond has been sized appropriately (38,200 m3 with 1 m of freeboard) to contain this volume of water. 4. Details related to culvert design and conveyance capacity are being developed as part of ongoing	This response has not been accepted, for the following reasons (numbers correspond with original IR): 1-2. In Figure 2.2-17 (Site Drainage Plan with Flow Direction and Culvert Locations) of EIS, site drainage or water management layout is not included for the access road to the airport and the airport area although they constitute part of the Project site. Although surface run off from airstrip or site road are mainly expected to be clean or non-contact water, CNSC expects Denison to provide information on water management system to mitigate risk of flooding and erosion at the airport and the access road. In addition, the access road connecting the mining site with airport crosses two streams (Kratchkowsky Creek and Hart Creek) that flow into Whitefish Lake, CNSC staff expects Denison to ascertain that culverts or crossings will be designed in such a manner that the flood hazard does not increase. Therefore, CNSC staff request that Decision provide information on how the surface runoff generated at airstrip and airport access road would be managed. 3. CNSC accepts estimated total volume of runoff from the wellfield area to Wellfield Pond however the PMP value of 489.3mm is obtained from 1999 study [A.1], based on historical rainfall data pre-1998, which appears to require updated PMP value. CNSC requests that Denison use a PMP value that is estimated using historical rainfall data that includes the most up to date meteorological data or provide justification on the validity of the current PMP. Further, the site infrastructure runoff water has not been considered in the water management infrastructure. Site water management planning should consider the capture of noncontact water to understand the potential effects of contaminants from non-contact water on the surrounding environment. Please also see follow-up IR-12-R1A and IR-12-R1B, related to this IR. Reference: [A.1] Atmospheric & Hydrologic Sciences Division – Atmospheric Environment Branch. 1999. Environment Canada Prairie & Northern Region – Point Probable Maximum Precipitation for the Prairie Provinces. Regina, Saskatchewan. Report No. AHSD – R99 – 01.	1-2. The water management design information presented in the draft EIS is considered appropriate at the EA stage and for this stage of the Project and fit-for-purpose to support the assessment of potential effects. The detailed design information on site water management infrastructure and runoff management requested in this IR and related IRs (i.e., IR-12-R1A and IR-12-R1B) will be provided to the CNSC and province as part of licensing and permitting. Nevertheless, and building on information provided previously, additional information and context regarding site water management and design concepts is provided as follows: • Conceptual site drainage maps spanning the full Project Area scale has been provided in Attachment IR-12 to this IR response table as context for the reviewer. • Design for the access roads and airstrip will in general be such that runoff will be encouraged through appropriate grading to drain away and not pond on or near the road or airstrip. • The overall vision for non-contact water along the access roads and airstrip is to use shallow ditching to dissipate the energy of runoff, to promote settling of suspended solids and allow the runoff to report to ground via natural grades that flow away from the infrastructure and into the natural drainage systems. • The condition of the airstrip and roads would be inspected and maintained routinely. For example, should unexpected water pooling be observed at the airstrip or site roads during Operation, temporary water removal means such as vac trucks or sump pumps could be employed, and the areas would be re-graded to minimize water accumulation. • Infrastructure features that are within 50 to 100 m (depending on grade) of waterbodies and that are associated with cleared land where there is no vegetated buffer may require additional erosion management / controls to ensure protection of the waterbodies from unmitigated suspended solids inputs. A map showing the distance of Project components to waterbodies is available in Attachment IR-12 as context for the reviewer. The map shows for example, that four waterbodies (waterbody numbers 1, 16, 23, and 86) are within 100 m of the Project footprint where potential erosion protection measures may be employed. The details of erosion control measures at these locations will be outlined in the Environmental Management System to support licensing. • Conceptually, minimizing changes in surface drainage patterns and watersheds is an important mitigation measure in the surface water quantity assessment. Collecting and managing non-contact water along roads and at the airstrip would result in a larger potential Project effect on surface water quantity associated with changes in surface drainage patterns and is not preferred. • As described in the draft EIS, the proposed crossings at Kratchkowsky Creek and Hart Creek are not culverts, but clear span bridges. Clear span bridges are designed to completely span	Item one of the IR has been accepted, but a follow-up item of advice can be found within the Advice to the Proponent table [reference to come]. There is outstanding information required to resolve item two. The Proponent did provide the requested proposed water management structures in Attachment IR-12; however, for the road to airstrip and the airstrip, the water management strategy does not include any containment structures or information about runoff quality. Contaminants may be contained in non-contact water from all site infrastructure, including the airstrip, roads, and the camp area. This information is required in order to make a determination on significant adverse effects, as it relates to potential impacts to water quality and fish, which are assessed as part of the EA process. The Proponent should confirm that the proposed water management structures, for the roads, camp pad, operation, substation and airstrip, will be included in the Final EIS. The Proponent should also describe how quality of runoff from infrastructure will be monitored, and what proposed mitigation and management measures will be taken if necessary. *With regards to items three and four, these have been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a license.* Denison is expected to address the following: 3. From FIRT's Information Request Rationale (2023-12-05): CNSC requests that Denison use a PMP value that is estimated using historical rainfall data that includes the most up to date meteorological data or provide justification on the validity of the current PMP. 4. From Denison submission of responses to IRs (2023-08-18): Details related to culvert design and conveyance capacity are being developed as part of ongoing engineering activities. Culverts will be a designed with a sufficient size and length to convey water around the site during a PMP event.	Refer to Attachment IR-12, IR-12-R1A, and IR-112-R1B (Round 3) below.	In a supplementary submission provided by Denison on July 9th, 2024, much of the information requested has been provided. Table 1 of round 3 attachment IR-12 is a screening of constituents of potential concern (COPCs) in water catchments. For the "Camp" catchment, risks to the aquatic environment from nutrients is described as "*None expected.*" However, sewage spills occur occasionally at camps and would release nutrients which could reach the aquatic environment. Also in Table 1, a management/mitigation often referred to is, "*A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.*" No further details were found on how wash bay water will be handled such that it does not pose a risk to the aquatic environment. The Proponent is relying on its spill response plan to handle any spills from the freeze plant and substation as well as the camp. Section 14 of the EIS, Accidents and Malfunctions, does not discuss these hazards. Given the stated reliance on the spill response plan for brine and sewage spills on site, it will be important that the plan explicitly address brine and sewage spills. In order to resolve this IR, Denison are expected to: • Include nutrients from sewage as a contaminant of potential concern for the Camp Watershed in Table 1 of round 3 attachment IR-12 or provide justification why there are no risks to the aquatic environment from nutrients from the camp. • Clarify how wash bay water will be handled, given that it may potentially contain contaminants. The following will be assessed during licensing: Denison will be expected to incorporate information provided in this supplementary submission in the Spill Response Plan.	In response to this IR, the Site Water Management Plan has been updated using track changes; see Attachment IR-12, IR-12-R1A, and IR-112-R1B (Round 3) below. Briefly for context, nutrients as a COPC related to sewage in the Camp Watershed have been incorporated into Table 1, and clarification with respect to the wash bay water management has been provided. In addition, responses to the CNSC's round 4 comment related to nutrients, the wash bay, and commitments for the Spill Response Plan are also provided here. **Nutrients:** The domestic wastewater treatment plant pond stores treated domestic wastewater prior to conveyance to the process water pond that reports to the industrial wastewater treatment plant (IWWTP). To clarify, the accidents and malfunctions assessment (EIS Section 14) considered four scenarios that could introduce COPCs to the environment from site "ponds and retention berms" (see Table 3-13, Appendix A or EIS Appendix 14-A), including overtopping, flooding and containment failure – the domestic wastewater treatment plant pond would fall into this generic "ponds and retention berms" category. The "ponds and retention berms" scenarios were deemed low risk or risks were deemed to be as low as reasonably practical (ALARP), given design and other mitigations. **Wash Bay:** Described in Section 2 of the EIS, a wash bay is proposed as part of the Wheeler River Project infrastructure. The wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. The wash bay area will have an impermeable floor and a lined water collection sump. Rinse water from the wash bay sump will be routed to the wellfield runoff pond or directly to the process water pond. It will be subsequently conveyed as a component of the influent stream to the IWWTP where it will be treated. Treated effluent would be discharged to Whitefish Lake once deemed suitable for release. For the purpose of the site water management strategy, water derived

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		site water management and flood risk potential, more information needs to be provided regarding the site water infrastructure designs and capture volumes during PMP events. This information will aid ECCC in understanding how contact and non-contact water will be conveyed throughout the site. Runoff from roads and the site airstrip will contain contaminants from vehicles, heavy machinery, aircrafts and de-icing practices. Additional information on the runoff collection systems and expected contaminant concentrations for the site airstrip and roads is needed to determine if the receiving environment and aquatic and terrestrial receptors are protected.		engineering activities. Culverts will be a designed with a sufficient size and length to convey water around the site during a PMP event.		a watercourse without interfering with the channel bed and banks. • As a reminder to ECCC that the road to the Project's proposed airstrip follows an existing, decommissioned road, the Fox Lake Road. • The Project is located within the Wheeler Upland Landscape Area of the Athabasca Plain Ecoregion within the Boreal Shield Ecozone of Saskatchewan. The area is characterized by Brunisolic soils which are typically sandy, well-drained soil. Standing water is not a common occurrence and the well-drained characteristics of the region support the plans to divert non-contact water to ground, and as noted made surfaces would be graded to promote drainage and discourage pooling. • Please refer to our initial response to IR-12 (refer to Annex 1, IR-12 on page 6/419) for additional context on best practice and mitigation measures related to water management and also the scoping and evaluation of accident and malfunction scenarios in the draft EIS. • Importantly, the conceptual management scheme outlined above for non-contact water runoff is consistent with other roads and airstrips in the region – that is, runoff is not currently captured from other roads and airstrips in the region as envisioned by the review comment. This includes infrastructure associated with Saskatchewan Ministry of Highways and Infrastructure, existing uranium mines and mills, and communities including First Nation communities. It is not practical to do so and collection of non-contact water is not needed based on risk and moreover as noted above is to be avoided so as not to necessarily affect water quantity in local drainages and sub-drainages. 3. The reviewer is referred to the response to IR-103 for a discussion regarding the PMP and its suitability and relevance given available data and different methods of calculation included that provided by CSA guidance. Notwithstanding the information provided in response to IR-103 Denison is committed to revisiting this issued as per CNSC's recommendations, as applicable, for the licensing phase of the Project. To reiterate, Denison believes it has fulfilled its information requirements for the EIS as outlined in the EA guidance provided by the province and federal government, including CEAA 2012, and that the FIRT has been provided with the appropriate level of detail on the water management topic for drawing conclusions on the EA process. Notwithstanding that, Denison recognizes that further information will be required as the Project moves past the EA and into the licensing and permitting phases. It is Denison's opinion that this comment is not an IR related to the EIS. A request for clarification or additional information on a detailed design aspect would need to be responded to by the Denison as part of the licensing process; however, this level of detail is not necessary for drawing conclusions on the EA process.				from the wash bay is by definition "contact water". **New Commitment:** Denison concurs that it will incorporate information provided in this supplementary submission in the Spill Response Plan during licensing. This commitment is reflected in the updated commitment register (see commitment 2-35) that is provided as part of the EIS submission.
n/a	IR-12-R1A	Context: Runoff water from site infrastructure such as the airstrip and roads may be categorized as non-contact water because it does not come into contact with contaminants of potential concern	*n/a*	*n/a*	1. Update site water management plans to include management of potentially deleterious substances contained in non-contact water from all site infrastructure. 2. Provide updated estimates of water volumes to be drained and managed from overall site infrastructure (including runoff	1 and 2. Denison understands the prohibition related to deleterious substances under Section 36 of the Fisheries Act and Denison affirms its commitment to ensuring no such events occur. However, in the context of this IR, we interpret ECCC is connecting the concept of deleterious substances under MDMER (those constituents identified in Part 1(3) i.e., arsenic; copper; cyanide;	The Proponent has not adequately answered either part of the IR. An updated site water management plan that includes the management of all water that has been in contact with project infrastructure and updated estimates of water volumes to	Refer to Attachment IR-12, IR-12-R1A, and IR-112-R1B below.		

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		(COPCs) directly from mining operations infrastructure. However, it still has the potential to contain deleterious substances from mine-related activities such as operation of vehicles, including heavy machinery and aircraft, spills, fire management practices, and snow removal practices. The Metal and Diamond Mining Effluent Regulations (MDMER) pursuant to the Fisheries Act requires all mine effluent and seepage from the mine site that contains deleterious substances be discharged through a final discharge point. This includes deleterious substances in non-contact water from all site infrastructure including the airstrip, roads, and camp area. Rationale: All mine effluent and seepage that contains deleterious substances must be discharged through a final discharge point. This includes site non-contact water which has the potential to contain deleterious substances such as those released from vehicles, machinery, aircrafts, spills, and de-icing practices. The Proponent has not included how non-contact water runoff from site infrastructure will be captured within site water management planning. To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the capture of non-contact water.			from roads, airstrip, camp area, etc.) during the different Project phases. Include updated information on water treatment flows, capacity and effluent discharge during normal operations, and a 24-hr Probable Maximum Precipitation (PMP) Event.	lead; nickel; zinc; suspended solids; radium 226; and un-ionized ammonia.) with the general concept of deleterious substance per the Fisheries Act. Mine effluent associated with MDMER defined deleterious substances will be discharged through a final discharge point to Whitefish Lake, and this has been reflected in the water management information presented in the draft EIS, including Section 2.2.3. The IR is suggesting Denison collects runoff water from the airstrip and roads with the rationale that this is needed in order to collect potential contact water associated with hydrocarbons spills (the text in rationale notes: This includes site non-contact water which has the potential to contain deleterious substances such as those released from vehicles, machinery, aircrafts, spills, and de-icing practices). As indicated in the draft EIS and in our initial response to IR-12 (refer to Annex 1, IR-12 on page 6/419), should a spill occur, the spill response plan will be followed. The details of Denison's response plans will be developed to support licensing as part of the Waste Management and Emergency Management and Fire Protection programs. Importantly, hydrocarbons are not mine waste-related deleterious substances perm MDMER definition. Collecting and treating non-contact runoff throughout the life of the Project would mean Denison collects an extremely large volume of clean water to protect against infrequent hydrocarbon spills which will be cleaned up in the appropriately scaled process (spill response), in terms of cost and risk to the environment. No other roads or airstrips in the region (including those associated with uranium mine and mill operations) requires the collection and treatment of runoff water from infrastructure such as roads and airstrips. It is not practical to do so and based on risk, the collection of non-contact water is not required. The road or trail to the airstrip is currently an unmaintained road: the decommissioned Fox Lake Road. For road upgrades and airstrip construction, Denison will be using material from the borrow area. Borrow pit area selection was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples. As such, the material used to upgrade roads and construct the airstrip will not be a source of metals or ARD. Denison will implement erosion control measures at infrastructure locations within 50 to 100 m of a waterbody (refer to response to IR-12 above and to Attachment IR-12, Figure IR-12-5: Distance from Project Footprint to Waterbodies) where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). In consideration of the above, Denison maintains that the runoff at the airstrip and roads are non-contact water. The water management mandate for the Wheeler River Project is to keep clean water clean and minimize the total volume of water requiring management, treatment, and discharge. In the draft and revised draft EIS, Denison has evaluated potential Project effects on surface drainage in Section 8.1, as part of the Project-surface water quantity interaction of Project overprinting of drainage areas. As noted in the draft EIS, Section 8.4.1.4.2.1, this assessment was appropriately focused on areas of active water collection. It was noted that the road and airstrip were not considered to affect hydrology materially. Both may potentially redirect some flow and have a small influence on the timing of concentration of runoff and infiltration rates; however, in general, they are anticipated to have a very small influence and are not expected to change runoff volumes at assessment nodes.	be drained and managed from overall site infrastructure (including runoff from roads, airstrip, camp area, etc.) are required to understand the potential effects of contaminants on the surrounding environment. The Proponent should include updated information on water treatment, flows, capacity and effluent discharge during normal operations, and a 24-hr Probable Maximum Precipitation (PMP) Event.			

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 9, 2024)	IR (ROUND 4, Sept.6, 2024)	Denison Response (ROUND 4, Sept. 16, 2024)
	IR-12-R1B	Context: The Proponent has clarified that there is no infrastructure in place for management of non-contact water from site infrastructure that may contain COPCs, including but not limited to roads, the airstrip, and the campground. Rationale: To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the type of infrastructure and its location for the capture of non-contact water	n/a	n/a	Provide a map marking the locations of proposed surface drainage structures for runoff collection including collection ditches, culverts, diversion ditches, perimeter berms, collection ponds and other similar structures.	It is Denison's opinion that this comment is not an IR related to the EIS. A request for clarification or additional information on a detailed design aspect would need to be responded to by Denison as part of the permitting and licensing process; however, this level of detail is not necessary for drawing conclusions on the EA process. In the draft and revised draft EIS, Denison has evaluated potential Project effects on surface drainage in Section 8.1, as part of the Project-surface water quantity interaction of Project overprinting of drainage areas. As noted in the draft EIS, Section 8.4.1.4.2.1, this assessment was appropriately focused on areas of active water collection. It was noted that the road and airstrip were not considered to affect hydrology materially. Both may potentially redirect some flow and have a small influence on the timing of concentration of runoff and infiltration rates; however, in general, they are anticipated to have a very small influence and are not expected to change runoff volumes at assessment nodes. Notwithstanding the above, Denson has provided the reviewer with additional, conceptual site drainage maps in Attachment IR-12, Figures IR-12-1, IR-12-2, IR-12-3, and IR-12-4; these are supplemental to the site drainage map provided in the draft EIS Figure 2.2-17.	n/a (accepted)	Refer to Attachment IR-12, IR-12-R1A, and IR-112-R1B below.		

ATTACHMENT IR-12 (included in Round 2 submission)

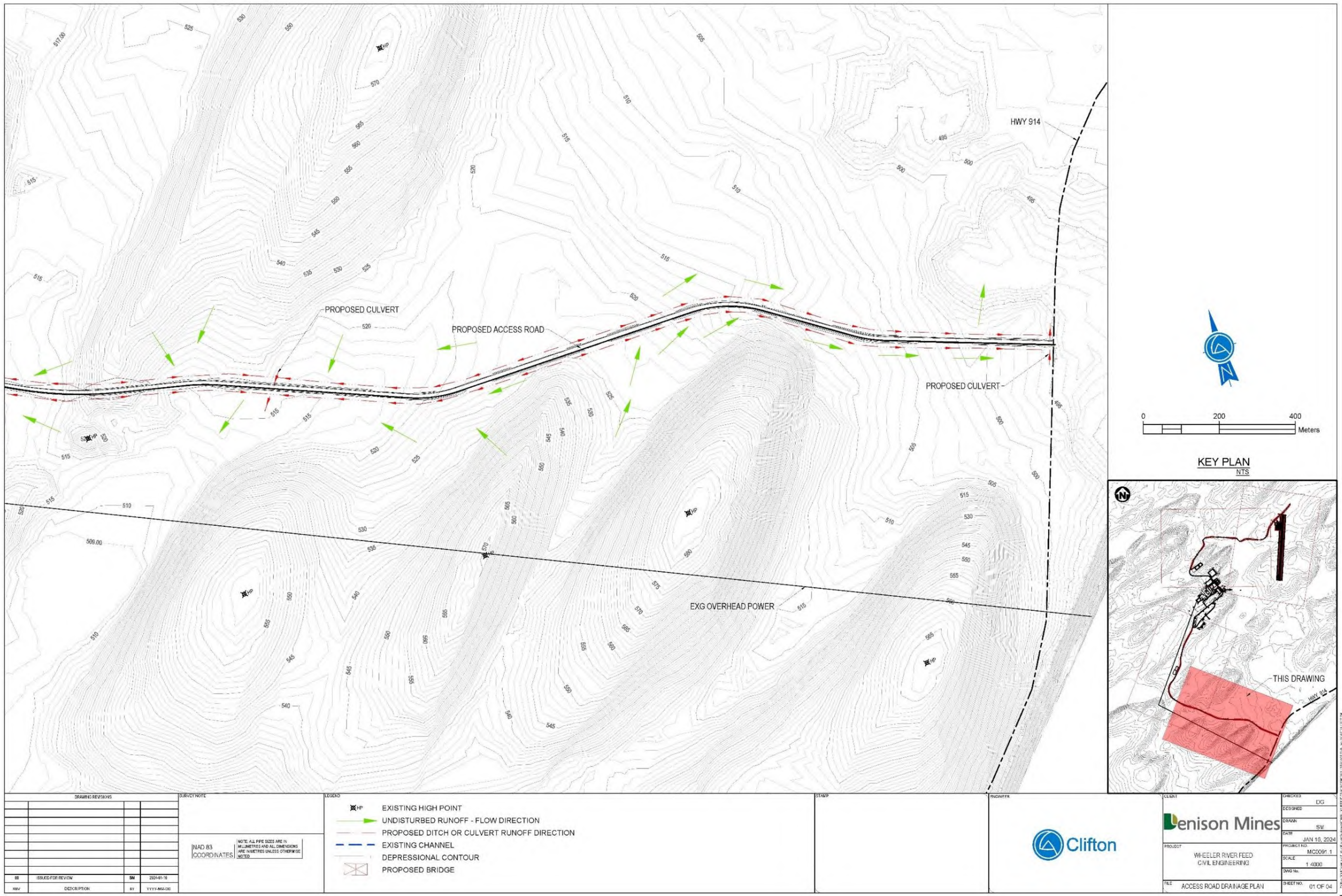


Figure IR-12- 1: Conceptual Site Drainage – Access Road (segment 1 of 2)

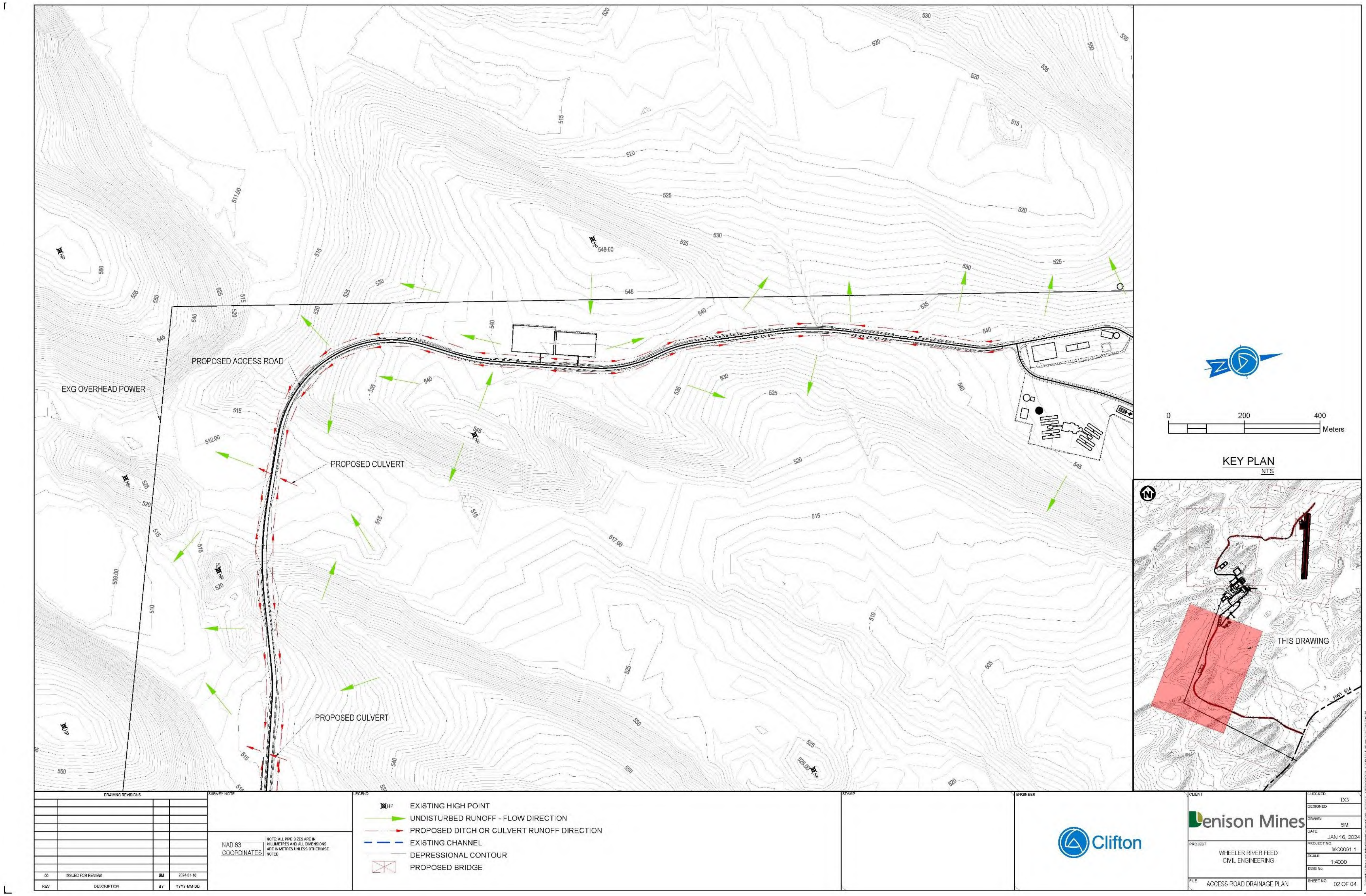


Figure IR-12- 2: Conceptual Site Drainage – Access Road (segment 2 of 2)

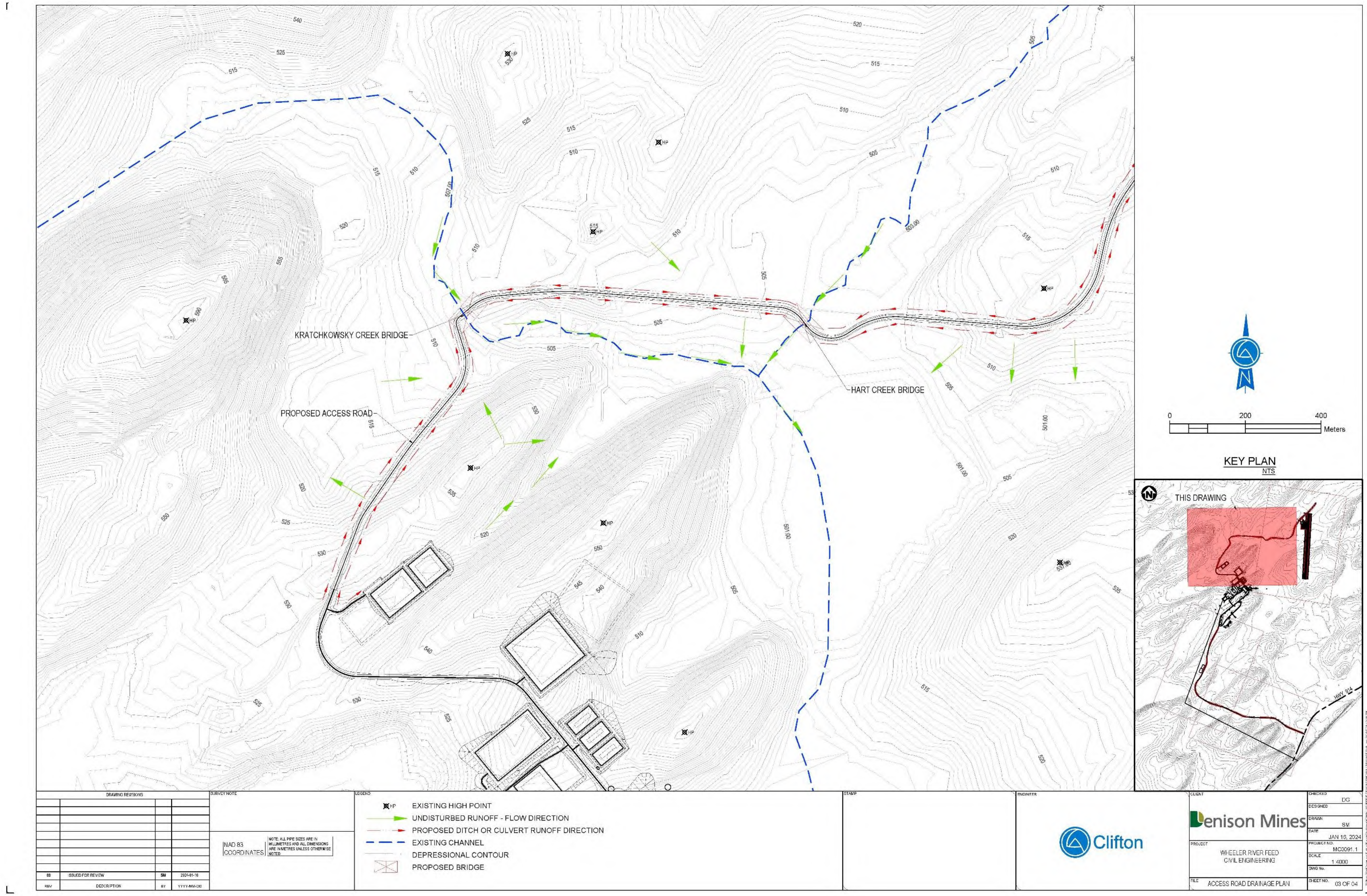


Figure IR-12- 3: Conceptual Site Drainage – Road to Airstrip

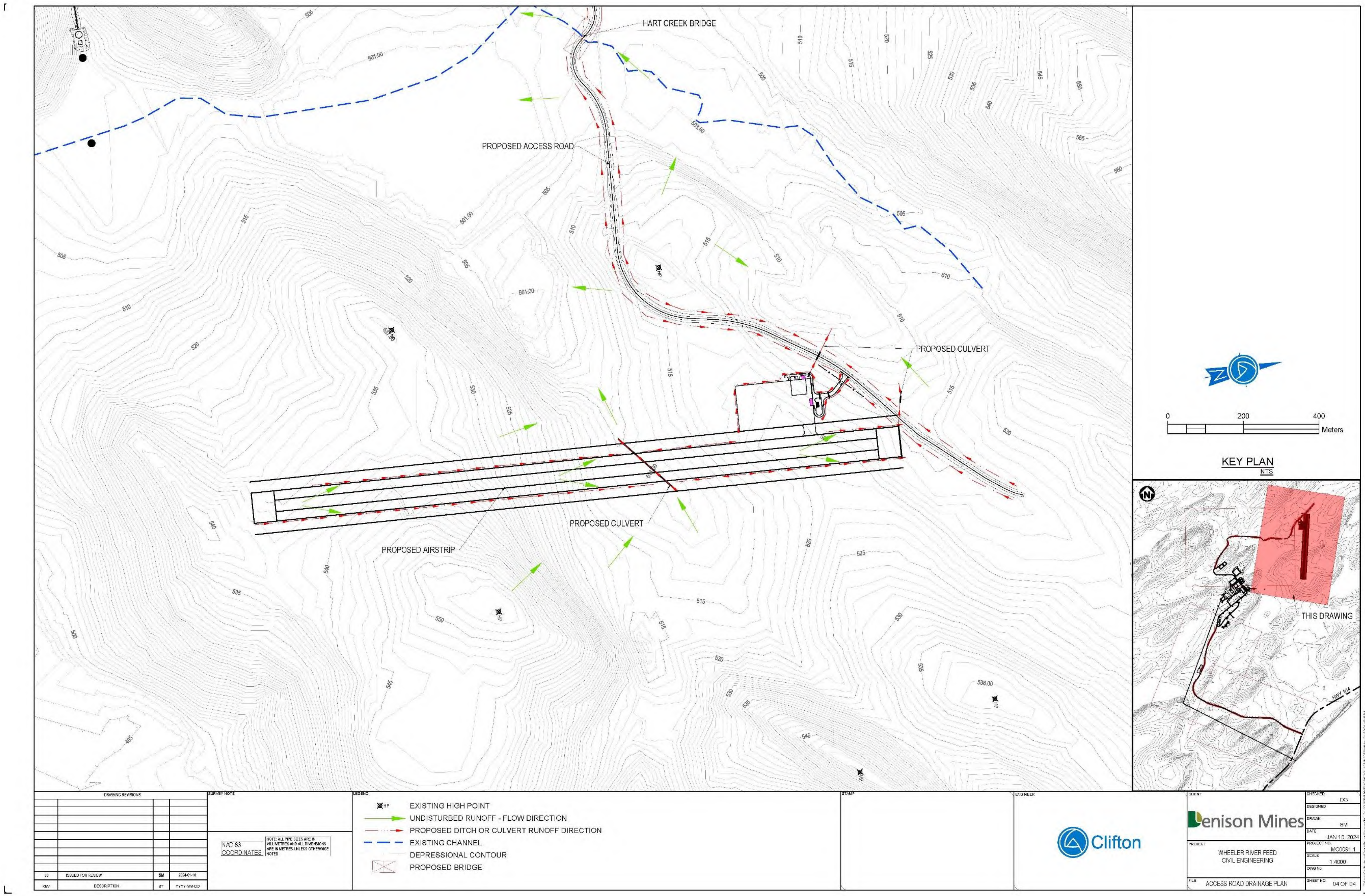


Figure IR-12- 4: Conceptual Site Drainage – Near Airstrip

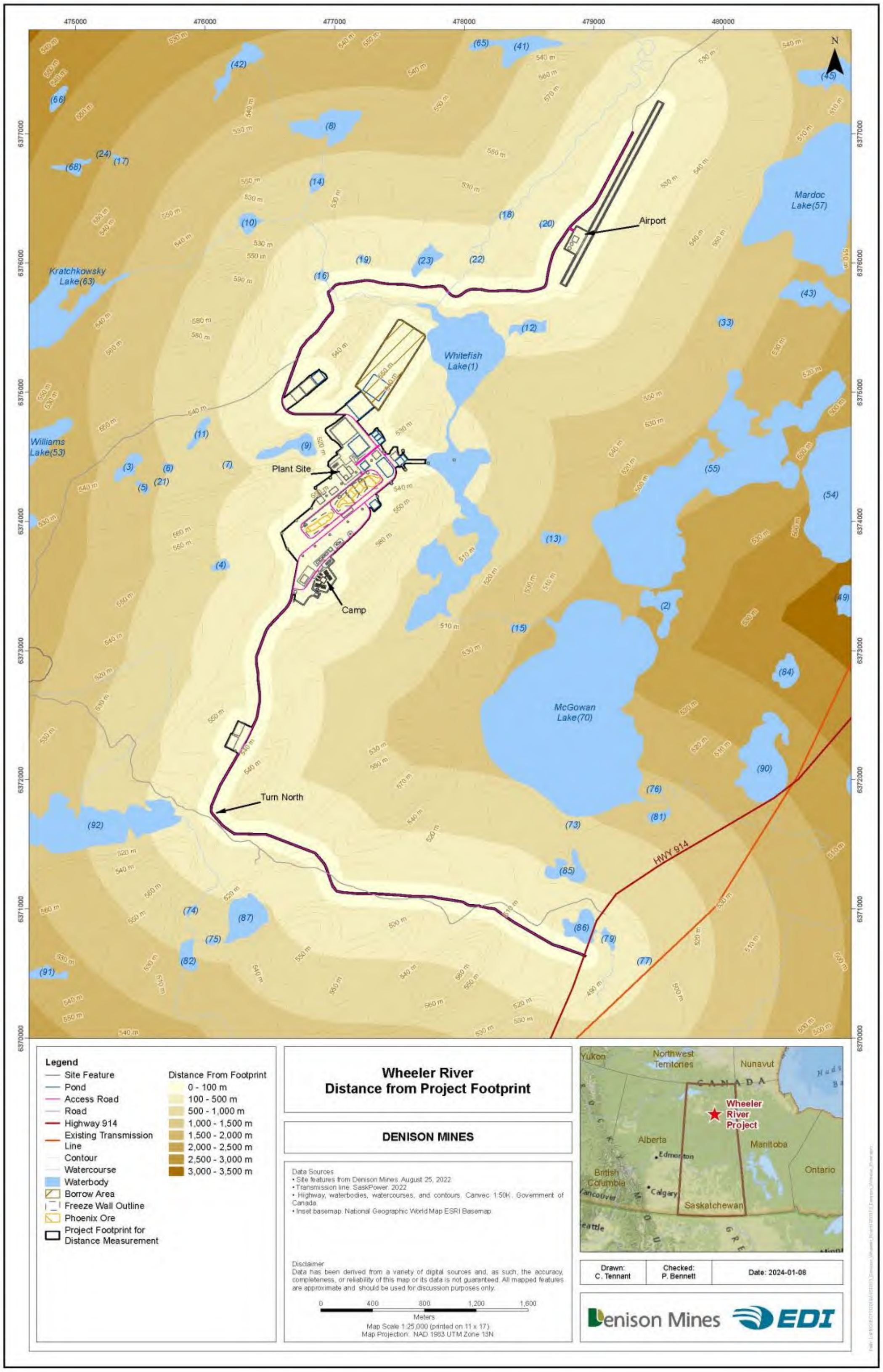


Figure IR-12-5: Distance from Project Footprint to Waterbodies

WHEELER RIVER PROJECT REVISED DRAFT EIS – JANUARY 2024

Denison Mines

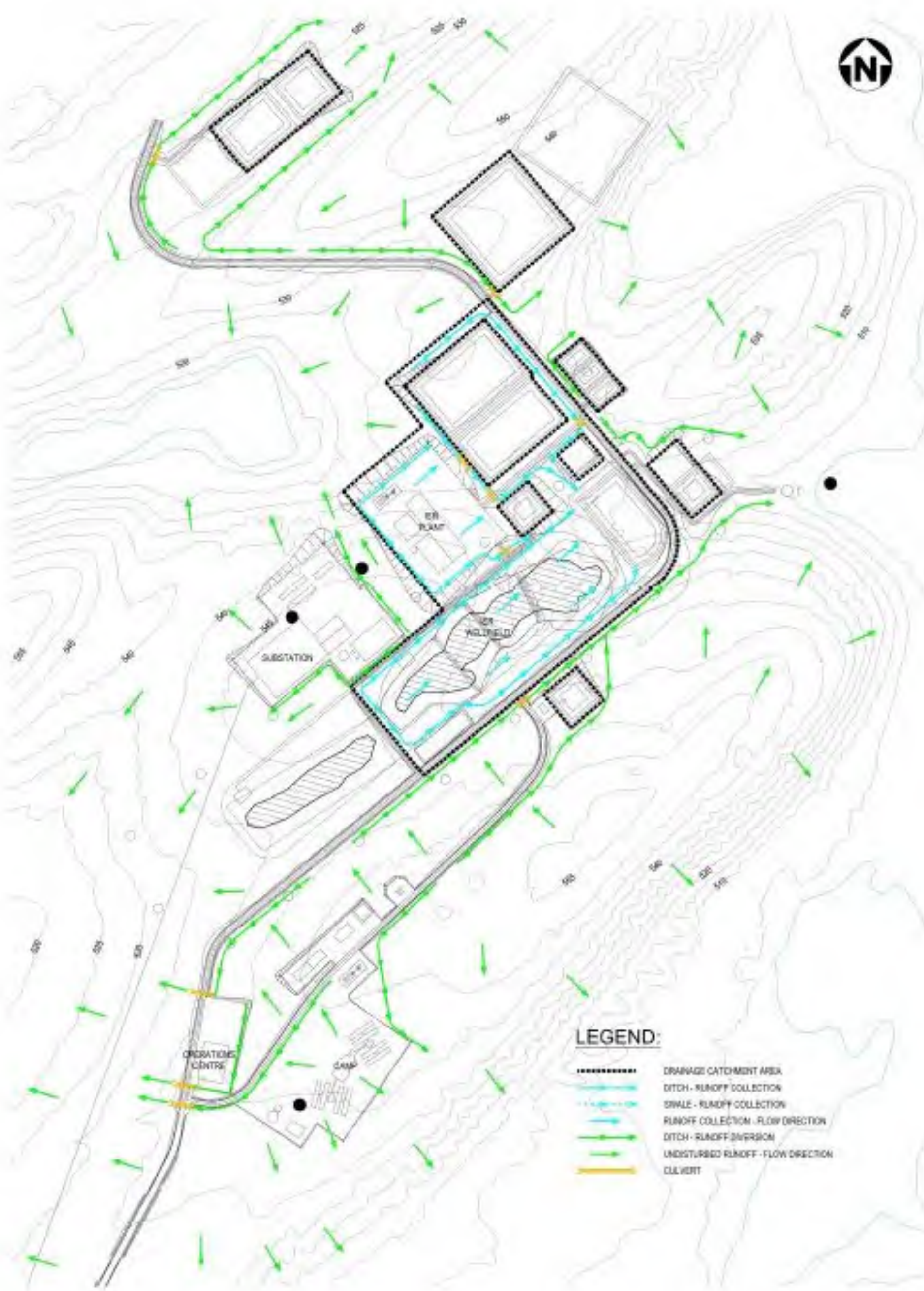


Figure 2.2-17: Site Drainage Plan with Flow Direction and Culvert Locations

For reference: Figure 2.2-17 from revised draft EIS

Attachment IR-12, IR-12-R1A, IR-12-R1B (Round 3 with updates from Round 4 in track changes)

In response to IR-12 and related IRs 12-R1A and 12-R1B Denison offers the following that has been divided into two parts.

In **Part 1**, an updated site water management plan is presented commensurate with the stage of the EA process for Wheeler River Project (or Project). That is, the site water management plan is largely conceptual at this time; however, Denison is able to provide additional information that builds on information presented previously in the EIS and supporting documentation including Round 1 and Round 2 IR responses as the Project-related engineering design process is advancing in parallel with the EA.

In **Part 2**, Denison has prepared specific responses to specific questions raised in IRs 12, 12-R1A and 12-R1B that are not necessary fully described by Part 1 of the response.

Part 1 – Wheeler River Project Site Water Management Plan

Introduction

The following conceptual Site Water Management Plan (SWMP, or Plan) has been prepared in response to the third round (May 2024) of Federal Indigenous Review Team (FIRT) information requirements (IRs) regarding the Wheeler River Project (Project) Environmental Impact Statement (EIS) submission, as well as the comments provided by CNSC on the Round 3 comment/disposition submission. The information offered herein builds on information provided previously by Denison Mines (Denison) in the EIS, its supporting documents, and responses to ~~Round 1 (March 2023) and Round 2 (November 2023)~~ FIRT IRs.

As noted, the Plan builds on information provided previously by Denison; but further seeks to consolidate this information into once place for ease of reference, as well as provide additional water management related detail that has been developed as Project-related engineering design has been advancing in parallel with the environmental assessment process. The Plan describes the SWMP design concept, its design basis, the delineation of so-called “contact” versus “non-contact” water management areas on the Project site, water management structures / infrastructure, the quantities of water that would be expected to be managed within the water management areas under normal and event-related conditions and monitoring.

The SWMP is provided with a conceptual level of detail and information commensurate with the stage of development of the Project and advancement of engineering design. Further detail and documentation, including engineering design to support construction, regarding site water management will be developed as the Project moves from the environmental assessment (EA) process into permitting and licensing, initially for site preparation and construction, subsequently for operations and ultimately for decommissioning.

Design Concept

The Project's design concept related to site water management is to keep clean water clean and minimize the total volume of water requiring more active management, treatment, and discharge. Denison will achieve this by 1) diverting clean, non-contact runoff around Project components and 2) collecting contact water for treatment in the Industrial Wastewater treatment Plant (IWWTP), and eventual release to Whitefish Lake. In general terms and within the context of this Plan, the following definitions are provided for contact and non-contact waters:

- Contact water is potentially contaminated as the result of interaction with Project process/structures/infrastructure and therefor requires management through site water infrastructure and conveyance to the IWWTP prior to controlled release to the environment.
- Non-contact water is suitable for direct release to the environment with appropriate, conventional best management practices and mitigation measures.

The rationale for the distinction of the two water types and management strategies is primarily associated with the desire to affect local hydrology as little as possible by only diverting runoff from natural catchments and sub-catchments where it is deemed necessary to protect water quality. Conceptually, minimizing changes in surface drainage patterns and watersheds is an important mitigation measure in the surface water quantity assessment. Collecting and managing non-contact water would result in a larger potential Project effect on surface water quantity associated with changes in surface drainage patterns and is not preferred.

Design Basis

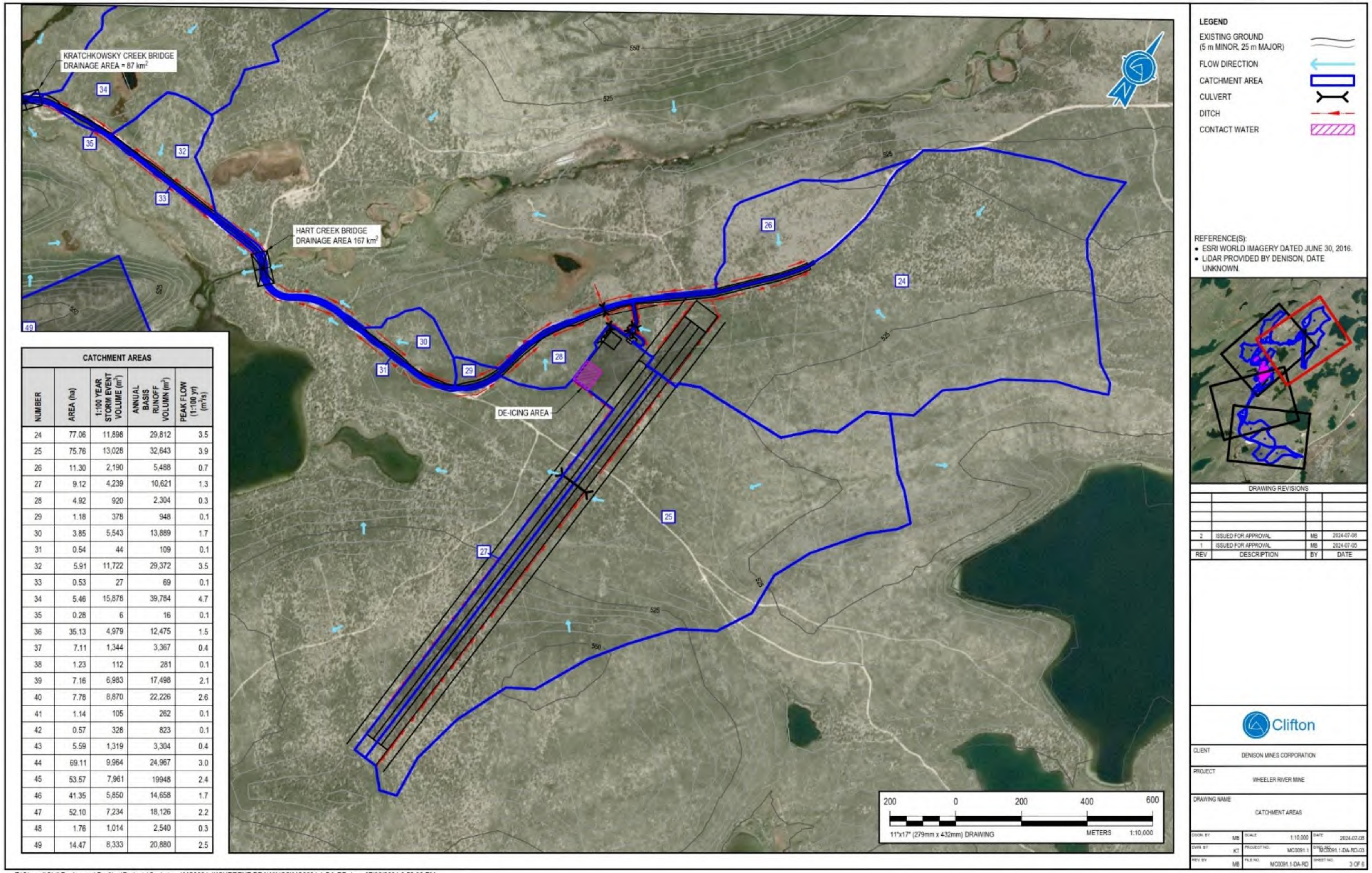
For the purpose of contact and non-contact water management, the following design bases have been assumed.

For the contact water portion of the system, all water management structures/infrastructure would be designed to contain an event equivalent to 493 mm of precipitation over a 24-hour period (herein referred to as the 24-hour probable maximum precipitation (PMP) event). By definition, events exceeding this magnitude would be conveyed to the environment through purposely built emergency spillways so that the structural integrity of the structures/infrastructure would be maintained and not result in further event related consequences. For context, this volume of water is greater than the average annual precipitation recorded at nearby Key Lake (refer to Appendix D to Appendix 6-C) for the period 2011 through 2020 that was 456 mm. Additionally, as described in Section 2 of the EIS, a wash bay is proposed as part of the Wheeler River Project infrastructure. The wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. For the purpose of the site water management strategy, water derived from the wash bay is by definition "contact water" (i.e., fits the definition of contact water above), despite the fact that the wash bay is associated with the "camp" area and is not considered in the screening of non-contact water sources below for that reason. The wash bay area will have an impermeable floor and a lined water collection sump. Rinse water from the wash bay sump will be routed to the wellfield runoff pond or directly to the process water pond. It will be subsequently conveyed as a component of the influent stream to the IWWTP and treated. Treated effluent would be discharged to Whitefish Lake once deemed suitable for release.

For the non-contact water portion of the system, all water management structures/infrastructure would be designed to withstand an event equivalent to 89 mm of precipitation over a 24-hour period (herein referred to as the 24-hour intensity-duration frequency (IDF) event). This event is the 1 in 100 year return event and was calculated utilizing the publicly available web-based intensity-duration-frequency tool that is pre-loaded with data from 898 Environment and Climate Change Canada rain stations. This number was derived based on the projection of conditions for the period 2020 - 2050 for the Wheeler River Project site coordinates and therefore considers the time period that overlaps with the time period when water is likely to be actively managed on the site (i.e., construction, operation, initial phase of decommissioning).

Delineation of Catchments Areas

For the purpose of defining water management areas / nodes within and adjacent to the Project site, a series of maps delineating catchments areas based on local topography and drainage patterns have been developed. The delineation of key catchments at the Project site is shown in Figures 1 to 5 below.



CATCHMENT AREAS

NUMBER	AREA (ha)	1:100 YEAR STORM EVENT VOLUME (m^3)	ANNUAL BASIS RUNOFF VOLUMN (m^3)	PEAK FLOW (1:100 yr) (m^3/s)
24	77.06	11,898	29,812	3.5
25	75.76	13,028	32,643	3.9
26	11.30	2,190	5,488	0.7
27	9.12	4,239	10,621	1.3
28	4.92	920	2,304	0.3
29	1.18	378	948	0.1
30	3.85	5,543	13,889	1.7
31	0.54	44	109	0.1
32	5.91	11,722	29,372	3.5
33	0.53	27	69	0.1
34	5.46	15,878	39,784	4.7
35	0.28	6	16	0.1
36	35.13	4,979	12,475	1.5
37	7.11	1,344	3,367	0.4
38	1.23	112	281	0.1
39	7.16	6,983	17,498	2.1
40	7.78	8,870	22,226	2.6
41	1.14	105	262	0.1
42	0.57	328	823	0.1
43	5.59	1,319	3,304	0.4
44	69.11	9,964	24,967	3.0
45	53.57	7,961	19948	2.4
46	41.35	5,850	14,658	1.7
47	52.10	7,234	18,126	2.2
48	1.76	1,014	2,540	0.3
49	14.47	8,333	20,880	2.5

Figure 1: Site water management catchment areas – layout 1 of 5: Airstrip and portion of airstrip access road

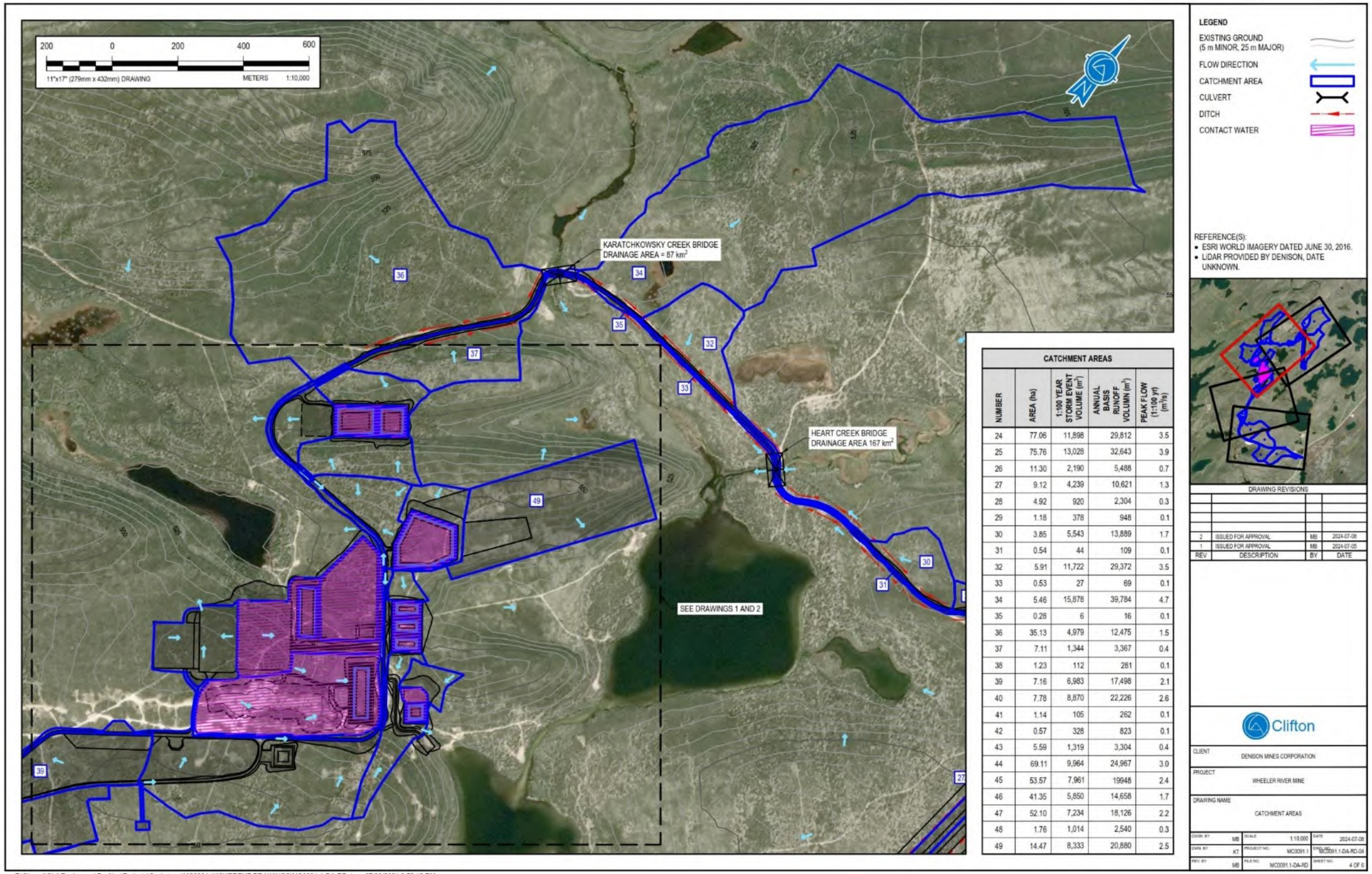


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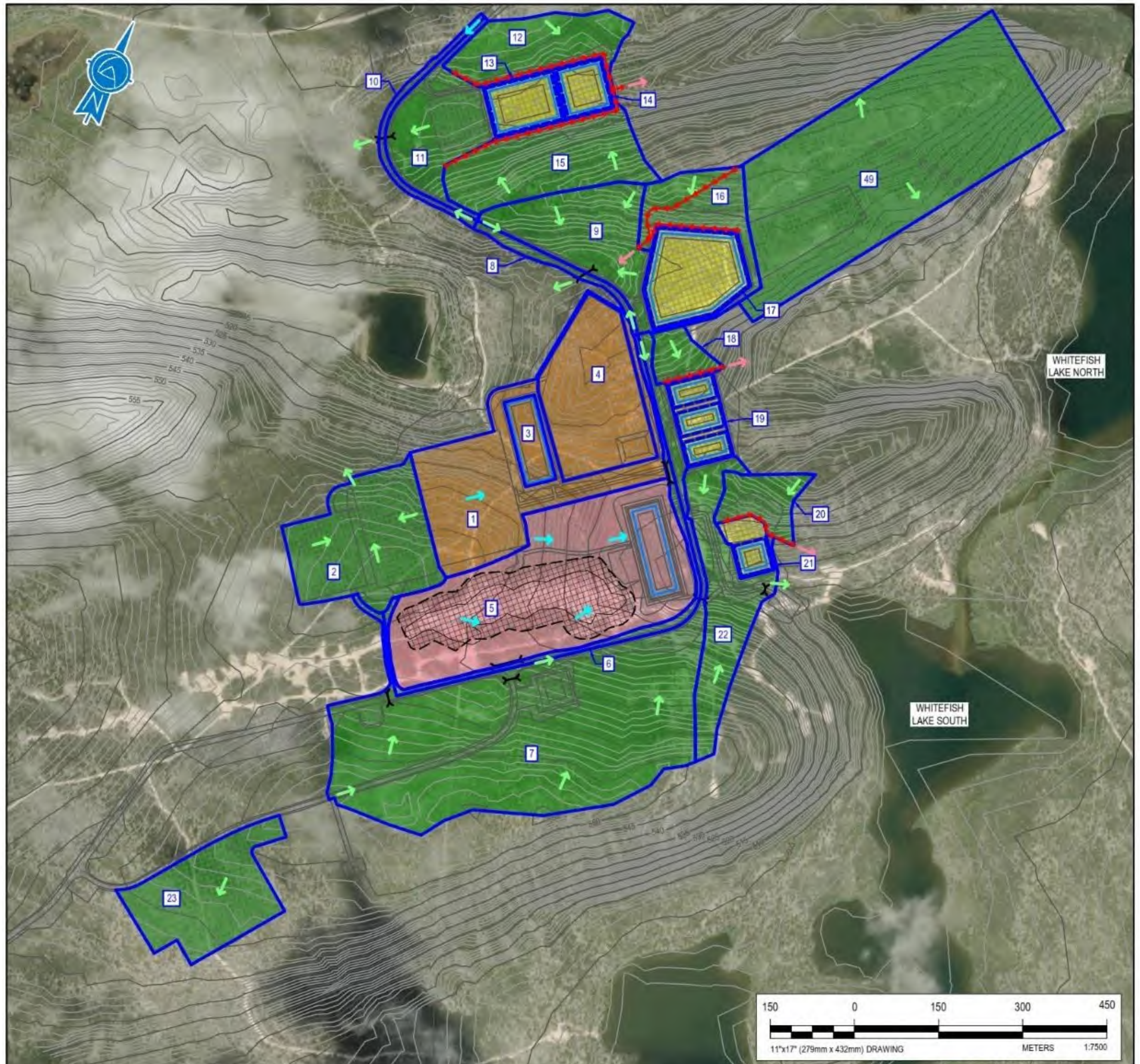
Figure 2: Site water management catchment areas – layout 2 of 5: Airstrip access road

CATCHMENT AREAS (ha)				
AREA	NAME	TOTAL	SELF-CONTAINED	EFFECTIVE AREA
1	PROCESS PLANT	6.01		6.01
2	FREEZE PLANT AND SUBSTATION	5.06		5.06
3	PROCESS WATER POND AND PUMPHOUSE	0.87		0.87
4	PROCESS PRECIPITATES SOLIDS PAD	4.58		4.58
5	ISR WELLFIELD	11.54		11.54
6	MAIN ROAD 1 WEST	1.14		1.14
7	MAIN ROAD 1 EAST	17.58		17.58
8	MAIN ROAD 2 WEST	0.53		0.53
9	MAIN ROAD 2 EAST	3.80		3.80
10	MAIN ROAD 3 WEST	0.57		0.57
11	MAIN ROAD 3 EAST	3.12		3.12
12	LANDFILL NORTH DIVERSION	2.89		2.89
13	INDUSTRIAL LANDFILL	1.20	1.20	0.00
14	LEACHATE COLLECTION POND	0.82	0.82	0.00
15	LANDFILL SOUTH DIVERSION	4.21		4.21
16	GYPSUM DIVERSION	2.24		2.24
17	GYPSUM PRECIPITATES POND	2.63	2.63	0.00
18	EFFLUENT NORTH DIVERSION	0.83		0.83
19	TREATED EFFLUENT MONITORING AND RELEASE PONDS	1.31	1.31	0.00
20	CLEAN WASTE DIVERSION	1.31		1.31
21	CLEAN WASTE PAD AND RUNOFF COLLECTION POND	0.71	0.32	0.39
22	LAKE ROAD	3.63		3.63
23	CAMP	4.15		4.15



LEGEND

EXISTING GROUND (1 m MINOR, 5 m MAJOR)
DIVERSION DITCH
FLOW DIRECTION (DIVERSION DITCH OUTLET)
FLOW DIRECTION (RELEASED TO ENVIRONMENT)
FLOW DIRECTION (CONTAINED ON SITE)
ZONE2, 3, OR NATURAL CATCHMENT AREA (RELEASED TO ENVIRONMENT)
POND SELF-CONTAINED CATCHMENT AREA (CONTAINED ON SITE)
ZONE 1 PLANT SITE CATCHMENT AREA (CONTAINED ON SITE)
ZONE 1 WELLFIELD CATCHMENT AREA (CONTAINED ON SITE)
CONTAINMENT BERM
POND
CULVERT

NOTE:
DOES NOT INCLUDE THE CAMP SITE AREA AND AERODROME.

REFERENCE(S):
- ESRI WORLD IMAGERY DATED JUNE 30, 2016.
- LiDAR PROVIDED BY DENISON, DATE UNKNOWN.

DRAWING REVISIONS			
2	ISSUED FOR APPROVAL	MB	2024-07-08
1	ISSUED FOR APPROVAL	MB	2024-07-05
0	ISSUED FOR APPROVAL	MB	2024-04-02
REV	DESCRIPTION	BY	DATE

Clifton

CLIENT: DENISON MINES CORPORATION
PROJECT: WHEELER RIVER MINE
DRAWING NAME: CATCHMENT AREAS

DSGN. BY	MB	SCALE	1:7500	DATE	2024-07-08
DWN. BY	ZS	PROJECT NO.	MC0091.1	DWG. NO.	MC0091.1-DA
REV. BY	MB	FILE NO.	MC0091.1	SHEET NO.	1 OF 6

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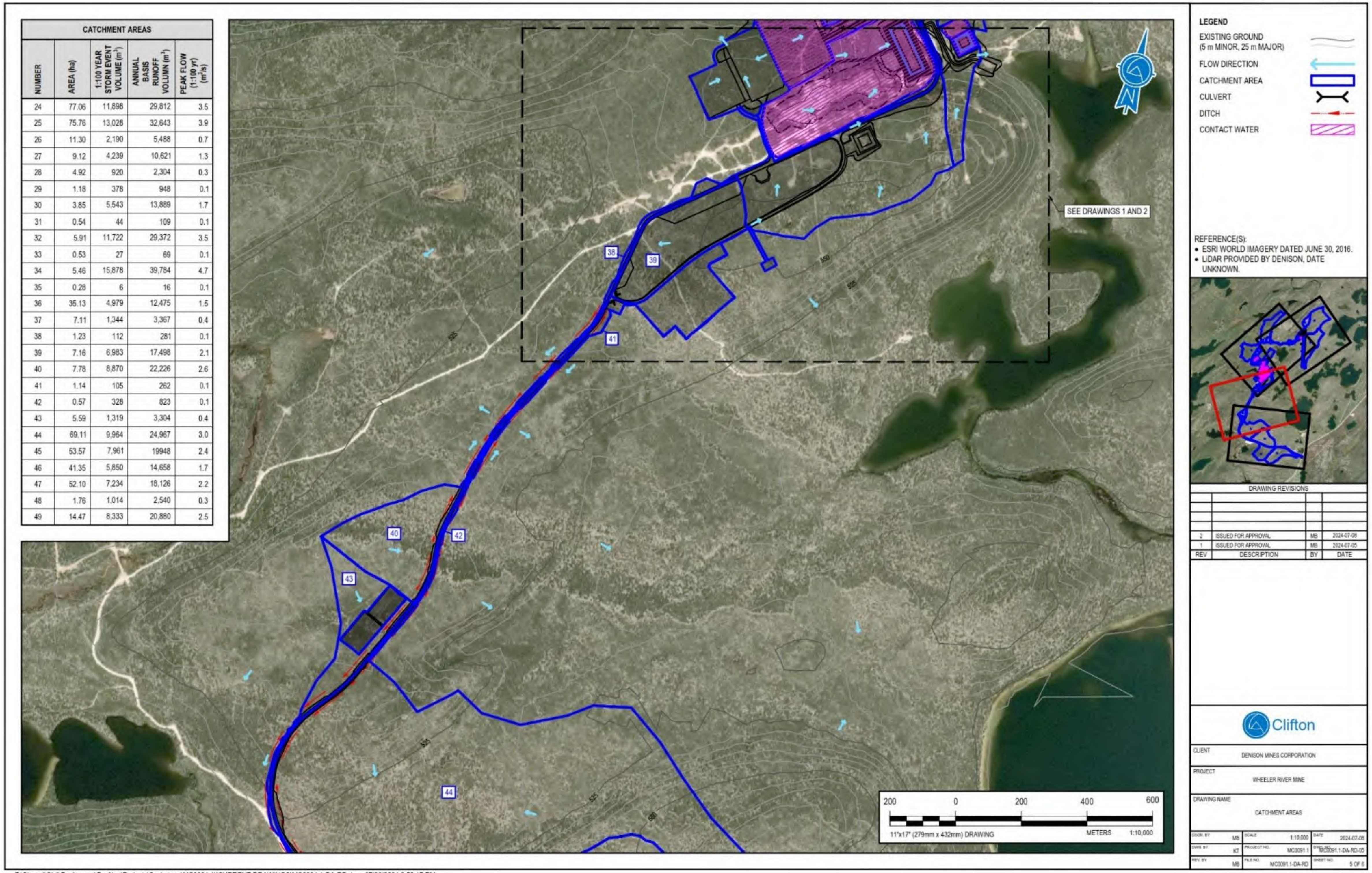
Figure 3: Site water management catchment areas – layout 3 of 5: main Project area



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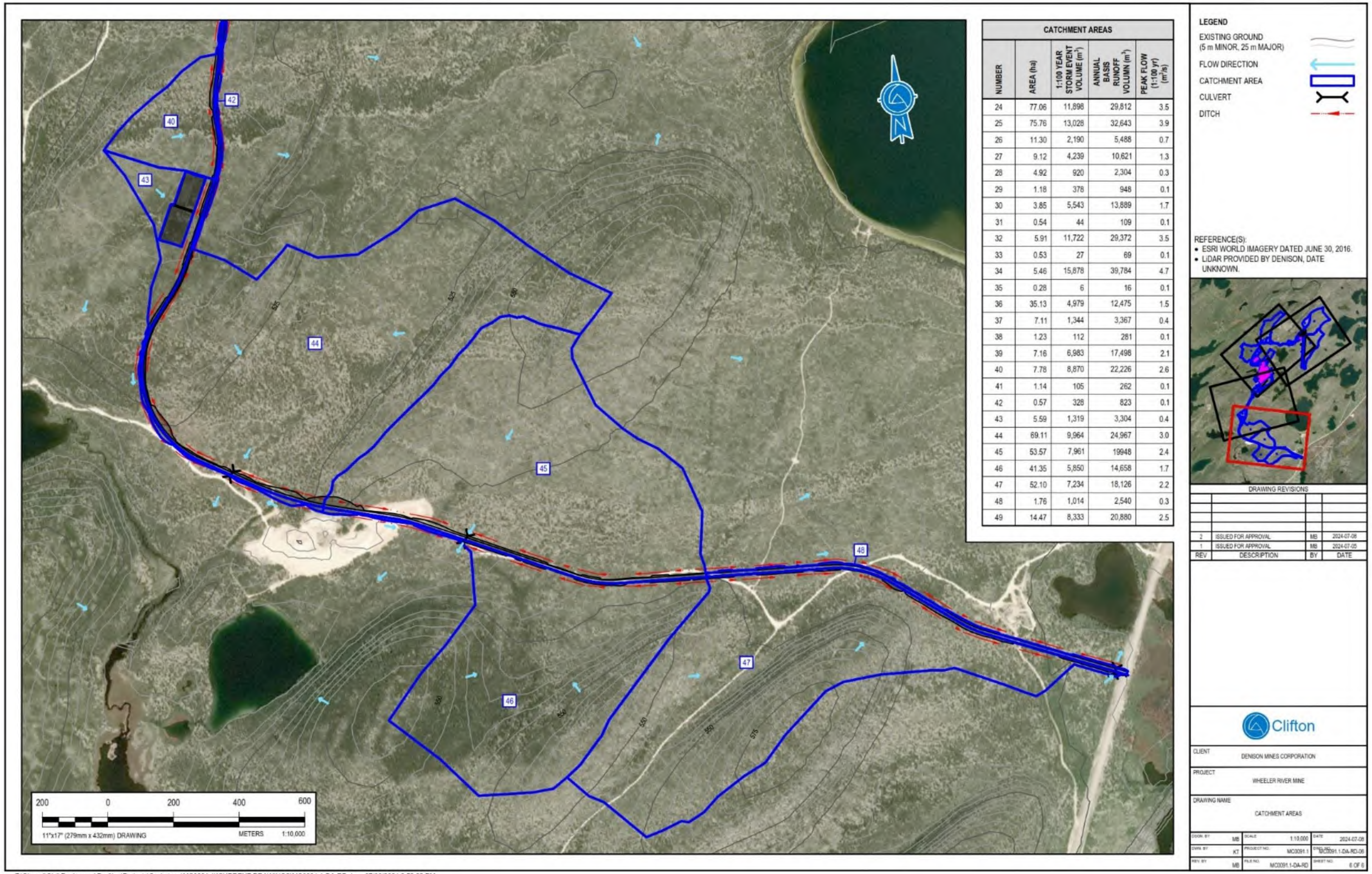
47	52.10	7,234	18,126	2.2
48	1.76	1,014	2,540	0.3
49	14.47	8,333	20,880	2.5

Figure 4: Site water management catchment areas – layout 4 of 5: Access road south of main Project area



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49	14.47	8,333	20,880	2.5

Figure 5: Site water management catchment areas – layout 5 of 5: Access road connection to Highway 914

Screening of Constituents of Potential Concern (COPCs) and Non-contact Water Source Areas

The screening of constituents of potential concern (COPCs) in non-contact water is provided in Table 1 and is organized in terms of catchment characteristics / land use and Project components within or adjacent to the catchments. A screening was not completed here for contact water, as Denison has previously outlined the need to collect and treat this water (refer to Section 2.3.3 of the EIS).

A description of the Project's landscape, key Project components and activities, and management system plans are included here to facilitate the screening exercise.

Setting

The Project is located within the Wheeler Upland Landscape Area of the Athabasca Plain Ecoregion within the Boreal Shield Ecozone of Saskatchewan. The area is characterized by Brunisolic soils which are typically sandy, well-drained soil. Standing water is not a common occurrence.

Ground surface topography regionally has been shaped by glacial and fluvial processes active for over tens of thousands of years. The terrain is characterized by northeast to southwest trending drumlins and eskers, with small variations in elevation (ranging 480 to 590 m above sea level) resulting in a gently sloping terrain. Most of the Project Area consists of upland forest ecosite. Refer to Figure 1-6 in the EIS for a summary of landscape features and current site conditions.

Airstrip

The airstrip will be constructed and maintained using locally-sourced granular material. Denison will be using material from the borrow area (overburden material). Borrow pit area selection was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples. As such, the material used to construct and maintain the airstrip will not be a source of metals or ARD.

Design for airstrip will in general be such that runoff will be encouraged through appropriate grading to drain away and not pond on or near the airstrip. The condition of the airstrip will be inspected and maintained routinely. For example, should unexpected water pooling be observed at the airstrip during Operation, temporary water removal means such as vac trucks or sump pumps could be employed, and the areas would be re-graded to minimize water accumulation.

All fueling and de-icing activities will occur in specifically designed areas to collect any hydrocarbons and de-icing fluids. Collected waters will be characterized and brought to the Project site for treatment, shipped offsite to an approved facility or released to environment if water quality allows.

Roads

Mainland access to the site will be from Highway 914. A 7-km section of road will be constructed from the highway to the Project site and a 5-km long road will also be constructed from the Project site to the airstrip; the total road length is 12 km. The road or trail to the airstrip is currently an unmaintained road: the decommissioned Fox Lake Road. Additional site roads will include, for instance, a service loop to the camp.

Roads will be constructed of locally-source granular subbase and base. For road upgrades and maintenance, Denison will be using material from the borrow area (overburden material). Borrow pit area selection was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples. As such, the material used to construct, upgrade, and maintain roads will not be a source of metals or ARD. Design for roads will in general be such that runoff will be encouraged through appropriate grading to drain away and not pond on or near the road. The condition of site roads will be inspected and maintained routinely. For example, should unexpected water pooling be observed during Operation, temporary water removal means such as vac trucks or sump pumps could be employed, and the areas would be re-graded to minimize water accumulation.

In terms of material being transported on the site roads, the final product (yellowcake) will be transported in sealed drums from the processing plant south to the public highway network. With the selection of the in-situ recovery method the Project does not involve transporting large volumes of mine waste rock around the site.

Stream Crossings

Two water crossings (Kratchkowsky Creek and Hart Creek) will be installed along the road from the Project site to the airstrip. Both stream crossings occur along the section of the road which is an existing, unmaintained road (the decommissioning Fox Lake Road). The crossings will be designed, constructed, and maintained to avoid causing harm to fish and fish habitat and will be clear span bridges. Clear span bridges are designed to completely span a watercourse without interfering with the channel bed and banks.

Miscellaneous Project Components

In the SWMP, specific consideration is given to other areas of the Project including the diversion ditches at the main Project area, borrow area, camp, freeze plant and substation based on the delineation of catchments / land uses. Infrastructure in these areas will be constructed using locally-source material from the borrow area and are subject to Project-wide management system and best management practices. Any specifics of relevance to water quality are provided in Table 1.

Management System

We note that accident and malfunctions screening and assessment was completed in Section 14 of the EIS. The SWMP and screening of COPCs contained herein focuses on more routine events within the Project design basis, for example discrete leaks or spills of hydrocarbons from equipment. Events outside of the design basis were appropriately considered in Section 14 of the EIS. For instance, through the hazard identification process (see Appendix 14-A Section 3.0 and Appendix A), the release of fuel (diesel) was carried forward for more detailed analysis.

While details of Denison's management system programs and plans will be developed to support licensing, for context on the SWMP a description of key topics is provided here.

Erosion and Sediment Control (ESC):

Soil erosion is a natural process, but erosion is increased when land is disturbed. Erosion can result in sedimentation. The main concern is erosion caused by precipitation and run off. Erosion control is any measure undertaken to reduce the potential for erosion to occur (SK MHI 2012). Sediment control is any measure implemented to reduce the potential for sediment to be transported and/or deposited beyond the limits of the site (SK MHI 2012). Erosion control will be viewed as a first defense when protecting downstream aquatic habitats, while sediment control will be implemented as a contingency plan. Denison will focus on preventing soil erosion in order to reduce sedimentation and potential effects to the aquatic environment. In selecting the appropriate ESC treatment for areas of the Project, Denison will consider both temporary and permanent measures. Selection of ESC measures are dependent on site slopes, drainage patterns, existing vegetation and other site-specific conditions. Erosion control measures may include preventing or minimizing ground disturbance when working near water, maintaining/retaining as much vegetation as possible, erosion control blankets, and rip rap. Sediment control measures may include wattles and silt fencing.

Spill Response Plan:

Should unplanned events or conditions occur, it will be important for Denison to address and respond in an appropriate manner. Denison will identify and reduce the potential for accidents and emergency situations, and implement emergency response plans that will protect the health and safety of its workers, contractors, the public and the environment. Spill response plans would include procedures for worker and environment protection, details about personnel protection equipment, and procedures to evaluate exposures during a spill.

Radiation Protection Program:

The Radiation Protection Program has been designed, and will be implemented, such that Denison complies with, or exceeds, the level of radiation safety that is required by the applicable regulations and Denison’s Environment, Health, Safety and Sustainability Policy. Areas within the Operation are designated according to potential radiological hazards and contamination control requirements. The movement and accumulation of all forms of radioactive contamination will be monitored via dosimetry and area monitoring. Contamination control measures will be in place to minimize the spread of radioactive materials into unintended locations.

Waste Management Program:

The Waste Management Program provides the framework that confirms Denison’s licensed activities involving the processing, storage, and disposal of wastes are performed in a manner that complies with applicable regulatory and licence requirements and protects workers, the public, and the environment. The Waste Management Program includes identification of waste inventory and the characteristics of the waste (radiological and hazardous non-radiological). The program also includes waste segregation, waste packaging, and transfer requirements, and the plan for storage or disposal of wastes. The Waste Management Program outlines the principles of reduction/reuse/recycle/and recovery (4 Rs) applied at the Project.

Personnel and Contractor Training and Performance Management Program:

A Personnel and Contractor Training and Performance Management Program would be developed to ensure all Project related personnel are fully equipped to effectively implement their work functions, in particular consideration of how job function may affect the environment, including worker and public health, within the context of the Environment Management System (EMS). Measurement of performance provides the means to Denison to foster a culture of continuous improvement.

Table 1: Screening of Constituents of Potential Concern (COPCs) in Water Catchments

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
Airstrip	24, 25, 27, 28	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If the material used to construct, and maintain the airstrip contains metals, then there is the potential for metals to leach into runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	At the airstrip, the infrastructure design in combination with management plans (e.g., geochemical characterization of borrow material, spill response plans, ESC) and best management practices result in a determination that runoff in this area is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage (ARD) is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If the material used to construct and maintain the airstrip results in ARD, the quality of runoff will be impacted and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	None expected	n/a	
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• All fueling and de-icing activities will occur in specifically designed areas to collect any hydrocarbons and de-icing fluids. ○ Collected waters will be characterized and brought to the project site for treatment, shipped offsite to an approved facility or released to environment if water quality allows. • Personnel training. • Spill Response Plan will be in place throughout the life of the Project. • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • Fuel storage and distribution infrastructure will be constructed in accordance with applicable legislation requirements. • Fuels will be stored in approved, above-ground, double-walled storage tank(s) equipped with secondary containment in accordance with provincial regulations and standards.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024): sediments can cover the small spaces between productive rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Restrict all construction activities to the approved construction footprint. • Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with erosion and sediment control (ESC).	
		Other Chemicals	A release of glycol and other de-icing fluids to the environment poses a threat to aquatic organisms.	• All fueling and de-icing activities will occur in specifically designed areas to collect any hydrocarbons and de-icing fluids. ○ Collected waters will be characterized and brought to the project site for treatment, shipped offsite to an approved facility or released to environment if water quality allows. • Personnel training • Spill and Emergency Response Plan will be in place throughout the life of the Project	

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
Roads	26, 29, 30, 31, 32, 33, 34, 35, 36, 37, 11, 10, 9, 8, 7, 6, 22, 38, 41, 42, 40, 43, 44, 45, 46, 47, 48	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If the material used to upgrade, construct, and maintain roads contains metals, then there is the potential for metals to leach into runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	On and adjacent to the Project's roads, ESC will be the focus. Best management practices are important for ESC throughout the life of the Project, and of particular importance during construction. Routine inspections and monitoring will be completed to document the effectiveness of the erosion and sediment control measures, and any required maintenance or replacement of ESC structures would be completed as required. Through the implementation of road design and best management practices, the runoff in these areas is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage (ARD) is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If the material used to upgrade, construct, and maintain roads results in ARD, the quality of runoff will be impacted and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	None expected.	n/a	
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • Traffic control measures. • Travel management plan. • A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing. • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • Fuel storage and distribution infrastructure will be constructed in accordance with applicable legislation requirements. • Fuels will be stored in approved, above-ground, double-walled storage tank(s) equipped with secondary containment in accordance with provincial regulations and standards. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024): sediments can cover the small spaces between productive rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Restrict all construction activities to the approved construction footprint. • Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with ESC, with a particular focus on Project components and activities located within 50 to100 m of a waterbody where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). Refer to Figure 6 below. • Traffic control measures.	
		Other Chemicals	Radionuclides are a potential contaminant associated with the Project activities.	• A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. • Administrative controls will be in place to control radioactive materials and radiological clearance: All objects (equipment, vehicles, etc.) from potentially contaminated work areas that need to be transported off-site as non-radioactive materials must be thoroughly cleaned and checked for contamination prior to release.	

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
Stream crossings	Kratchkowsky Creek bridge area and Hart Creek bridge area	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If the material used to upgrade, construct, and maintain roads adjacent to the stream crossings contains metals, then there is the potential for metals to leach into runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	The stream crossings are clear span bridges. At the stream crossing location, the infrastructure design in combination with management plans associated with the adjacent roads (e.g., geochemical characterization of borrow material, spill response plans, ESC) and best management practices result in a determination that runoff in these areas is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If the material used to upgrade, construct, and maintain roads adjacent to the stream crossings results in ARD, the quality of runoff will be impacted and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	None expected.	n/a	
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing. • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024): sediments can cover the small spaces between productive rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Restrict all construction activities to the approved construction footprint. • Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with ESC, with a particular focus on Project components and activities located within 50 to100 m of a waterbody where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). Refer to Figure 6 below. • Traffic control measures.	
		Other Chemicals	None expected	n/a	
Borrow area	49	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If the borrow area contains metals, then there is the potential for metals to leach into runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	Erosion and sediment control will be important at the borrow area. Routine inspections and monitoring will be completed to document the effectiveness of the erosion and sediment control measures, and any required maintenance or replacement of ESC structures would be completed as required. Through the implementation of various best management practices, the runoff at the borrow area is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If earthworks associated with the borrow area results in ARD, the quality of runoff will be impacted and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	None expected.	n/a	

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing. • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024): sediments can cover the small spaces between productive rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Restrict all construction activities to the approved construction footprint. • Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with ESC, with a particular focus on Project components and activities located within 50 to100 m of a waterbody where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). Refer to Figure 6 below. • Traffic control measures.	
		Other Chemicals	None expected	n/a	
Diversion ditches around Project components (Figure 3)	12 (landfill north diversion), 15 (landfill south diversion), 16 (gypsum diversion), 18 (effluent north diversion), 20 (clean waste diversion)	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If diversion ditches are constructed with material containing metals, then there is the potential for metals to leach into runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	At the diversions ditches, the infrastructure design in combination with management plans (e.g., geochemical characterization of borrow material, spill response plans, ESC) and best management practices result in a determination that runoff in this area is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If diversion ditches are constructed of sulfide containing material, then there may be potential for ARD to occur, the quality of runoff will be impacted, and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	None expected.	n/a	
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing. • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024): sediments can cover the small spaces between productive	• Restrict all construction activities to the approved construction footprint.	

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
			rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with ESC, with a particular focus on Project components and activities located within 50 to100 m of a waterbody where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). Refer to Figure 6 below. • Traffic control measures.	
		Other Chemicals	None expected.	n/a	
Freeze Plant and Substation	2	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If the freeze plant and substation foundations/pads are constructed with material containing metals, then there is the potential for metals to leach into runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	At the freeze plant and substation area, the infrastructure design in combination with management plans (e.g., geochemical characterization of borrow material, spill response plans, ESC) and best management practices result in a determination that runoff in this area is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If the freeze plant and substation foundations/pads are constructed of sulfide containing material, then there may be potential for ARD to occur, the quality of runoff will be impacted, and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	None expected.	n/a	
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing. • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024): sediments can cover the small spaces between productive rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Restrict all construction activities to the approved construction footprint. • Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with ESC, with a particular focus on Project components and activities located within 50 to100 m of a waterbody where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). Refer to Figure 6 below. • Traffic control measures.	
		Other Chemicals	Freeze plant chemicals, e.g., calcium chloride brine	• Spill Response Plan will be in place throughout the life of the Project	
Camp	22	Metals (metal leaching)	Metal leaching can occur when certain minerals in rocks containing metals are exposed to air and water. If the camp foundations/pads are constructed with material containing metals, then there is the potential for metals to leach into	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are	At the camp area, the infrastructure design in combination with management plans (e.g., geochemical characterization of borrow material,

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
			runoff, and report to the surrounding environment, where there is the potential for negative effects on the aquatic environment.	ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	spill response plans, ESC) and best management practices result in a determination that runoff in this area is classified as **non-contact water**.
		Acid Rock Drainage	Acid rock drainage is a process where sulfide minerals in rocks react with air and water to produce sulfuric acid, which then leaches metals from the rocks. If the camp foundations/pads are constructed of sulfide containing material, then there may be potential for ARD to occur, the quality of runoff will be impacted, and there is the potential for negative effects on the aquatic environment.	• The borrow pit area selected for construction and maintenance of various Project components was based on geotechnical program completed in 2021 which did not identify any potential for ARD/ML. Further works are ongoing part of engineering activities and with confirmation of characterization through assays of representative samples.	
		Nutrients	The domestic wastewater treatment plant (DWWTP) is a contained modular facility and as such represents low risk of routine or accidental release. The domestic wastewater treatment plant pond stores treated domestic wastewater prior to conveyance to the process water pond that reports to the industrial wastewater treatment plant (IWWTP). The accidents and malfunctions assessment (EIS Section 14) considered four scenarios that could introduce COPCs to the environment from site "ponds and retention berms" (see Table 3-13, Appendix A or EIS Appendix 14-A), including overtopping, flooding and containment failure. The "ponds and retention berms" scenarios were deemed low risk or risks were deemed to be as low as reasonably practical (ALARP), given design and other mitigations. Overtopping, flooding and containment failure related to releases at the domestic wastewater treatment plant pond is unlikely; however, it would have the potential for release of constituents in treated domestic wastewater to reach the aquatic environment (Whitefish Lake). For reference Whitefish Lake is approximately 500 m downgradient of the domestic wastewater treatment plant pond. Consequences of a release of treated domestic wastewater into Whitefish Lake could result in localized and/or transient effects such as increased nutrient concentrations (and associated algal growth), oxygen depletion, or toxicity to aquatic biota.	• Personnel training and orientation • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • Surface water management • Pond designed for PMP • Pond designed with composite liner system • Monitoring (surface water and groundwater) • Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan.	
		Hydrocarbons	A release of hydrocarbons such as diesel, gasoline, or jet fuel to the environment poses a threat to aquatic organisms.	• Spill Response Plan will be in place throughout the life of the Project • Appropriate spill response kits will be positioned adjacent to areas where hazardous materials such as hydrocarbons are stored in accordance with the Spill Response Plan. • A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing. • Project components including equipment and machinery will be regularly maintained and inspected to make sure they are in good working order. • A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants.	
		Suspended solids	Erosion and the resulting sedimentation can have a number of impacts on the aquatic environment (WSA 2024):	• Restrict all construction activities to the approved construction footprint.	

Catchment Description	Catchment IDs	Constituent Group	Risk to Aquatic Environment	Management / Mitigation	Summary
			sediments can cover the small spaces between productive rock or gravel habitats; increased levels of sediment in the water can displace aquatic organisms from prime habitat into less suitable areas; cloudy or turbid waters affect visual predators' ability to forage; high levels of suspended sediment in the water can affect fish and other aquatic organisms' ability to breath; and turbid water absorbs more sunlight energy increasing the water temperature, which in turn, does not allow the water to hold as much oxygen.	• Leave vegetated buffer zones around watercourses and other sensitive features when developing/operating supporting infrastructure. • Implement best management practices associated with ESC, with a particular focus on Project components and activities located within 50 to100 m of a waterbody where required (i.e., at locations where there is no vegetated buffer adjacent to the waterbodies). Refer to Figure 6 below. • Traffic control measures.	
		Other Chemicals	Radionuclides are a potential contaminant associated with the Project activities.	• A wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. • Administrative controls will be in place to control radioactive materials and radiological clearance: All objects (equipment, vehicles, etc.) from potentially contaminated work areas that need to be transported off-site as non-radioactive materials must be thoroughly cleaned and checked for contamination prior to release.	

Notes:

- As described earlier in the SWMP, the screening completed in Table 1 is based on routine or normal operating conditions. Accidents and malfunction type risks were assessed separately in Section 14 of the EIS and mitigations associated with accident and malfunction events have been incorporated and described in that analysis in the EIS.
- As described in Section 2 of the EIS, a wash bay is proposed as part of the Wheeler River Project infrastructure. The wash bay will be available to clean items, equipment, and vehicles that may have been in contact with potential contaminants. For the purpose of the site water management strategy, water derived from the wash bay is by definition "contact water" (i.e., fits the definition of contact water above) and is not considered in the screening of non-contact water sources in Table 1 for that reason. The wash bay area will have an impermeable floor and a lined water collection sump. Rinse water from the wash bay sump will be routed to the wellfield runoff pond or directly to the process water pond. It will be subsequently conveyed as a component of the influent stream to the IWWTP and treated. Treated effluent would be discharged to Whitefish Lake once deemed suitable for release.

n/a = not applicable
ARD = acid rock drainage
ARD/ML = acid rock drainage/metal leaching
ESC = erosion and sediment control

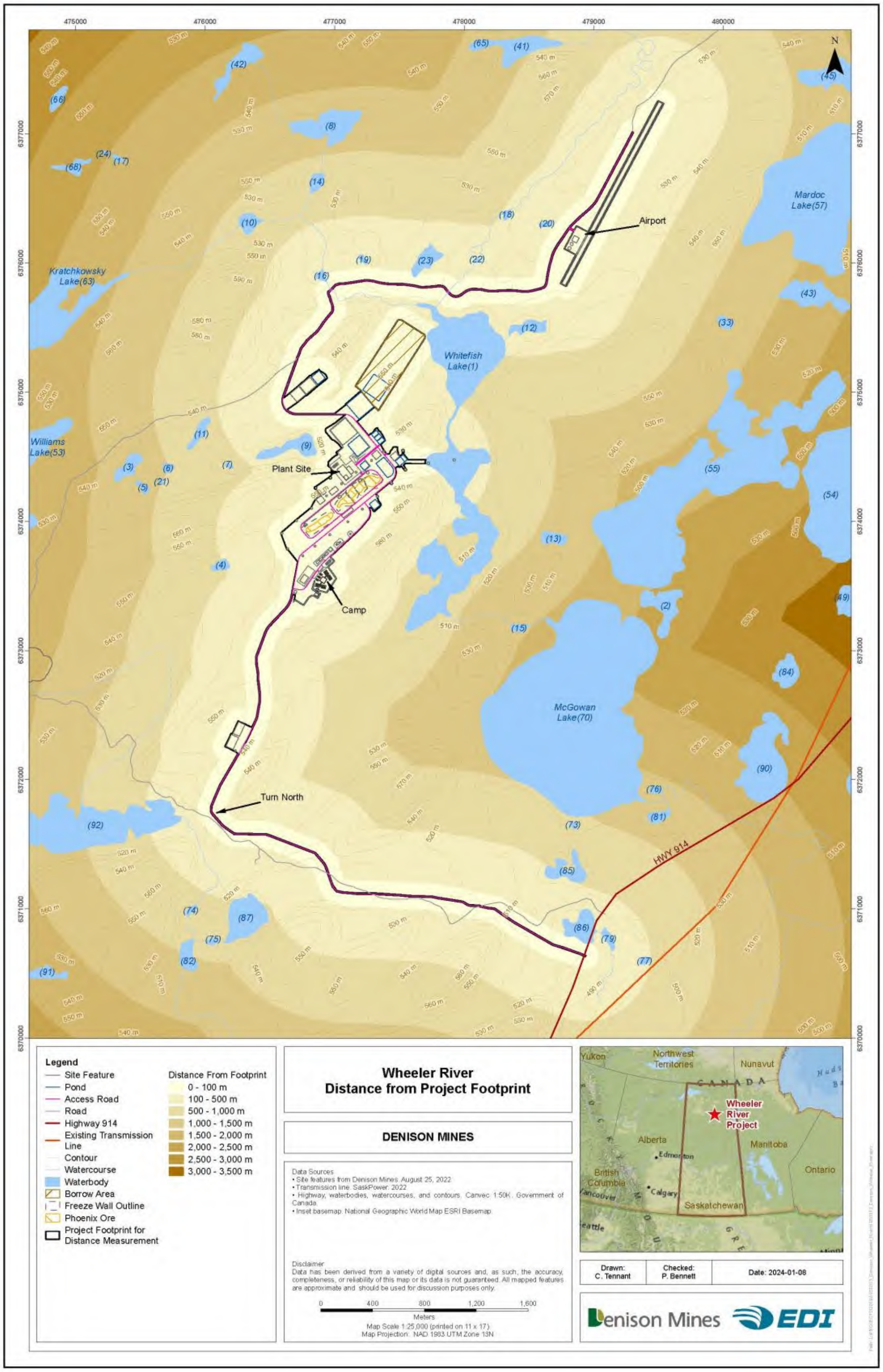


Figure 6: Distance from Project Footprint to Waterbodies

Delineation of Contact and Non-contact Water Source Areas on the Site

Based on information in the EIS and additional clarifications contained here, contact water is expected at the wellfield, processing plant terrace, the refueling and de-icing area at the airstrip, and leachate collection areas at the landfills. Contact water will be collected in various ponds and eventually routed through the IWWTP for treatment prior to release to Whitefish Lake.

Based on the screening completed in Table 1 using Figures 1 through 5, the non-contact water areas are locations where clean water can be diverted away from Project infrastructure. Through design and implementation of best management practices, the catchment areas described above were determined to contain non-contact water. The runoff from these areas will not be collected and treated.

Estimation of Typical and Event Volumes from Contact and Non-contact Water Source Areas

Refer to Figures 1 to 5 for information on the size of individual catchment areas, the volume of water expected on an annual basis and with a 1:100 year storm event, and the peak flow associated with a 1:100 year storm event.

At the wellfield and processing plant terrace the volume of water expected during a 24-hour PMP of 493 mm is approximately 37,240 m^3. The wellfield runoff pond has been sized appropriately (38,200 m^3 with 1 m of freeboard) to contain this volume of water.

Water Management Structures

The Stormwater Management Plan associated with non-contact water uses shallow ditching to dissipate the energy of runoff, to promote settling of suspended solids and allow the runoff to report to ground via natural grades that flow away from the infrastructure and into the natural drainage systems. The approximate location of proposed ditches are shown in Figures 1 through 5.

Diversion ditching of non-contact water away from disturbed and developed areas. Diversion ditching is designed to divert as much clean non-contact surface water as reasonably possible away from any disturbed areas, facilities or works where that water may become contaminated, including but not limited to the wellfield, processing plant area, and waste management areas.

Road ditch inverts adjacent to roadways and graveled pads should be lower than the subgrade at the shoulder and ditches will be designed based on specific criteria for slopes (sideslopes, longitudinal slopes), bottom widths, a range of velocities, and a minimum freeboard (refer to Table 2). Ditch design criteria will be refined as the Project advances.

Table 2: Preliminary Ditch Design Criteria

Ditch Element	Design Criteria
Conveyance Capacity Requirements	a) 1:100 yr., 24 hr. event for diversion ditches and non-contact water collection ditches b) 24 hr. PMP event critical ditches where upset would be considered a release to environment (i.e., contact water)
Manning's Roughness Coefficient	n = 0.030

Preferred Ditch Sideslopes	3H:1V
Maximum Ditch Sideslopes	2H:1V (with depth restrictions and possible sideslope erosion protection determined on case-by-case basis)
Minimum Longitudinal Slope	0.20%
Maximum Longitudinal Slope	2.00% (steeper ditching require engineered channels)
Minimum Velocity	0.3 m/s
Maximum Velocity	0.73 m/s (subject to variance dependent on ditch bottom materials)
Preferred Ditch Bottom Width	1200 mm
Minimum Ditch Bottom Width	600 mm
Minimum Ditch Freeboard	200 mm (below road finished grade shoulder to 1:100 yr 24 hour rain event)

Armouring such as rip-rap or re-vegetation will be required for erosion prone areas on all road slopes and ditching. Because of the sandy soil conditions of this site, erosion control will be an important consideration in design for all ditching and grading features due to high erodibility of the soils. Ditches require armouring for a minimum horizontal distance of 3 metres around culvert inlets, or as determined by hydraulic modeling. The general rule for protecting the downstream of a culvert is that armouring of three (3) pipe diameters should be used for each 1 m/s of velocity reduction required.

Monitoring and Compliance

Site water management plan monitoring will be conducted, primarily to confirm the best management practices related to ESC are functioning as intended. Routine inspections and management would be completed to document the effectiveness of the ESC measures, and any maintenance or replacement of ESC structures would be completed as required.

The EIS Section 2.9 Management System outlines the framework to support EIS review. The Project's detailed management programs and plans will be developed to support licensing and permitting. Of relevance to this Plan, the following is noted:

- The Spill Response Plan will outline how Denison will appropriately respond to and clean-up any unexpected spills. Spill reporting to Saskatchewan Ministry of Environment, ECCC, and the public will be required depending on the nature of the spill.
- The Effluent and Emissions Monitoring Plan includes sampling plans for stormwater during construction.
- The Construction Management Plan incorporates environmental considerations. Construction activities with higher potential risk of ESC problems include excavation and borrow areas, clearing and grubbing, ditch construction, and earthwork near/across streams and lakes
- Environment inspections will be conducted at various project areas on a frequency specified in future licences and permits. This may include for instance daily and weekly

inspections of fuel storage tanks, ponds, pads, lines, etc. to ensure compliance with operational conditions, best management practices and other requirements. Inspection (and sampling) plans for non-contact water mitigation measures such as silt fencing will coincide with precipitation events and spring runoff.

Various aspects of Project monitoring will not only be included in Denison's management system documentation but also included as conditions in permits, authorizations, and licences. The Provincial laws governing development in, or near, water are set out in *The Environmental Management and Protection Act, 2010* and *The Environmental Management and Protection (General) Regulations*. Denison will apply to the Saskatchewan Water Security Agency for an Aquatic Habitat Protection Work for any work near water and will adhere to the conditions of the permit. Fish and fish habitat are protected by provisions of the *Fisheries Act*. The Project will be constructed, operated and decommissioned in a manner compliant with Section 36 of the *Fisheries Act*. The Ministry of Environment enforces provincial legislation in collaboration with federal regulators.

Education and Training

Denison will provide education and training to staff and contractors about the importance of non-contact water management and best practices associated with erosion and sediment control. This helps ensure that everyone involved in the safe Construction, Operation and Decommissioning of the Project understands their role in protecting the aquatic environment.

In Closing

Denison views the EIS as an important planning tool that will be used to support future activities and represents one stage in the rigorous overall approvals process for a uranium mining facility in Canada. Denison is completing a sequential EA and licensing process for the Project. In the EIS, a framework for the EMS is provided along with a clear commitment for Denison to include Project design and water management-related mitigation measures into the EMS documents as they are developed / as the Project proceeds through the licensing and permitting phases. We trust that the FIRT has been provided with the appropriate level of detail on the water management topic for drawing conclusions on the EA process, and the summary contained in this SWMP will facilitate ECCC's review.

References:

Saskatchewan Water Security Agency. 2024. Aquatic Habitat Protection Permit - Preventing the discharge of deleterious substances. https://www.wsask.ca/preventing-the-discharge-of-deleterious-substances.

Saskatchewan Ministry of Highways and Infrastructure (SK MHI). 2012. Erosion and Sediment Control. June 2003, updated February 2012. Available online: https://pubsaskdev.blob.core.windows.net/pubsask-prod/124304/EP_ESC%252B%2528Feb% 252B2012%2529.pdf

Part 2 – Response to Specific Questions Raised in IRs 12, 12-R1A and 12-R1B

The table below highlights questions raised in IRs 12, 12-R1A and 12-R1B that weren't necessary fully described by the updated site water management plan (see Part 1).

Question from the IR	Denison Response
From FIRT's Information Request Rationale (2023-12-05): CNSC requests that Denison use a PMP value that is estimated using historical rainfall data that includes the most up to date meteorological data or provide justification on the validity of the current PMP.	Denison understands that validation of the current PMP will be assessed as part of CNSC licensing.
From Denison submission of responses to IRs (2023-08-18): Details related to culvert design and conveyance capacity are being developed as part of ongoing engineering activities. Culverts will be a designed with a sufficient size and length to convey water around the site during a PMP event.	Project design is bound by the EIS. Culverts within contact water areas are being designed to convey water associated with a PMP event.
The Proponent should include updated information on water treatment, flows, capacity and effluent discharge during normal operations, and a 24-hr Probable Maximum Precipitation (PMP) Event.	Non-contact water is not collected and routed through the industrial wastewater treatment plant (IWWTP). The wellfield runoff pond has been designed to accommodate the PMP. Influent to the IWWTP would be metered into the plant, per the treatment design rates and there would be no changes in effluent release rates beyond the assessed rates and plant design criteria.

IR- 101

- Department: ECCC
- Project Effects Link: Fish and fish habitat
- Reference to EIS, appendices, or supportant documentation: Section 8.1.1.3, Section 8.2.1.3 Aquati Environment

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, June 28, 2024)	IR (ROUND 4, Sept. 16, 2024)	Denison Response (ROUND 4, Oct. 18, 2024)
IR-101	-	**Context:** In Section 8.1.1.3 Spatial and Temporal Boundaries the Project Area, Local Study Area (LSA) and Regional Study Area (RSA) are established as they pertain to surface water quantity. The same is done in Section 8.2.1.3 for surface water quality. In Section 8.1.1.3 Figure 8.1-4, the locations of the Project Area, LSA, RSA and surface water features and monitoring stations are provided. However, the locations of wetlands located near the Project area and within the LSA and RSA have not been provided. The location of wetlands within or near the Project footprint, as well as the other wetlands existing within the LSA can be confirmed from Part II_S9 Terrestrial Environment, Section 9.2.3.3 Figure 9.2.-8, including the wetland classifications. There appears to be at least one shallow open water wetland and several bogs located within the Project Area. There is no consideration of wetlands or potential effects to wetland hydrology, surface water or sediment quality throughout the aquatic environment assessments. There is no baseline information regarding wetlands and their status as fish habitat and ecological function, or assessment of potential effects to flow rates, water levels, water quality, sediment quality, or biota. **Rationale:** There is currently not enough information provided for ECCC to provide advice on the potential risks of the proposed Project to wetland hydrology, surface water and sediment quality within the LSA. This pathway of effects is important to assess in terms of potential effects to wetland habitat availability and quality due to changes in flow rates, water levels, water quality, sediment transport, sediment quality and potential effects to terrestrial and aquatic receptors. It is necessary to evaluate if changes in groundwater and surface water runoff flows and routing will affect water levels and habitat availability	1. Provide baseline information regarding wetland characterization within the Project Area and LSA, including: locations, wetland type, size, water surface elevation, depth, water flow pathways, and the presence of wildlife receptors including presence of fish/fish habitat within the Aquatic Environment section of the draft EIS. If this information is available in annexes or baseline studies, summarize it within the main body of the Aquatic Environment section of the draft EIS with references to respective documents for review. 2. Provide baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint. 3. Provide an assessment of potential effects to wetlands within the LSA and potential effects to ecological receptors during all phases of the proposed Project. 4. Provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.	Responses are numbered as listed in the IR. Figures associated with this IR are provided in Attachment IR-101. 1) Below indicates the information that is presented in the draft EIS regarding wetland characteristics. This information was housed within the terrestrial environment component and potential impacts to wetlands as a valued component is further assessed under Section 9.2 of the draft EIS, and specifically Section 9.2.6.4. The following list indicates what information was provided in the draft EIS specific to information request #1. As such, repackaging the available information in Section 8 would be redundant and therefore in Denison's view unnecessary. a. *Locations of Wetlands* **Section 9, Figure 9.2-8** on page 9-83 of the draft EIS presents a map of the RSA and LSA detailing the locations of various wetland features including bogs and fens. b. *Wetland Types* **Section 9, Figure 9.2-8** on page 9-83, and **Table 9.2-8** on pages 9-91 to 9-92 of the draft EIS provides the geographical distribution and listing of the following wetland types within the LSA: i. BS17 – Black spruce treed bog ii. BS18 – Labrador tea shrubby bog iii. BS19 – Graminoid bog iv. BS19/24 – Graminoid bog/Graminoid fen v. BS20 – Open bog vi. BS21 – Tamarack treed fen vii. BS23 – Willow shrubby rich fen viii. BS24 – Graminoid fen ix. BS25 – Open fen x. BS27 – Sedge rocky shore (shallow open water) c. *Wetland Size* **Section 9, Table 9.2-8** on pages 9-91 to 9-92 of the draft EIS lists the following wetland types and the cumulative area they encompass within the LSA: i. BS17 – 18.2 ha ii. BS18 – 23.3 ha iii. BS19 – 2.8 ha iv. BS19/24 – 0.8 ha v. BS20 – 0.6 ha vi. BS21 – 1.9 ha vii. BS23 – 0.6 ha viii. BS25 – 0.4 ha ix. BS27 – 4.2 ha d. *Wetland Water Surface Elevation* Surface elevations for the wetland have been assessed and the information is summarized below and in the Attachment IR-101 **Figure 1 Elevations of wetland features in the LSA**. • Wetlands 1.5 km west of the SSA range from 526-524 masl • Waterbodies and their surrounding wetlands directly to the east of the SSA are at an elevation of between 506 and 500 masl • Waterbodies and surrounding wetlands 2 km east	This response has not been accepted for the following reasons: 1. The response (#1(d)) by the proponent states that "Surface elevations for the wetland have been assessed and the information is summarized below and in the Attachment IR-101 Figure 1 Elevations of wetland features in the LSA" but it is not indicated that this information will be placed in the EIS. CNSC staff requests proponent to include the information provided in response #1(d) and Attachment IR-101 Figure 1 (Elevations of Wetland Features in the LSA) and Attachment IR-101 Figure 2: (Denison Wheeler River Project SSA and Wetland Feature Distribution) in the EIS. 2. The Proponent stated in response #2 (a) and (b) that ''surface water quality and sediment quality in wetlands were not specifically sampled in the wetland complexes adjacent to the Project footprint during the original baseline assessment.'' CNSC staff requests the proponent to provide justification why they have relied on measurements upstream and downstream of the wetlands over direct measurements in the wetland areas. It is recommended to conduct direct measurements in the wetland areas. 3. The information provided did not satisfy the IR. Additional information regarding the potential impacts to wetlands due to changes in surface water quality and sediment quality should be included within Section 8.3 of the main EIS. This is needed to fully understand the scope of potential effects to the aquatic environment. a. Update Section 8.3 to include additional information on predicted water and sediment quality impacts to wetlands from the Proponent's response to directly consider wetlands as fish and fish habitat for the purpose of assessing water quality impacts. b. Update Section 8.3 to provide an assessment of potential effects to wetlands from water and sediment quality changes within the LSA. 4. It is stated in response #4 that "[...] Updated baseline information on wetland depths and water-levels may be useful in providing a frame of comparative reference to potential changes during the operation, decommissioning and post-decommissioning phases of the project" and CNSC staff agrees with the proponent and recommend collection of monitoring	1. This information has been incorporated into the EIS as Appendix 8-F. 2. Denison is committed to conducting surface water quality and sediment quality in wetlands within the LSA and specifically in wetlands directly adjacent to the Operation prior to construction commencing for the purposes of collecting baseline to further assess the effectiveness of mitigation measures. 3(a). Section 8.3 has been updated and specifically sections 8.3.1, 8.3.1.2, 8.3.3, 8.3.4.1, 8.3.4.2 (8.3.4.2.2 and 8.3.4.2.3, 8.3.4.2.5), 8.3.5, 8.3.7, 8.3.9 to include consideration of wetlands as aquatic habitat features within the context of their potential to provide fish and fish habitat. Sections 9.2.4.2.1, 9.2.6.2.1, 9.2.6.4.1, 9.2.7.3, and 9.2.9 have been updated to be aligned with Section 8. 3(b). Section 8.3 has been updated and specifically sections 8.3.1, 8.3.1.2, 8.3.3, 8.3.4.1, 8.3.4.2 (8.3.4.2.2 and 8.3.4.2.3, 8.3.4.2.5), 8.3.5, 8.3.7, 8.3.9 to include consideration of wetlands as aquatic habitat features within the context of changes to water quality and sediment quality within the LSA due to the Project. Sections 9.2.4.2.1, 9.2.6.2.1, 9.2.6.4.1, 9.2.7.3, and 9.2.9 have been updated to be aligned with Section 8. 4. Denison is committed to conducting surface water quality and sediment quality in wetlands within the LSA and specifically in wetlands directly adjacent to the Operation prior to construction commencing for the purposes of collecting baseline to further assess the success of mitigative measures.	Responses to items one and four have been accepted, but items two and three require additional information. For item two, the Proponent has not included justification regarding why they have relied on measurements upstream and downstream of the wetlands over direct measurements in the wetland areas within their response. Please provide the missing justification for item two, as well as describe how baseline information will be used to further assess the effectiveness of mitigation measures. Water and sediment quality in wetlands differ than those in stream and lakes systems because of their distinct biota and hydrology. In wetlands, there is a greater cycling of nutrients, more nutrients and metals can be sequestered in sediment, and metal toxicity modifying water quality factors such as pH and dissolved organic carbon are not the same as in streams and lakes. Baseline data on water and sediment quality in wetlands are necessary to evaluate potential effects on fish and fish habitat of proposed discharge to Whitefish Lake upstream of the wetlands. The information would also be used to assess possible effectiveness of proposed mitigation measures. For item three, the Proponent has not provided the predicted sediment quality impacts within item three, which is part of the wetlands assessment that was requested. Please also update Section 8.3 to include additional information on predicted sediment quality impacts to wetlands and to provide an assessment of potential effects to wetlands from sediment quality changes within the LSA. This Information is required in order to identify and define potential effect pathways linked to project-related changes to wetland sediment quality and assess effects on wetland functions, fish and fish habitat, and other valued components. Potential effect pathways in wetlands can be different than those in lakes and streams and warrant a separate assessment.	Per the Round 3 IR, responses to items 1 and 4 from the Round 2 IR have been accepted, but items 2 and 3 require additional information. For Item 2, for clarity ECCC specified during the meeting on June 14, 2024, that the wetlands of interest are those located within the nearshore environments of Whitefish Lake (Upper, Mid and Lower) as these lakes will directly receive treated effluent during operation. Water quality was sampled both upstream (river inlet to lake) within the lakes and downstream (river outlet of lakes) (e.g., SA4, SA-5, SA-6, LA-5 and LA-6; refer to Appendix 8-D for the aquatic baseline report including photographs of water quality sampling areas for context). As identified in Denison's response to the IR-107 (round 3), the baseline water quality variability was very low between these stations and therefore overall representative of the LSA and encompassing depositional and non-depositional environments. This was deemed appropriate and suitable for the scale of the EIS. The rationale for using water and sediment quality specific to the inlet/lake/outlet is further described below. Surface water quality modelling included predictions of water and sediment concentrations in Whitefish Lake, the lake into which treated effluent will be released, as well as locations farther downstream. Water quality was predicted as the incremental change in constituent concentrations during periods of effluent discharge on a monthly time step. Sediment quality predictions (as concentrations of constituents in sediment) were made on the same time step from surface water concentrations using the partitioning coefficients (Kd). The Kd values are presented in Table 3-6 of the ERA. They consist of regional published values that have been calibrated on similar sites in northern Saskatchewan over several years and have been checked against Wheeler River measurement data as shown in Figure 3-2 and Figure 3-3 of the ERA. For the purposes of the analysis the Kd value was used for a lake environment meaning that one estimate of sediment quality was assumed to be reasonable for the purposes of the EIS because the wetlands are directly connected to the lake as they are functional nearshore environments of the waterbody itself. The wetland portions under discussion are more accurately described as littoral areas and these wetland portions are not cut-off from or	Denison has not adequately responded to the request to identify potential effects to sediment quality to support identification of project-related effect pathways to wetlands. The Kd values could differ significantly in wetland environments compared to in lake/stream measurements where all samples were taken and there are discrepancies in wetland classification within the EIS and information provided in IRs with the actual classification standards for various wetland types. For further explanation, the descriptions of the wetland areas provided in the round 3 response do not correspond to information provided in the last round of responses received from Denison. For example, Figure 2 of Appendix 8-F: Wetland Effects Assessment Report identifies a black spruce treed bog (ecotype BS17) between Whitefish Lake North and Whitefish Lake Middle (La-5), where effluent will be discharged. According to the Canadian Wetland Classification System (Warner & Rubec, 1997), bogs are defined as receiving water only from precipitation, with no hydrological connections to groundwater or littoral areas. This does not match with the response of "*littoral areas and these wetland portions are not cut-off from or isolated from the main basin of the lake.*" The response also does not correspond to the BS17 ecotype described in Appendix 9-B: Terrestrial Environment Wildlife and Vegetation Baseline Inventory. The uncertainty introduced as to the conditions on site complicates the discussions on baseline conditions and potential impacts in wetlands which the Proponent assumes to provide fish habitats. Bogs and fens (ecotypes BS17, BS18, BS19, BS21) are identified in and around Whitefish Lake and these wetlands will have different water and sediment chemistry than lakes and creeks. For example, the partitioning coefficients of sediments in a fen would not be expected to be the same as those in a lake, though both may be depositional environments, sediments in the fen would be richer in organic matter because of the vegetation present. Organic matter in sediment is an important factor affecting soil-water partitioning coefficients. Because of this, the sediment in wetlands is likely to adsorb more metals than sediment found in lakes. So it is important to understand baseline conditions and model impacts in order to ensure the aquatic environment will not be impacted by the project's planned discharges. The Proponent should clarify if the wetlands were misidentified in the Terrestrial Environment Wildlife and Vegetation Baseline Inventory. If they have been misidentified, then corrections should be made to the Baseline Inventory and Wetlands Assessment Report, and information provided in the Proponent's round 3 response should be integrated in Section 8.3 of the EIS. If they have not been misidentified, then the Proponent should respond to round 3 information requests considering the wetland environment. In order to resolve this IR, Denison are expected to: 1. Update wetland classification in the LSA according to the Canadian Wetland Classification System (Warner & Rubec, 1997). Focus should be applied to	Denison reaffirms the approach taken with baseline sediment data as utilized in the EIS and more specifically in the ERA (e.g., pooled sediment data from locations in an unimpacted system in the same watershed where land use and type is homogeneous) as an appropriate and acceptable basis to define existing conditions (and the variability thereof) and to identify potential Project effects to sediment and evaluate the significance of these effects. The IMPACT model predicts how constituents travel through the environment and concentrations of constituents change as a result of interactions with natural flows and lake sediments. The Kds applied in the model have largely over predicted the baseline sediment concentrations throughout the lakes demonstrating that the model and model inputs are conservative, and impacts (i.e., incremental changes in constituent concentrations resulting from Project emissions to the aquatic environment) have not been under predicted. For context on a sensitivity analysis for sediment quality predictions, refer to Appendix 10-A, Section 6.2.2 Effluent Discharge Rate. A sensitivity analysis of key model parameters was undertaken to understand the degree to which the results or conclusions of the risk assessment would vary if parameters differed from what was assumed. In this section, sediment predictions are shown for a scenario where effluent is released at the maximum upper bound rate of 81 m^3/hr and the maximum concentrations of COPCs in the receiving environment increases up to 120%. It is also a conservative prediction in that it assumes effluent is released during decommissioning at the same upper bound flow and quality as during operations. In this sensitivity analysis, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines, with the exception of cadmium, molybdenum, selenium and vanadium; however, the predicted exceedances for cadmium, molybdenum, selenium and vanadium are all below their probably effect level (PEL), no-effect (NE2), or severe effect level (SEL) values, therefore, adverse effects to benthic communities are not anticipated under the upper bound discharge scenarios. Importantly, monitoring programs will be implemented to assess the environmental performance of the Project relative to the predictive assessment that has been completed in support of the EA process. Such monitoring is needed since there is always some level of uncertainty associated with EA predictions (and it is noted that uncertainty analysis has been completed as part of the EIS and considered within the context of assessing the significance of effects).

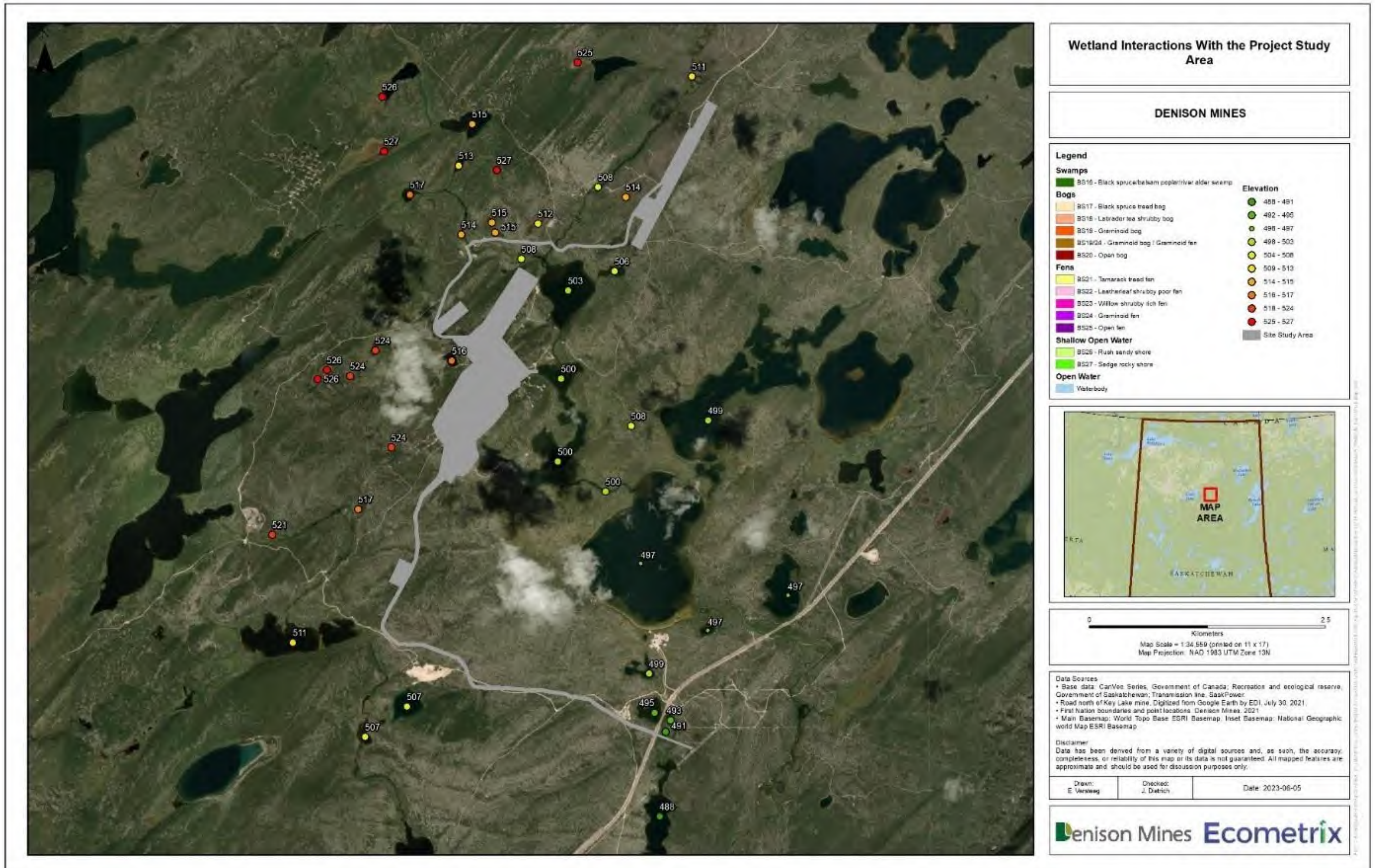
		within wetlands. Potential effects from COPCs and radionuclides to surface water and sediment, or potential effects to ecological receptors within wetlands have not been evaluated.		of site are approximately between 499 and 497 masl • Wetlands north of the SSA and in the vicinity of the proposed air strip range from 514-508 masl. • Wetlands situated further north of the SSA in the LSA were at an elevation of approximately 526 masl • Southern wetlands that will interact with the proposed hydro corridor extension for the mine have an elevation of 491masl • Most wetland evaluated south of the SSA had elevations ranging from 491-488 masl e. *Wetland Depth* – information associated with wetland depth for those in the LSA is not available. f. *Wetland Flow Pathways* - Nearly all wetlands are connected or adjacent to rivers and tributaries, and thus flow pathways are discernable in **Figure 9.2-8** of the draft EIS. g. *Presence of Fish and Fish Habitat* For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA. Section 9.2.6.4.1 of the draft EIS described the estimated change in the aerial extent of wetland due to direct impacts of the Project footprint (see also Figure 9.2-8). The assessment indicated a total loss of 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA. 2) As noted in other parts of this IR response, the wetlands within the Project footprint are limited to two areas (i.e., stream crossings along the access road to the airstrip and powerline connection SE of Highway 914 [See Figure 2: Denison Wheeler River Project SSA and Wetland Feature Distribution in Attachment IR-101]) and these wetland areas can be avoided through design and construction mitigations. As such, no direct impact to any wetlands or waterbodies are expected as part of the Wheeler River Project that may impact fish or fish habitat. In regard to baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint: a. Surface water quality in wetlands – surface water quality was not specifically sampled in the wetland complexes adjacent to the project footprint during the original baseline assessment. However, surface water quality was sampled and assessed at stream and lake stations situated upstream and downstream of wetland areas. These stations were selected for sampling as they were identified as providing repeatability (i.e., relative water depth) and informative with respect to desired segments of the system. For example, water quality was sampled at SA-4, SA-5, LA-6, SA-6 and LA-5	information on the wetland areas.			isolated from the main basin of the lake. As such, it can be assumed that the lake environment is likely to be as depositional as the nearshore environment. The lakes of interests are very shallow (on average 1.5 m in depth) and therefore deposition may be as likely in the "offshore" environment as the nearshore. The wetlands are not likely to have a dominating effect on the water quality of Whitefish Lake due to their lesser aerial extent vs. the lake proper and the connectivity between the zones suggests that water quality would be similar between the shoreline and the "offshore" (i.e. likely good exchange). With respect to Item 4, and to further confirm these assumptions discussed above, Denison has committed to the collection of additional baseline information with the wetlands for water quality and sediment quality prior to construction as part of operational licencing (Commitment 8-46). Denison has also committed to conducting a pre-construction preliminary EEM for the site. The EEM study design will be further guided by the final design of the diffuser and the behaviour of the effluent plume (Commitment 8-49). Based on this and if applicable, the EEM study design could include an investigation of the differences in WQ and SQ nearshore and offshore. This would allow for an understanding of the differences in water to sediment contaminant ratios between nearshore and offshore environments.	updating areas with hydrological connections to groundwater and littoral sources, which may have been misclassified as bogs. This should include any sub-classification of wetlands currently categorized as Shallow Open Water in Appendix 8-F: Wetland Effects Assessment Report. Updates should be made as necessary to all relevant reports, including the Terrestrial Environment Wildlife and Vegetation Baseline Inventory as needed. 2. Update habitat mapping for wetlands to reflect any changes in wetland classifications, particularly for wetlands that may include fish and fish habitat. 3. Update Table 8.3-3 and 8.3-4 in Section 8 of the EIS to include more specific information on wetlands that may contain fish and fish habitat, such as information on wetland type & extent, vegetation, substrate type, organic matter content, etc. 4. Provide a table with summary statistics (grain size analysis and sediment quality) from sediment sampling specific to each individual sampled lake or stream, rather than summary statistics for all waterbodies and watercourses pooled together. 5. Provide the source reference for the Kd values used for the ERA in Table 3-6 and the specific characteristics of sediments (i.e. grain size and composition) of the regional study areas as they compare to LA-5, the LSA and the RSA. 6. Conduct a statistical analysis with a power analysis comparing sediment characteristics (grain size analysis and sediment quality) from the various sub-samples taken within each waterbody to conclude if there are any significant differences between sub-sampling stations, and determine if there is within-lake variation in sediments. Denison should provide the methodology they will use to conduct the statistical analysis and power analysis for CNSC review and acceptance prior to completing the analysis. Based on the results of this statistical analysis, Denison should: a. If the results determine that there is enough statistical power to confirm there is no within-lake variation in sediment characteristics within LA-5, Denison should then complete a statistical analysis and power analysis comparing LA-5 to other sampled areas to determine if there is any between-lake variation in sediment characteristics. b. If the results determine that there is not enough statistical power, or that there is enough statistical power but there is significant within-lake variation between sub-samples in LA-5, Denison will require the additional baseline data that Denison has already committed to collecting, to update the modelling during the EA phase to support conclusions on significance of effects to the receiving environment. This IR relates closely to IR-107 that demonstrates that there is not enough	Specific to this IR, sediment sampling will be completed to verify the accuracy of predicted effects and the effectiveness of proposed mitigation measures. Monitoring and follow-up programs will be integrated within Denison's overall Environmental Management System (EMS) framework and implemented through the various programs, plans and procedures that would be developed therein. Denison is committed to achieving continual improvement in environmental performance through its EMS. As part of this overall commitment to continual improvement, monitoring programs will be implemented via an adaptive management approach. Adaptive management is a systematic process for continuously improving environmental management practices by learning from their outcomes. It provides the flexibility to address/accommodate new circumstances, to adjust monitoring, to identify and implement new mitigation measures, or to modify existing measures throughout all Project phases. Further, it provides a means to confirm that the monitoring elements remain valid, meet regulatory requirements, and be responsive to evolving objectives. At the EIS stage, the conceptual plan is for sediment sampling at Whitefish Lake South (near-field), at an upstream reference location (Whitefish Lake North), and at downstream locations (far-field) every three years. The far-field monitoring locations will be located in Whitefish Lake South prior to its discharge to McGowan Lake. The details of the sediment monitoring program will be refined as the Project advances. Sediment constituent concentrations will be compared to the values used in the EIS and to applicable regulatory criteria or objectives. As noted, above sampling effort will be predetermined that meet the rigor required of federal / provincial requirements as described in relevant technical guidance documentation for operational monitoring. In general, applying equally to sediment quality as with all other environmental aspects that have been considered in the EIS, where an environmental monitoring program identifies predicted effects are greater than anticipated, Denison would evaluate whether these effects could result in changes to the conclusions in this EIS. If changes are confirmed, then Denison would evaluate the need for revised mitigation actions and management practices to manage effects. As highlighted above, Denison's interpretation of monitoring data would include reference to environmental performance criteria. An exceedance of environmental performance criteria would trigger Denison to respond to further investigate the potential issue. Based on this investigation, where need for revised mitigations is identified these measures would be developed and implemented. It is expected that the adaptive management process would be informed by input sought from Indigenous people,

				following the flow path from upstream to downstream, respectively. The water quality at these nodes was inclusive of upstream wetland influences. For further reference to surface water sampling station during baseline, please refer to Figure 8.2-4 of the EIS. b. Sediment quality in wetlands - sediment quality was not specifically sampled in the wetland complexes adjacent to the project footprint during the original baseline assessment. However, sediment quality was sampled and assessed at depositional lake stations situated upstream and downstream of wetland areas. The sediment quality at these nodes would be inclusive of upstream wetland surface water and sediment influences. For further reference to sediment sampling stations during baseline, please refer to Figure 8.2-4 of the EIS. 3) For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA. Section 9.2.6.4.1 of the draft EIS described the estimated change in the aerial extent of wetland due to direct impacts of the Project footprint (see also Figure 9.2-8). The assessment indicated a total loss of 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA However, when further scrutinizing the potential overprinting of wetland features as a result of the Project it is evident that even this loss is avoidable. The interaction of the Project with wetlands is relegated to those areas where stream crossings for access roads and powerline connections are proposed (**See Figure 2: Denison Wheeler River Project SSA and Wetland Feature Distribution (Attachment IR-101)**). Wetlands associated with stream crossings have been identified to have mitigative designs (clear-span) to ensure no impacts to fish and fish habitat. The hydro-line as shown in Figure 1 will be constructed to avoid direct impacts to fish and fish habitat following best installation practices. As such, no direct impact to any wetlands or waterbodies are expected as part of the Wheeler River Project that may impact fish or fish habitat. As discussed in Section 8.1.6.1 of the EIS, water levels in the ponds and lakes in the vicinity of the of the Project are expected to experience negligible effects, with magnitudes of changes in water levels predicted to be in the sub-centimeter range. As natural fluctuations in lake water levels were approximately 0.4 m from 2011 to 2019, Project-related changes are not expected to be of a magnitude to compromise the Surface Water Quantity VC. It can then be considered a reasonable assumption that any changes to wetland features will have similar sub-centimeter impacts to water levels due to changes in surface flow and/or groundwater and therefore do not pose an indirect effect to water quantity or fish and fish habitat associated with these wetland features. 4) As no impact is expected due to overprinting or due to draw down effects by the ISR, additional mitigation measures are not warranted. Updated baseline information on wetland depths and water-levels may be useful in providing a frame of comparative reference to potential changes during the operation, decommissioning and post-decommissioning phases of the					baseline data to support conclusions on significance of effects.	stakeholders, and regulatory agencies. The following section provides a response to each to the specific IR questions: 1. The project's ecosite classification is outlined in Section 9. Ecosite classification was completed using the Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlin et al. 2010) Ecosite information was transferred directly into Appendix 8-F which originated in January 2024 during the EIS review process in response to FIRT IRs. Refer to Section 9 for the wetland assessment and Appendix 9-B for the terrestrial baseline report with information on ecosite mapping in Section 2.1.3 and ecosite characterization methods and results in Section 2.2. The measurable parameter for the wetlands assessment in Section 9 was change in areal extent of wetlands; this was also considered in Appendix 8-F. The EIS guidelines do not require use of the suggested classification scheme (Canadian Wetland Classification System (Warner & Rubec, 1997). Denison used information from the province's land classification system and have fulfilled that EIS requirement. Effectively, to be conservative in one assessment (assessing change in areal extent of wetlands in Section 9) we have introduced questions and confusion in Appendix 8-F. The data was fit for purpose for Section 9 and to be consistent, it was carried over into Appendix 8-F without any adjustments or reclassifications. This IR is not questioning the assessment of changes in areal extent of wetlands, but the purported under estimation of risk through the effluent modelling. As such, no updates to the wetland classifications are warranted at this time. Further, Denison has committed to completing additional wetland studies (see response to point 2). 2. Additional wetland surveys will be completed after the EA stage, per commitment 8-46 in Denison's commitment register (i.e., "To further supplement existing information that exists for the LSA wetlands, Denison is committed to undertaking wetland surveys including the collection of water quality, sediment quality, benthic invertebrates and fish and fish habitat surveys prior to the construction to provide an updated baseline for assessing the success of mitigation measures and to assess potential effects of the project on wetlands. These locations will then be further considered as part of the EMP for continued monitoring for these media and biota."). Appendix 8-F has been updated and specifically, a new appendix (Appendix A) has been added. This new appendix provides photos and text to orient the reviewer to the in-lake wetlands of interest. While some of these in-lake areas were conservatively classified as wetlands in the terrestrial assessment (EIS Section 9), from an aquatic perspective, these in-lake wetlands of

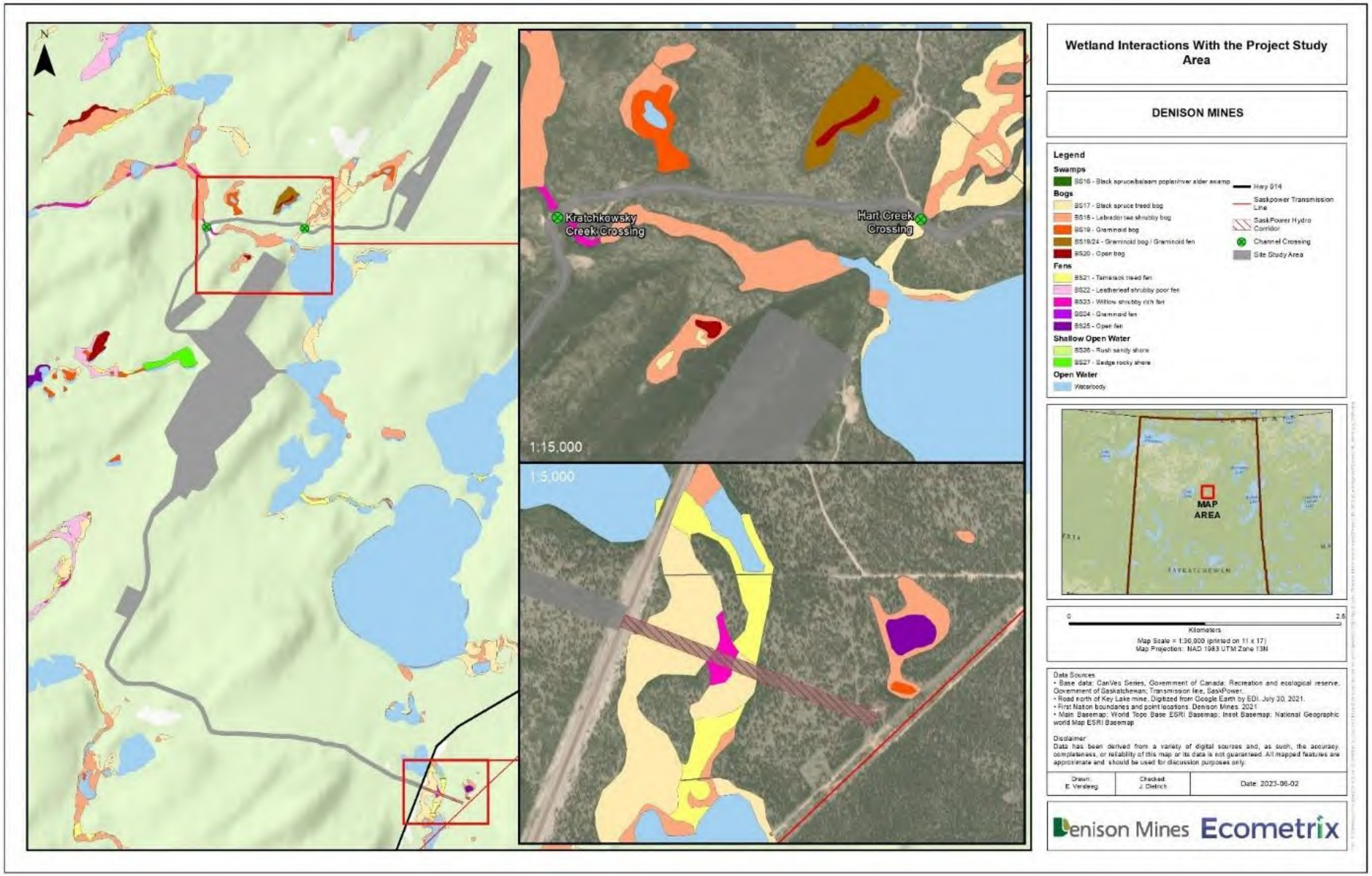
				project. However, such changes are expected to be less than measurable.						interest are littoral / nearshore zones in the lake and connecting channels. The balance of this IR response outlines the rationale for why the CNSC's suggested wetland mapping updates to the EIS would not change any EIS conclusions and are not required at this stage for EA determination. 3.Any wetlands that were present within water bodies, were mapped as part of the baseline program and results would be incorporated into the existing fish habitat summaries provided in Tables 8.3-3 and Table 8.3-4. Refer to Section 8.3.3 for the existing environment methods and results. It is noted in the EIS that detailed information regarding fish and fish habitat baseline data collection and analyses are provided in Appendix 8-D, Appendix 8-B, and additional information pertaining to wetlands is provided in Appendix 8-F. 4. Sediment grain size results for McGowan Lake, Whitefish Lake south, Whitefish Lake north and Russell Lake are summarized in EIS Section 8 Table 8.4-2, and sediment chemical composition results are summarized in Table 8.4-3. The baseline sediment grain size and chemistry analysis for all stations within the baseline study area are provided in Appendix 8-D Aquatic Baseline, Tables A-3 and A-4 of Appendix A, respectively. 5. A summary of the source reference for the Kds is provided in Attachment IR-101 (Round 4), and a discussion on sediment grain size for the Wheeler River and regional study area is also provided. 6. Based on discussions between the CNSC and Denison in September 2024, the primary request from the CNSC was related to additional information on the IMPACT Kds, which has been provided as part 5 of this response. The requested power and additional statistical analyses can be completed as part of licensing and will include results from pre-operational sediment sampling. Any pre-operational sediment sampling results will be included in the environmental risk assessment (ERA) update to support Denison's application for a licence to operate. Additionally, the pre-operational sediment sample results in combination with existing data will be the basis of future comparisons of measured data from effluent exposed and reference areas. Such comparisons would be based on statistically based study designs that meet the rigor required of federal / provincial requirements as described in relevant technical guidance documentation for operational monitoring.

Attachment: IR-101 (included in Round 1 submission)

<u>Supporting figures to the response provided in table:</u>



Attachment IR-101 Figure 1 – Elevations of Wetland Features in the LSA.



Attachment IR-101 Figure 2: Denison Wheeler River Project SSA and Wetland Feature Distribution

Round 2: New EIS Appendix 8-F

Denison Mines

Wheeler River Project

Revised Draft Environmental Impact Statement

January 2024

Powering PEOPLE, PARTNERSHIPS AND PASSION.

TO:	**FROM:**
Denison Mines – Janna Switzer	Ecometrix
REF:	**DATE:**
Wheeler River Project EIS – Appendix 8-F: Wetland Effects Assessment Report	19 January 2024

1.0 Introduction

On October 21, 2022, Denison Mines Corp. (Denison) submitted a draft Environmental Impact Statement (EIS) for the proposed Wheeler River Project (the Project). Based on their initial review, the Canadian Nuclear Safety Commission indicated that the submission contained the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review of the draft EIS. On March 20, 2023, the FIRT provided Denison with a list of information requests (IRs) for Denison to respond to and eventually submit a final EIS document. Responses to these IRs were provided in July and August of 2023. Additional FIRT IRs were provided to Denison on December 5, 2024. Of these IR-101 was not adequately answered and additional information was requested.

This appendix provides additional information to address IR-101 provided by Environment Canada and Climate Change (ECCC) as part of the second round of FIRT comments. The comment included a request for a further summary of wetland characterization information from available sources, baseline information pertaining to water quality and sediment quality, and assessment of potential effects to wetlands within the LSA for all phases of the Project and provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.

2.0 Scope of the Assessment

This section addresses the potential effects of the Project on the Fish and Fish Habitat VC for which wetland habitats are considered a component. The purpose of this assessment is to assess potential changes to wetlands (as represented by the Fish and Fish Habitat VC) in consideration of all phases of the Project at the Project Area, local, and regional study area scales. Pathways affecting wetlands are directly associated with potential changes to the Surface Water Quantity (hydrology), Surface Water Quality, Sediment Quality, and Benthic Invertebrates VCs. Changes to hydrology, water quality, sediment quality, and benthic invertebrate communities may directly affect wetlands as both fish and wildlife habitat and food resources. The assessment approach reflects these connections within the environment, as the significance determination for the Surface Water Quantity and Surface Water Quality VCs was conducted at the receptor VC level.

The Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs are interrelated, to varying extents, and are linked to other VCs, including:

Surface Water Quality – surface water contributes to local moisture regimes, and surface water quality can influence the persistence of Vegetation and Ecosystems, Listed Plant Species, and Wetlands.

Surface Water Quantity – surface water contributes to local moisture regimes, and surface water quantity contributes to site drainage and discharge, which can influence the persistence of Vegetation and Ecosystems, Listed Plant Species, and Wetlands.

Sediment Quality – Vegetation and Ecosystems, Listed Plant Species, and Wetlands contribute to ecosystem form and function that stabilize riparian areas and influence quality of surface water runoff to aquatic systems.

This appendix will focus on the interrelations between these VCs as they apply to Wetland function.

Pathways that are of interest include those associated with site clearing and the potential for erosion-driven mobilization of suspended sediment into local surface waters; groundwater interactions with surface water features including wetlands; the establishment of new subwatershed boundaries and the resulting effects of effluent discharge to the receiving environment; and the potential overprinting of wetland habitat by Project infrastructure.

2.1 Key indicators and Measurable Parameters

The KIs for the wetland component of the Fish and Fish Habitat VC include potential changes in surface water quantity, surface water quality, and available wetland habitat from baseline conditions. The rationale for each KI and associated MPs is summarized in Table 1.

Table 1: Key Indicators and Measurable Parameters for the Wetlands Valued Component

Key Indicator	Rationale for Key Indicator	Measurable Parameter
Change in available wetland habitat from baseline conditions	2. Project activities may result in a change in the extent of Wetlands. 3. Of provincial and federal management concern 4. Contributes to biodiversity and habitat for wildlife species and listed plant species. 5. Cultural importance. 6. Contributes to biodiversity, maintenance of hydrologic cycles, nutrient cycling, water quality, and carbon storage. 7. Sensitive to disturbance. 8. Historically addressed for other mining projects in northern Saskatchewan.	Aerial extent (m^2 or ha) of overprinted wetland habitat.
Change to water levels or flows from baseline conditions	Project activities are expected to result in changes to local hydrology. A reduction or increase in flows may result due to the elimination or redirection of subwatershed area and through Project water management (i.e., water taking, storage, and effluent discharge). These changes in flow to the environment may alter stream flows, lake levels and such feature interactions (inundation) with wetland features required for fish and wildlife during all life stages.	Changes in water levels (m) or percent changes to flow conditions (%).
Change in surface water quality from baseline conditions	Changes in water quality are regulated (subsection 36(1) of the *Fisheries Act* and the MDMER). Changes that may occur as a result of the Project include: • mobilization of solids into local watersheds; and • deposition of deleterious substances into the receiving environment as a result of mine effluent and/or surface runoff.	Change in the concentration of constituents that are directly related to Project activities, measured as a mass of a chemical per unit volume in water (e.g., mg/L).

2.2 Spatial and Temporal Boundaries

The areas used to assess the effects of the Project on the Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs are (Figure 1):

Project Area: the area within which the Project and all components/activities are located (i.e., the area of maximum physical disturbance). The Project Area is considered to be a conservative estimate of the area of direct disturbance effects on VCs in this assessment.

Vegetation LSA: the area that surrounds the Project Area where all direct effects and most indirect effects are likely to occur on the Vegetation and Ecosystems, Listed Plant Species, and

Wetlands VCs. The Vegetation LSA is defined as the Project Area plus a 250 m buffer along roads and a 500 m buffer around all other infrastructure (1,161.8 ha).

Terrestrial RSA: the area that surrounds and includes the Vegetation LSA, established to assess the potential, largely indirect effects of the Project on Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs in a regional context. The Terrestrial RSA (40,173.6 ha) is defined as a minimum 8 km buffer around the Vegetation LSA and has been delineated to capture all indirect effects of the Project on the Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs and provide context for the type, distribution, extent, and prevalence of plant species and ecosystems in the region. The Terrestrial RSA also defines the area within which cumulative effects are likely to occur (i.e., CEA boundary).

Temporal boundaries identify when an effect is expected to occur in relation to specific Project phases and activities. The temporal boundaries are based on the timing and duration of Project activities, with the associated interactions with each VC and KI (where applicable). In the EA, the temporal boundaries are described as appropriate for each activity and cumulatively for the life of the Project.

The temporal boundaries for the EA represent the timeframes that the Project is expected to interact with and potentially affect Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs. The temporal boundaries are aligned with the Project development schedule as described in the EIS: Construction; Operation; Decommissioning; and Post-Decommissioning.

3.0 Existing Conditions

Wetlands are defined as "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment" (National Wetlands Working Group 1997). As such, ecosites have been determined to be wetland ecosystems where these conditions are expected to occur. This includes both wetland ecosites and sparsely vegetated ecosites where the water table is within 50 cm of the ground surface (McLaughlan et al. 2010). No wetlands within the Terrestrial RSA have been designated as Ramsar Wetlands of International Importance (The RAMSAR Convention Secretariat 2022).

Project-specific investigations pertaining to the Terrestrial Environment were conducted by Omnia Ecological Consulting (Omnia; Calgary, AB) from 2017 to 2019. Details on the methods, survey parameters and assumptions, and comprehensive data summaries/findings are presented in the Project-specific baseline report (Omnia 2020; see **Error! Reference source not found.** of the EIS) and a supplementary baseline annex report completed in 2021 (EDI 2021; see **Error! Reference source not found.** of the EIS).

Project baseline studies for vegetation presented a description of the ecosystems/habitat types (i.e., ecosite classifications) within the Terrestrial RSA. Vegetation communities and ecosystems are represented by provincial ecosite classifications for the Boreal Shield Ecozone in accordance with the Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010). These ecosite classifications were summarized within a 1:20,000 interpreted ecosite mapping product compiled within the Terrestrial RSA with the use of the following inputs:

- 1:5,000 anthropogenic features mapping;
- historical fires data;
- provincial Predicted Ecosite Mapping;
- current and historical imagery; and
- field sampling/ground truthing sites (EIS Appendix 9-B).

As the Boreal Shield Ecozone experiences a largely natural fire regime, much of the vegetation within the Terrestrial RSA (70.6%) is comprised of post-fire regeneration (i.e., shrubby structural stages).Twenty (20) upland ecosites were identified within the RSA with relative percentages by area estimated for each ecosite code.

The assessment also identified fourteen (14) wetland ecosite types within the RSA which included swamps, bogs, fens and shallow open water ecosite codes. The area of these wetlands was also estimated to provide a relative percent area of representation within the RSA.

This cataloguing of ecosite presence and relative area composition across the RSA provides the basis for understanding landscape change and succession over the course of the construction and operation of the Wheeler River Operation.

Waterbodies were conservatively included here as wetlands, as they have the potential to be classified as shallow open water wetlands (i.e., water bodies 2 m deep or less; Warner et al. 1997). Waterbodies represent the most common wetland ecosystem within the Vegetation LSA and the Terrestrial RSA, comprising 3.9% (44.9 ha) and 10.7% (4,101.9 ha), respectively. The black spruce treed bog is the second most common wetland ecosystem within the Vegetation LSA (18.2 ha, 1.6%) and the Terrestrial RSA (1,157.1 ha; 2.9%). The Labrador tea shrubby bog is the most common wetland ecosystem in the Vegetation LSA, comprising 2.0% (23.3 ha), and the second most common wetland ecosystem in the Terrestrial RSA (989.9 ha, 2.5%). All other wetland ecosites are relatively uncommon, each comprising less than 0.5% of the Vegetation LSA and

Terrestrial RSA. The location, size and relative area composition of the wetland features is provided in Table 2 and Figure 1).

Table 2: Summary of Wetlands

Ecosite Code[1]	Ecosite Description[1]	Structure Code[2]	Vegetation LSA (ha)	Vegetation LSA (%)	Terrestrial RSA (ha)	Terrestrial RSA (%)
Swamps						
BS16	Black spruce / balsam poplar / river alder swamp	6	--	--	8.8	<0.1
Swamps Subtotal			**--**	**--**	**8.8**	**<0.1**
Bogs						
BS17	Black spruce treed bog	5	18.2	1.6	1,157.1	2.9
BS18	Labrador tea shrubby bog	3	23.3	2.0	967.6	2.4
		3a	--	--	20.3	0.1
		3b	--	--	2.0	<0.1
		Total	23.3	2.0	989.9	2.5
BS19	Graminoid bog	2	2.8	0.2	160.5	0.4
BS19/24[3]	Graminoid bog or graminoid fen	2	0.8	0.1	1.2	<0.1
BS20	Open bog	1	0.6	<0.1	65.5	0.2
Bogs Subtotal			**45.6**	**3.9**	**2,374.2**	**5.9**
Fens						
BS19/24[3]	Graminoid bog or graminoid fen	2	0.8	0.1	1.2	<0.1
BS21	Tamarack treed fen	5	1.9	0.2	66.5	0.2
BS22	Leatherleaf shrubby poor fen	3a	-	-	28.5	0.1
BS23	Willow shrubby rich fen	3b	0.6	<0.1	20.9	0.1
BS24	Graminoid fen	2	-	-	9.0	<0.1
BS25	Open fen	1	0.4	<0.1	5.7	<0.1
Fens Subtotal			**3.6**	**0.3**	**131.8**	**0.3**
Shallow Open Water						
BS26	Rush sandy shore	2	-	-	15.1	<0.1

Ecosite Code[1]	Ecosite Description[1]	Structure Code[2]	Vegetation LSA (ha)	Vegetation LSA (%)	Terrestrial RSA (ha)	Terrestrial RSA (%)
BS27	Sedge rocky shore	2	4.2	0.4	29.3	0.1
Waterbody[4]	--	0	44.9	3.9	4,101.9	10.7
Shallow Open Water Subtotal			**49.0**	**4.2**	**4,146.3**	**10.3**
Total Wetlands[5]			**98.3**	**8.5**	**6,661.1**	**16.6**

Notes:

1 Ecosystems are described in detail in the Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010).

2 Modified from the Field Manual for Describing Terrestrial Ecosystems (BC Ministry of Environment, Lands, and Parks, and BC Ministry of Forests 1998). 0 = unvegetated; 1 = sparse / bryophyte / lichen; 2 = herb/graminoid; 3a = low shrub; 3b = tall shrub; 5 = young forest, 6 = mature forest.

3 This ecosite type is an artifact of mapping uncertainty, as baseline mappers were unable to distinguish between these ecosites due to a lack of available information (e.g., soil information, vegetation field plots, water quality data). As such, this ecosite has conservatively been split between bog and fen classifications.

4 Areas of open water <2 m deep are defined as shallow open water wetland ecosystems (National Wetlands Working Group 1997); as such, unnamed waterbodies and areas of open water observed to exhibit an average depth of <2 m (Ecometrix Incorporated 2020) have been conservatively included as wetland ecosystems.

5 Some numbers are rounded for presentation purposes. Therefore, the totals may not equal the sum of the individual values.

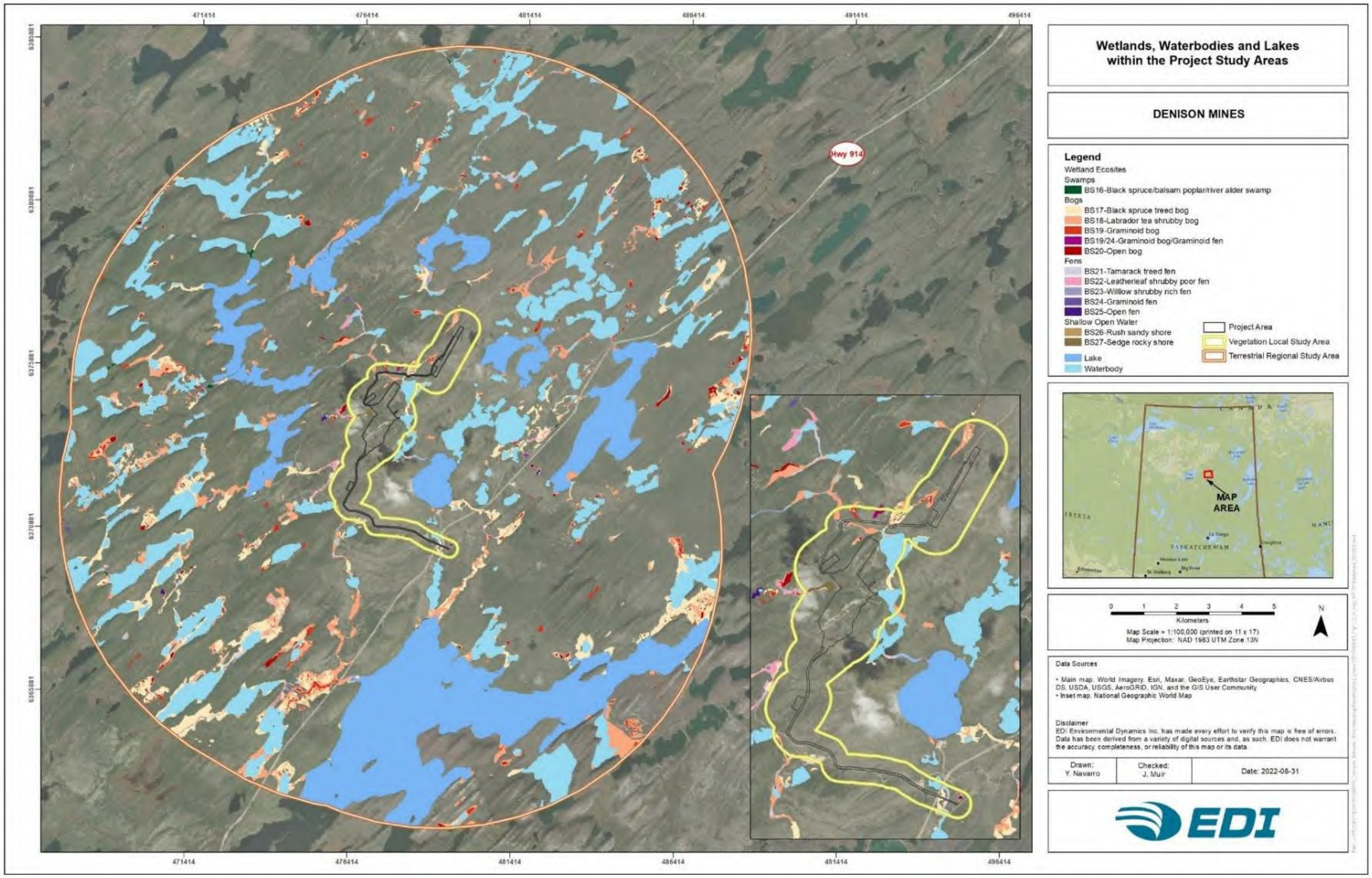


Figure 1: Wetlands, Waterbodies and Lakes within the Project Study Areas

Surface elevations for the wetland have been assessed and the information is summarized below and in the Figure 1 .

- Wetlands 1.5 km west of the Project Area range from 526-524 masl
- Waterbodies and their surrounding wetlands directly to the east of the SSA are at an elevation of between 506 and 500 masl
- Waterbodies and surrounding wetlands 2 km east of site are approximately between 499 and 497 masl
- Wetlands north of the Project Area and in the vicinity of the proposed air strip range from 514-508 masl.
- Wetlands situated further north of the Project Area in the LSA were at an elevation of approximately 526 masl
- Southern wetlands that will interact with the proposed hydro corridor extension for the mine have an elevation of 491masl
- Most wetland evaluated south of the Project Area had elevations ranging from 491-488 masl

Wetland depth, presence of fish or fish habitat, water quality and sediment quality are not currently available for the non-waterbody wetlands (i.e. those not identified as a lake or watercourse in Section 8 of the EIS). However, Denison is committed to conducting field surveys to collect this data prior to the initiation of construction of the Operation. This will allow for baseline information to be available to compare future changes and assess the success of mitigation measures and the predicted effects or lack thereof.

For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA.

DATE: 19 January 2024

TO: Denison Mines – Janna Switzer

REF: Wheeler River Project EIS – Appendix 8-F: Wetland Effects Assessment Report

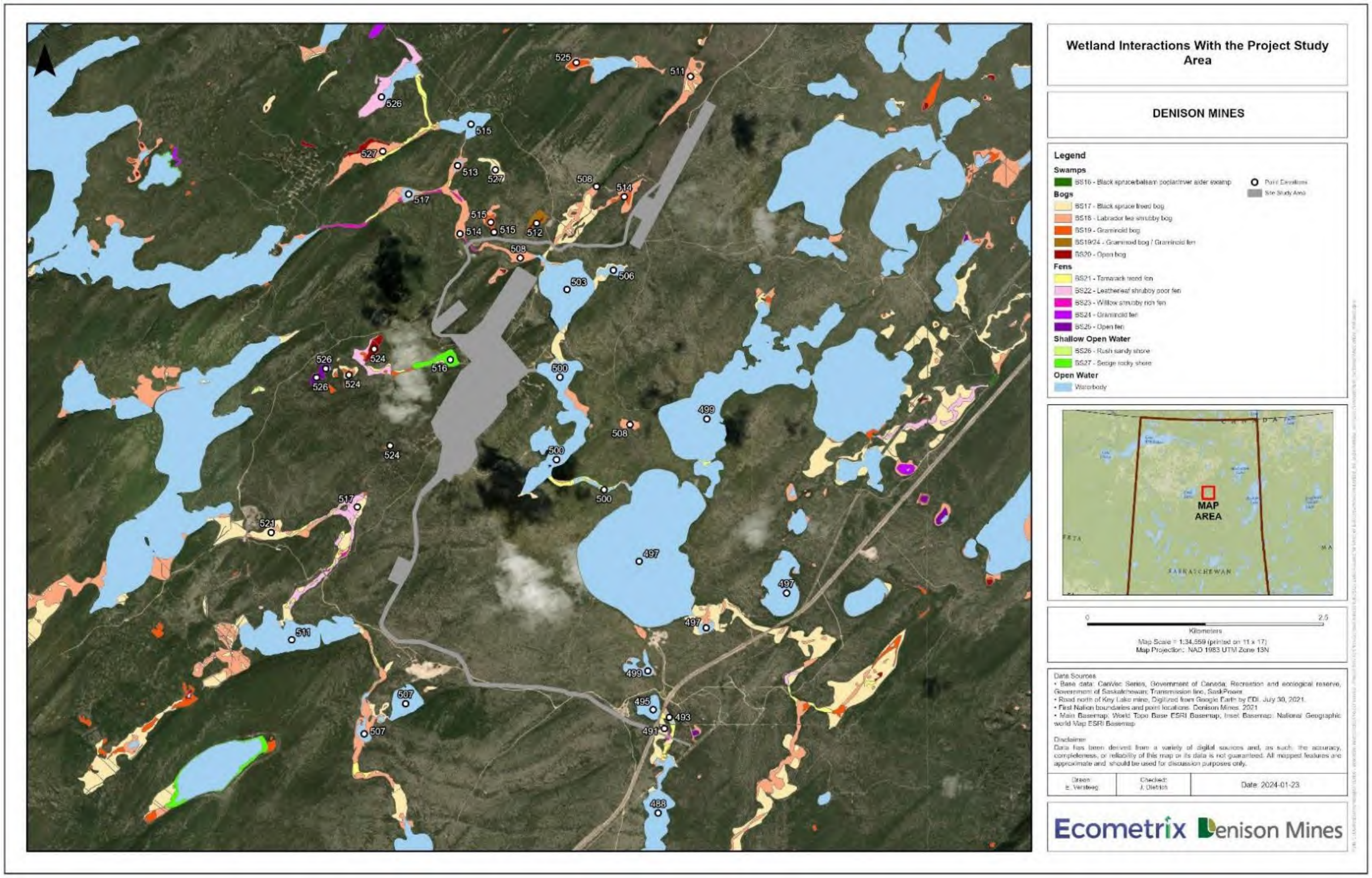


Figure 2: Elevations of wetland features in the LSA

4.0 Assessment of Project Related Effects

4.1 Potential Interactions Between the Project and Valued Component/Key Indicators

The Project will require the Construction, Operation, and Decommissioning of several components (as described in Section 2 of the EIS). Potential interactions between these Project components and activities and Fish and Fish Habitat in the form of Wetlands and their associated KIs are summarized by Project phase and activity in Table.

Potential interactions in Table are ranked as:

Primary Interaction (✓): Project activity is expected to interact with the VC / KI which may result in an adverse effect on the VC (i.e., a measurable or detectable change in the MP) and is further considered in the effects assessment as the primary contributor to potential adverse effects.

Other Interaction (✓): Project activity is expected to interact with the VC / KI. While the interaction is further considered in the effects assessment, it is not expected to be a primary contributor to potential adverse effects.

No Interaction: Project activity is not expected to interact with the VC or the KI, no adverse effects are expected, and rationale is provided for not considering this potential interaction further.

Table 4: Potential Project Interactions for Wetlands Valued Component

Project Phase/Activity	Wetlands Valued Component and Key Indicator
Development of access roads and air strip	✓
Site preparation and earthworks; clearing, leveling and grading of the Project Area	✓
Power generation - generators	✓
Installation of main substation and distribution of power around site	✓
Wellfield and freeze hole drilling; ground freezing	✓
Batch plant operation (concrete); crusher at borrow area	✓
Development of surface infrastructure (camp, operations centre, plants, ponds, pads and support facilities)	✓
Waste management (composting, domestic and industrial landfill operation, recycling)	
Water management (including treatment and site runoff)	✓
Groundwater supply	✓

Project Phase/Activity	Wetlands Valued Component and Key Indicator
Surface water withdrawal	✓
Fuel management (e.g., propane for comfort heating; vehicle and aircraft fuel)	✓
On-site and off-site operation of vehicles and transportation of materials	✓
Air transportation for workers	✓
Regulatory site inspections	✓
Engagement – site visit from Interested Parties	✓
Operation of the ISR wellfield	
Wellfield and freeze wall drilling	✓
Operation and expansion of freeze wall	✓
Batch plant operation (grout and cement); crusher in borrow area	✓
Expansion of pond and pads	✓
Operation of the processing plant and production of uranium concentrate	
Water withdrawal from groundwater or surface water body	✓
Management of surface water (including seepage and site runoff)	✓
Water treatment, both domestic and industrial	
Water release to surface water body	✓
Waste management (composting, domestic and industrial landfill operation, recycling)	
Hazardous waste management (temporary storage, handling, and off-site transportation)	✓
Storage and disposal of drill waste rock, process precipitates and industrial wastewater treatment plant precipitates	✓
On-site and off-site operation of vehicles and transport of materials	✓
Power supply – primarily power from the grid, also generators and back-up generators	✓
Package and transport of nuclear substances	✓
Fuel management (e.g., propane for comfort heating; vehicle and aircraft fuel)	✓
Air transportation for workers	✓
Progressive decommissioning and reclamation	✓
Regulatory site inspections	✓

Project Phase/Activity	Wetlands Valued Component and Key Indicator
Engagement – site visit from Interested Parties	✓
Site water management, treatment, and release	✓
Mining horizon remediation and thawing of freeze wall	✓
Process water treatment and release	✓
Closure of ISR and freeze wells and related infrastructure	✓
Decontamination of surface facilities and injection, recovery and monitoring wells	
Asset removal (including site power transmission lines and electrical infrastructure)	✓
Demolition and disposal of non-salvageable surface infrastructure and materials	✓
Remediation of contaminated areas (wellfield, pads, ponds, domestic wastewater treatment location, and process plant area)	✓
Generators	✓
Waste management (composting and landfill operation)	
Decommissioning of landfills; hazardous materials management (temporary storage and off-site disposal)	✓
On-site and off-site operation of vehicles and transportation of materials	✓
Reclamation of disturbed areas	✓
Regulatory site inspections	✓
Engagement – site visit from Interested Parties	✓
Environmental monitoring	✓
Regulatory site inspections	✓
Engagement - Site visit from Interested Parties	✓

1 Operational activities include maintenance.

4.2 Potential Project-related Effects

Based on the timing and nature of the interactions identified in Table 4, the following adverse effects have a potential to occur on the Wetland VC (Table 5). The key indicator of effects to wetlands is the change in areal extent of wetlands in the study area.

Table 5: Potential Project-related Effects on Wetlands Valued Component During all Project Phases

Project Phase/Potential Effect	Wetlands Valued Component and Key Indicator
Construction	
Direct disturbance / Overprinting	✓
Mobilization of suspended materials	✓
Introduction and/or Proliferation of Invasive Plants	✓
Changes in Water Quantity (water levels or flow)	✓
Edge Effects	✓
Changes to Water Quantity and Quality	✓
Dust Deposition	✓
Operation	
Direct disturbance / Overprinting	✓
Mobilization of suspended materials	✓
Edge Effects	✓
Introduction and/or Proliferation of Invasive Plants	✓
Controlled Discharge	✓
Changes in Water Quantity (water levels or flow)	✓
Controlled Discharge / Water Quality	✓
Dust Deposition	✓
Decommissioning	
Direct disturbance / Overprinting	✓
Mobilization of suspended materials	✓
Edge Effects	✓
Introduction and/or Proliferation of Invasive Plants	✓
Controlled Discharge	✓
Changes in Water Quantity (water levels or flow)	✓
Controlled Discharge / Water Quality	✓
Dust Deposition	✓
Post-Decommissioning	

Project Phase/Potential Effect	Wetlands Valued Component and Key Indicator
Direct disturbance	✓
Introduction and/or Proliferation of Invasive Plants	✓
Edge Effects	✓
Changes to Water Quantity and Quality	✓
Dust Deposition	✓

4.3 Mobilization of Suspended Materials

Construction

The primary effect pathway during Construction relates to the mobilization of suspended material into natural surface water features including wetlands as a result of land disturbance and clearing. The mobilization of suspended material into natural surface water features is readily mitigatable by virtue of the mine development plan and through the implementation of standard water management and sediment control practices. Water management infrastructure (e.g., collection ditches, ponds, pumping stations) and various aspects of the water management and sediment control management systems will be put into place coincident with the initiation of construction activities. Waters (e.g., runoff) associated with areas under development will be collected and stored within management infrastructure (e.g., clean waste rock pond, see Figure 2.2-14 in Section 2 of the EIS). In the event that releases to the natural environment are necessary, they would only occur once it is safe to do so (i.e., suspended solid levels in the water would be at acceptable levels). No downstream effects on surface waters, natural sediments, fish and fish habitat including wetlands are expected.

Operation

During Operation, mobilization of suspended materials will be managed through the development and operation of water management infrastructure and implementation of surface water management through the Surface Water Management Program. Releases of contact water to the natural environment will be directed through applicable collection ponds, the IWWTP, and the Effluent Monitoring and Release Ponds. No specific discharge is expected to wetland features in the Project Area. Discharge will only occur once it is safe to do so (i.e., suspended solids levels in the water would be at acceptable levels). Denison may employ active means (e.g., filtering), if required, to achieve low TSS levels in discharge, in addition to passive means, such as settling and clarification in the IWWTP to manage TSS in the effluent stream to low levels. No downstream effects on surface waters, natural sediments, or fish and fish habitat including wetlands are expected.

Decommissioning and Post-Decommissioning

During Decommissioning and Post-Decommissioning, the site-wide water management system will continue to operate such that Denison will maintain control of the site aspect affected water through the IWWTP. Surface drainage during Decommissioning activities will continue to be directed to the system of collection ponds, the IWWTP, and the Effluent Monitoring and Release Ponds to facilitate the control of suspended solids and achieve low TSS levels in the discharge, thereby minimizing any potential for adverse changes to water quality, sediment quality, and fish and fish habitat including wetland features.

4.4 Overprinting of Wetlands as Fish Habitat

For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA.

Bogs are predicted to be the wetland class most affected by the Project, with 0.4 ha (less than 0.1%) of mapped bog ecosystems within the Terrestrial RSA expected to be disturbed within the Project Area during Construction. Fens are the next most affected, with 0.1 ha (0.1%) anticipated to be disturbed during Construction (Figure 3). Less than 0.1 ha (less than 0.1%) of shallow open water wetlands within the Terrestrial RSA are also anticipated to be affected by the Project.

Within these wetland classes, the wetland ecosite expected to be most affected is the willow shrubby rich fen (ecosite BS23) with direct disturbance to 0.1 ha predicted to occur within the Project Area (0.5% of the BS23 ecosite within the Terrestrial RSA). The remaining ecosites anticipated to be directly affected by the Project are locally abundant, with direct disturbance expected to affect <0.1% of these ecosites within the Terrestrial RSA (**Error! Reference source not found.** 2).

Investigation of the potential overprinting of wetland features as a result of the Project it is evident that wetland loss is avoidable. The interaction of the Project with wetlands is isolated to those areas where stream crossings for access roads and hydro-line connections are proposed (Figure 3). With the use of single span bridges and implementation of best management practices, direct wetland disturbance associated with the crossings of Kratchkowsky Creek and Hart Creek is expected to be avoided. It should be noted that SaskPower proposes to tap the existing I3P 138 kV line near Highway 914 and build approximately 4.5 km of new 138 kV line from the I3P tap to the Project site. SaskPower will be responsible for conducting activities such as line routing, environmental studies, and permitting, public consultation, and engineering design work as applicable to the load interconnection. As such, wetland disturbance related to the SaskPower Hydro Corridor is expected to be addressed through the SaskPower permitting process.

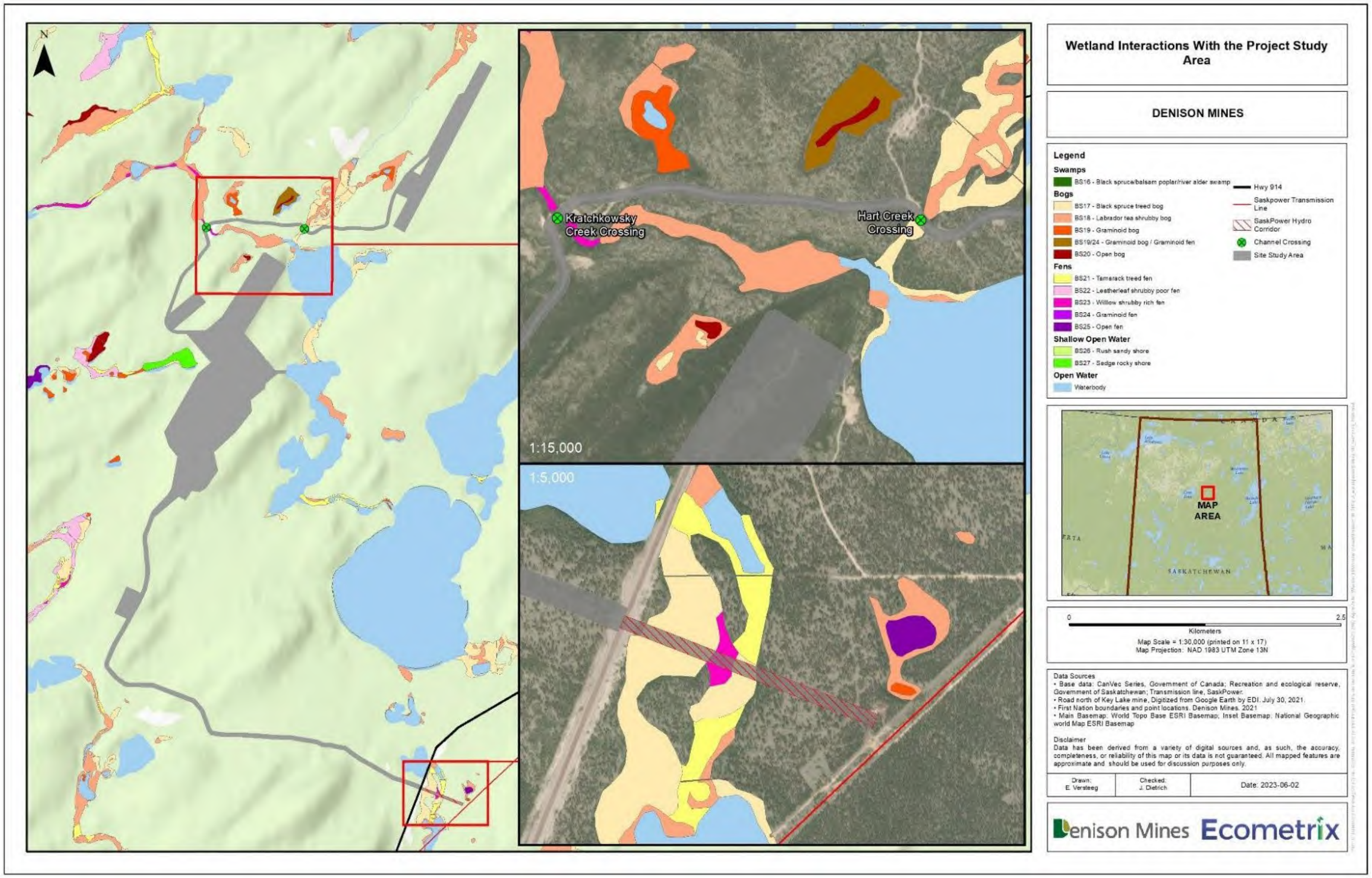


Figure 3: Denison Wheeler River Project Area and Wetland Feature Distribution

4.5 Controlled Discharge to Receiving Environments

According to the site water balance (Figure 2.2-14 in Section 2 of the EIS), there is no planned discharge to Whitefish Lake during Construction. Other than LA-5 (Whitefish Lake) no other controlled discharge will occur to the natural environment and no wetlands will be impacted as a result.

4.6 Change in Water Levels and Flow

As detailed in Section **Error! Reference source not found.** of the EIS, the projected withdrawal and discharge rates proposed for the Project are the largest influence on the hydrological effects of the Project. The largest predicted change in streamflow rate is -3.1% at the LA-5 and SA-2 nodes (immediately downstream of the Project) during Operation and Decommissioning, as projected against the 5th percentile low flow dataset in March. Lake levels and wetlands are expected to deviate less than ±0.01 m due to all Project influences. All Project influences on the environment are expected to return to baseline conditions during Post-Decommissioning. These changes are within the range of fluctuation of environmental flows and water levels and are unlikely to affect fish passage or life history environmental cues.

4.7 Introduction and/or Proliferation of Invasive Plants

Vegetation clearing and soil disturbance during Construction are expected to create conditions suitable for the introduction and proliferation of invasive plants. Vehicles and construction equipment can inadvertently transport seeds and other invasive plant propagules in tires or the undercarriage to previously unaffected areas. The effects of invasive plants on native vegetation diversity are well documented and recognized as the second greatest threat to listed species after habitat loss (Enserink 1999). Competition with native species can lead to a reduction in the growth and vigour of native species (including Wetlands), as well as changes in the diversity, structure and function of ecosystems and habitats.

The potential for the introduction and proliferation of invasive plants by transport on vehicles and equipment is expected to continue throughout Operation during wellfield and freeze wall drilling, expansion of ponds and pads, drill waste rock, process precipitates and industrial wastewater treatment plant precipitates, on-site and off-site operation of vehicles and transport of materials, package and transport of nuclear substances, and air transportation for workers (i.e., landing and taking off of airplanes). Progressive decommissioning and reclamation has the potential to introduce invasive plants on vehicles and equipment and if seed used for revegetation is not supplied from a native seed source (Polster 2003) with a certificate of analysis indicating an absence of invasive plant seeds.

The potential for the introduction and proliferation of invasive plants is expected to continue throughout Decommissioning (e.g., during closure of the ISR and freeze wells and infrastructure, asset removal, demolition and disposal of non-salvageable surface infrastructure and materials, remediation of contaminated areas, reclamation of disturbed areas, and operation of vehicles and transportation of materials). The potential for the introduction and proliferation of invasive plants is expected to continue throughout Post-Decommissioning, but at lower levels due to reduced vehicle traffic.

4.8 Edge Effects

Edge habitat refers to an area on either side of a border between vegetation communities. Edges between vegetation communities often result in altered microclimatic conditions that can influence environmental conditions further away from the edge (Bannerman 1998). Edge effects are expected to extend into areas of native vegetation and habitats at the interface of disturbed areas and undisturbed native ecosystems, and could include altered microclimatic conditions that can influence quality in habitat away from the edge (Bannerman 1998). Where edge effects occur, Wetlands may experience changes in light intensity, temperature, wind, moisture, relative humidity, and patterns of snow accumulation and melt relative to undisturbed conditions. This can, in turn, affect plant health and alter natural disturbance regimes (e.g., blowdown), plant population persistence, and the structure and function of ecosystems and habitats. If changes to microclimatic conditions or vegetative structure at an edge exceed a species habitat preference or physiological tolerance, then edge habitat may result in lower occupancy or use, reduced survival, or lowered reproductive success.

Edge effects at the interface of disturbed areas and native ecosystems are expected to occur along the edges of the Project Area resulting from vegetation clearing during site preparation and earthworks during Construction. Edge effects are expected to continue throughout Operation, Decommissioning, and Post-Decommissioning, decreasing over time as revegetation and tree growth within reclaimed areas of the Project create a gradual structural transition at forest edges, aided by natural encroachment.

4.9 Long-Term Transport of Groundwater Solutes to Whitefish Lake in Future Centuries

During the ‘future centuries’ scenario as described in Section 8.3.1.3 of the EIS, remediation works will be completed and the site naturalized, thereby restoring drainage patterns to report to surface waterbodies. As indicated in Section 7 of the EIS, groundwater plumes may develop from residual mass remaining post-mining based on bench-scale lab tests of core flushing, and numerical modelling of reactive fate and transport. The results of this was described in Section 8.3.4.2.5 with respect to Fish and Fish Habitat and therefore wetlands.

The results of the numerical modelling (as provided in Section 7 and Appendix 10-A in Section 10 of the EIS) support the conclusion that with the implementation of appropriate mitigation during the decommissioning and restoration phases of the Project, the residual effects of the

Project on the intermediate Groundwater VC will not result in an adverse effect on surface water. Dissolved constituent concentrations emanating over hundreds to thousands of years in the future from the deep Ore Zone to Whitefish Lake are expected to remain below fresh water environmental quality criteria in Whitefish Lake.

Although the precise location of the groundwater discharge to the surface is somewhat uncertain, the groundwater transport scenarios that have been evaluated (Appendix 7-C of the EIS) to date suggest groundwater discharge impacted from mining will most likely be relegated to Whitefish Lake. The discharge to Whitefish Lake is generally predicted to occur along the eastern shore of the lake, as this is interpreted to be the eastern edge of the underlying desilicified zone. The Laborador Tea Shrubby Bog habitat located on the eastern shore of Whitefish Lake may be in the zone of influence of groundwater discharge, yet chemically will remain below freshwater environmental quality criteria. Groundwater impacts to other surrounding wetlands will be negligible as groundwater is not predicted to discharge within any area beyond the central portion of Whitefish Lake.

4.10 Indirect Effects

Indirect disturbance associated with the potential to adversely affect BS19/24 includes the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases (as described in Section **Error! Reference source not found.**). Wetland ecosites BS19/24 (graminoid bog/fen) and BS25 (open fen) are peatland ecosystems typically characterized by high water tables (i.e., a very moist or very wet moisture regime), while ecosite BS27 (sedge rocky shore) is a sparsely vegetated ecosystem predominated by rocky substrates, typically occurring adjacent to lakes and ponds (McLaughlan et al. 2010). Because these ecosystems rely on high water tables and existing waterbodies, alteration of water quantity would be expected to have the highest potential to cause an adverse effect. Therefore, maintenance of wetland hydrology is expected to be the most effective mitigation to sustain these wetland ecosites within the Terrestrial LSA throughout the Project lifespan.

5.0 Mitigation Measures

Mitigation measures specific to the wetlands, discussed in the following subsection are applicable during all Operation phases and expected to be effective immediately following implementation and managed through the EMP.

Disturbance Reduction

- Wherever possible, wetlands will be avoided through Project design and instituting proper buffers.

- Disturbance to vegetation and soils will be avoided by clearly delineating Project Area boundaries (e.g., with the use of fencing, staking, or flagging), adhering to construction plans and schedules, and by restricting off-site machine use.
- Wetland boundaries in the proximity of planned disturbances will be clearly delineated (e.g., with the use of fencing, staking, or flagging) to facilitate avoidance to the extent practicable.
- Should they occur, areas prone to potential instability and areas in proximity to water bodies and drainage features will be identified and appropriate setbacks will be established and maintained.
- Temporary workspaces or laydown areas will be sited and constructed within existing disturbance or on previously compacted soils, where practicable. In areas requiring clearing only, grubbing will be avoided, and roots and groundcover will be retained to the extent feasible.
- Pre-construction listed plant surveys will be completed within the Project Area.
- Listed plants located adjacent to planned disturbances will be clearly delineated (e.g., with the use of fencing, staking, or flagging) to facilitate avoidance to the extent practicable and reduce the potential for accidental encroachment outside of the Project footprint.
- Should Listed Plants be identified within the Vegetation LSA prior to Construction, site- and species-specific mitigation measures to avoid and/or limit Project effects will be determined by a Qualified Vegetation Ecologist. Specific mitigation measures will depend on the species, its life history characteristics, time of year, and the location of the occurrence in relation to Project activities.
- Herbicide use will be avoided within 100 m of any known listed plant occurrences. Where herbicide use is unavoidable, use will be restricted to direct application instead of broadcast spraying and completed by qualified personnel.

Soil Handling and Reclamation

- Construction activities will be sequenced (i.e., site clearing, grading preparations, major earthworks and construction of infrastructure/facilities) so that surface vegetation, mineral soil and organic matter can be salvaged for later use in Project Decommissioning.
- Soil resources within the Project Area will be stripped/salvaged and stockpiled within the Project Area in accordance with relevant soil management BMPs, i.e., providing guidance on ground-truthing soil conditions, flagging potential hazards and sensitivities, and

modifying practices in relation to environmental conditions and avoiding or minimizing inadvertent/incidental disturbance.

- A soil monitoring program/protocol (or equivalent) will be undertaken to verify soil salvage volumes and reclamation suitability (Section 9.1.8.2).
- Soil stockpiling locations will be sited to reduce soil handling and travel distances and designed to minimize the potential for soil degradation and downgradient effects, e.g., having defined height and width that optimize soil storage and stockpile stability, and having integrated erosion control measures and surface water management features (if/where necessary). Sediment and erosion control measures will be implemented in accordance with BMPs and commensurate to site conditions and sensitivities.
- Sediment and erosion control measures and surface water management features will be installed and maintained at the Project. Erosion controls (e.g., sediment fencing, check-damns and/or sediment ponds) will be installed as necessary and at the discretion of construction personnel commensurate to site conditions and sensitivities to manage/mitigate erosion and sedimentation.
- Progressive reclamation and ecosystem-based revegetation will be conducted on disturbed areas as soon as practicable with the use of suitable native species and in accordance with the Reclamation and Closure Plan.

Surface Water Management

- Snow melt and runoff will be controlled within the Project Area to prevent the potential release of contaminated runoff from affecting vegetation in adjacent areas.
- Sediment and erosion control measures will be implemented in accordance with the EMS.
- Surface water management features (e.g., culverts and ditches) will constructed and maintained (as per Project design specification) along access roads and facility sites to facilitate surface drainage continuity and hydrologic connectivity—especially in proximity to wetlands, water crossings, and waterbodies.
- Hydrologic connectivity is expected to be maintained across the Project Area with the engineering, construction, and maintenance of surface water management features (e.g., culverts and ditches) as appropriate and as per Project design specifications along access roads and at facility sites.

Invasive Plant Management

- Equipment and vehicles will arrive at the Project Area clean, and will be inspected for soil, plant material, and seeds, and cleaned as appropriate, to limit the potential for the introduction of invasive plants and noxious weeds.
- Areas with a high risk for the potential spread of invasive plants and noxious weeds (i.e., within or adjacent to existing infestations) will be avoided to the extent practicable; if work must occur in these areas, invasive plant management will be implemented before starting work.
- Gravel, fill, straw matting, or similar materials to be used for erosion control will be inspected to minimize the potential for seeds or propagules of invasive plants being brought to site.
- All employees and contractors on the Project will receive an employee orientation appropriate to the work they are undertaking, including instruction on the definition of invasive plants and their potential effects, mitigation measures to avoid the introduction and spread of invasive plants, and training on the presence and identification of common invasive plant species and those known to occur within the Project Area.
- Invasive plant monitoring will be conducted periodically by personnel skilled in invasive plant identification during all Project phases to assess, evaluate, and document invasive plant occurrences within the Project Area. Invasive plant surveys will be completed during a biologically appropriate time of year (e.g., when invasive plants can be identified) within areas identified as most susceptible to invasive plant introduction and spread, including roads, ROW, debris and vegetation management areas (e.g., slash piles, timber decks, exposed soil or stockpiles) and other regularly disturbed habitats.
- Three general treatment options may be used alone or in combination to control of invasive plants in the Project Area:
  - mechanical control – involves the physical removal of the plants;
  - chemical control – involves application of synthetic and/or natural herbicides; and,
  - biological control measures – involves use of living organisms (e.g., rusts, insects) to control selected invasive plant species.
- The type of treatment option selected for an invasive plant occurrence will be based on a combination of specific information including the identity of the invasive plant species and its provincial designation, the size and extent of the occurrence, time of year, the proximity of the occurrence to other susceptible areas (e.g., rare plant occurrences, wetlands, waterbodies), and the available control options. Where possible, control of

invasive plants will be completed in consultation with a qualified professional to minimize potential effects on native vegetation, ecosystems and wetlands.

- Seed used during re-vegetation will be certified weed free, with a valid "Certificate of Seed Analysis".

6.0 Residual Effects Evaluation

6.1 Residual Effects Characterization

Residual effects on the Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs have been assessed in relation to the RSA, and characterized in terms of direction, magnitude, geographic extent, frequency, duration, reversibility, context, and likelihood (**Error! Reference source not found.** 6). Residual effect evaluation of residual effects are provided in Tables 7, 8 and 9.

Table 6: Definitions of Effect Characteristics Considered When Determining the Significance of Residual Effects

Residual Effect Characteristic	Definition	Rating
Direction	Identifies whether the residual effect will be adverse or positive.	**Adverse** – Negative effect or effect is not desirable. *Water Quantity* – Effect moves MPs (flow or water level) in a direction detrimental to water quantity relative to baseline conditions. A Project-related increase in surface water flows and levels during flooding, or a decrease in surface water flow below environmental flow requirements. *Water Quality* – An increase in constituent concentrations attributable to the Project in comparison to baseline conditions and trends. *Wetlands / Fish Habitat* – A physical loss of available fish habitat (extent of area) in comparison to baseline conditions. **Positive** – Beneficial effect or effect is desirable.
Magnitude	The amount of change in a measurable parameter relative to baseline conditions.	**Low** ▪ measurable decrease in the spatial extent of Wetlands, but less than a 10% loss; all original wetland classes are present. ▪ A measurable change that is not within the variability of baseline conditions but below relevant water quality objectives and criteria. A Project-related change in hydrology (flows or levels) compared to baseline conditions, but where the change is <5% from baseline conditions

Residual Effect Characteristic	Definition	Rating
		Moderate ▪ measurable decrease in the spatial extent of Wetlands between 10% and 30% loss; measurable changes in the diversity of wetland classes; some original wetland classes may be absent. ▪ A measurable change in water quality that is not within the variability of baseline conditions and not within applicable guidelines, legislated requirements, and/or federal and provincial management objectives. A Project-related change in hydrology (flows or levels) compared to baseline conditions, but where the change is >5% from baseline conditions, and could, therefore, have an adverse effect on Fish and Fish Habitat within the LSA. **High** ▪ measurable decrease in the spatial extent of Wetlands greater than 30% loss; some original wetland classes are absent. ▪ monthly flows (>10%), or lake surface elevation (m) in a waterbody or watercourse that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes. A measurable change in water quality that is not within the variability of baseline conditions and not within applicable guidelines, legislated requirements, and/or federal and provincial management objectives and is likely to have an adverse effect on Wetlands (Fish and Fish Habitat) within the LSA, with the effect extending beyond the LSA.
Geographic Extent	The geographic area within which the residual effect is expected to occur.	**Project Area** – Effect is limited to the Project Area. **Local** – Effect is limited to the Vegetation LSA. **Regional** – Effect extends beyond the Vegetation LSA into the Terrestrial RSA. **Beyond Regional** – Effect extends beyond the Terrestrial RSA.
Duration	Length of time over which the residual effect is expected to persist.	**Short-term** – Less than 3 years (i.e., effect happens during Construction only). **Medium-term** – 3 years to 38 years (i.e., effect happens from Construction through to the end of Post-Decommissioning). **Long-term** – More than 38 years (i.e., effect extends beyond Post-Decommissioning).
Frequency	How often the residual effect is expected to occur.	**Infrequent** – Effect occurs several times at sporadic intervals. **Frequent** – Effect occurs many times on a regular basis. **Continuous** – Effect occurs continuously.

Residual Effect Characteristic	Definition	Rating
Reversibility	Whether or not the residual effect can be reversed once the activity causing the residual effect ceases.	**Fully Reversible** – A residual effect that diminishes to baseline conditions. **Partially Reversible** – A residual effect that partially diminishes to baseline conditions. **Irreversible** – A residual effect that will not diminish to baseline conditions.
Context	The extent to which the VC or KI has been affected by past and present environmental and socio-economic processes and conditions, its potential sensitivity to the Project-related residual effect, and its ability to recover from that effect (i.e., resilience)	**Low** – VC/KI has high resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a lack of historic and ongoing anthropogenic or natural disturbance. No listed species present. **Moderate** – VC/KI has moderate resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or an intermediate level of historic or ongoing anthropogenic or natural disturbance with the capacity to assimilate more change. Presence of listed species **High** – VC/KI has weak resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a high level of historic or ongoing anthropogenic or natural disturbance. Presence of *SARA*-listed species
Likelihood	Likelihood that the residual effect will occur including consideration of the likelihood that the mitigation will be successful.	**Likely** – A moderate to high probability that the residual effect will occur. **Unlikely** – A low probability that the residual effect will occur.

Table 7: Wetland Fish and Fish Habitat – Summary of the Residual Effect Characteristics for Surface Water Quality

Residual Effect Characteristic	Rating	Summary Rationale for Rating
Direction	Adverse	The Project (specifically the discharge of effluent to the natural environment) will cause a change in the concentration of constituents, as measured as a mass of a chemical per unit volume in water (e.g., mg/L). Surface water quality in the local receiving environment will be adversely affected by effluent discharge to the aquatic environment, thereby providing a pathway to adversely affect surface waters. However, no discharge is planned to wetlands outside of Whitefish Lake.
Magnitude	Low	The magnitude of the residual effect is predicted to be low as constituents that may be introduced as part of Project activities are expected to remain below criteria for the protection of aquatic life and human health.
Geographic Extent	Local	The geographic extent of the residual effect is predicted to be confined to the immediate waterbody adjacent to the Project (i.e., Whitefish Lake). The estimated mixing zone is less than 5 m, implementing an effluent discharge configuration that promotes mixing.
Duration	Long-term	The residual effect is expected to last between 3 to 38 years (i.e., effect expected during Construction through to the end of Post-Decommissioning).
Frequency	Continuous	For the purposes of this EIS, a conservative scenario was identified, with effluent discharge being considered as continuous during Operation and Decommissioning.
Reversibility	Fully reversible	Surface water quality is expected to return to pre-development levels following Post-Decommissioning as Project-related sources will cease to operate.
Context	Low	Wetland health is expected to be resilient to changes in surface water quality in the context of this assessment, as COPC meet protective criteria even at the extreme low water scenario. Therefore, under applicable mitigative measures and average flow conditions, the contextual resilience of the aquatic system to respond to change is considered to be great.
Likelihood	Likely	A high probability exists that a change in water quality from background conditions will occur, but be restricted to Whitefish Lake and not other surrounding wetland features.

Table 8: Wetland Fish and Fish Habitat – Summary of the Residual Effect Characteristics for Change in Area Extent

Residual Effect Characteristic	Rating	Summary Rationale for Rating
Direction	Adverse	Impacts to wetlands in the LSA from physical disturbance or overprinting are expected to be minor in nature and relegated to wetlands located at stream crossings for access roads and the hydro-line corridor. In both cases the approach to design will be one of avoidance and minimal disturbance with clear span bridges and minimal clearing required for hydro-line installation where avoidance of open water areas can be met.
Magnitude	Low	The magnitude of the residual effect is predicted to be low. Less than 0.1% of Wetlands within the Terrestrial RSA are predicted to be directly affected as a result of Project Construction, and up to 1.5% may be indirectly affected during all Project phases.
Geographic Extent	Local	The residual effect is expected to be limited to the LSA, specifically to wetlands located at stream crossings for access roads and the hydro-line corridor
Duration	Long-term	Once natural drainage patterns are re-established following Operation, the structure and function of Wetlands altered as a result of indirect Project effects are expected to re-establish after Post-Decommissioning (more than 38 years).
Frequency	Frequent	While direct affects to specific Wetlands will occur over a short time period during Construction, Wetland alteration by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning, and infrequently during Post-Decommissioning.
Reversibility	Partially Reversible	Wetland effects are predicted to be partially reversible during Decommissioning once natural hydrologic conditions are reinstated. Alterations to wetland extent, structure and/or function as a result of indirect Project effects during all Project phases are predicted to be reversible over time once natural hydrologic conditions are reinstated and edge effects, dust, water quality changes, and invasive plant propagule pressure are reduced at the end of Decommissioning.
Context	Moderate	Wetlands can exhibit low resilience and high susceptibility to disturbance; however, disturbance is common within the Terrestrial RSA, and existing Wetlands have been historically disturbed by access roads and exploration activities.
Likelihood	Likely	The infrastructure associated with the bridges and the hydro-line are likely to affect the localized area for which they span in a limited way.

Table 9: Wetland Fish and Fish Habitat – Summary of the Residual Effect Characteristics for Change in Surface Water Quantity (Hydrology)

Residual Effect Characteristic	Rating	Summary Rationale for Rating
Direction	Adverse	Water quantity (flow and level) will be reduced in LA-5 as a result of the overprinting of its reporting drainage area by mine infrastructure and through site water balance. Water taking has an additional potential to reduce water levels in LA-5 and associated wetlands.
Magnitude	Low	The magnitude of the residual effect is predicted to be low. Under all scenarios, the Project-related change in hydrology (flows or levels) compared to baseline conditions is less than 5% of baseline conditions, and generally less than 3%.
Geographic Extent	Local	The residual effect is expected to be limited to the LSA, specifically the lakes and wetlands within proximity to the Project site (i.e., LA-5, LA-6, and LA-1).
Duration	Moderate	The residual effect is expected to last between 3 to 38 years (i.e., effect expected during Construction through to the end of Post-Decommissioning).
Frequency	Continuously	Although the mine is unlikely to require water taking on a continuous basis, this has been assessed as a bounding scenario and, as such, must be considered as a continuous effect.
Reversibility	Fully reversible	Surface water hydrology is expected to return to pre-development levels following Post-Decommissioning.
Context	Moderate	Surface water flow regimes are variable, and it is this variability that provides for morphological form to be maintained and for ecological reliance (i.e., wetlands, fish habitat). Some change to environmental flows is tolerated by wetland biota.
Likelihood	Low	Due to the localized nature and low magnitude of the effect on surface water hydrology, the likelihood of an effect is considered to be very low; therefore, the likelihood of an effect on Wetlands is expected to be low.

6.2 Significance and Confidence

The residual effect of change in the areal extent of the Wetlands VC as a result of the Project is not expected to result in a change to the wetlands KI that will alter its integrity within the Terrestrial RSA to the point where it is not sustainable or unavailable to contribute to ecological functions**.**

The threshold for significance for the Wetlands VC relates to predicted changes in the concentrations of water quality parameters, where changes could result in exceedances of relevant water quality benchmarks that are protective of aquatic biota in waterbodies that receive mine-affected drainage. The threshold for significance for Wetlands also includes predicted changes in surface water flows greater than baseline environmental flows and direct habitat loss.

The significance of the residual effects on the Wetlands VC has been deemed **not significant**. Following mitigation, the residual effects are not expected to cause a change in Wetland habitat (or associated KIs) to the extent that they might alter the ecological integrity of the VC in the LSA beyond an acceptable level.

The predicted confidence with respect to the Wetlands VC is high as the mobilization of suspended materials can be readily mitigated, making the effects prediction relative to this effect pathway easily understood.

Confidence in the assessment of predicted effects on water levels or flow is quite high due to available hydrological data for the LSA. Uncertainty is minimal with the assumptions that the water withdrawal and discharge scenarios presented herein represent the bounding case, and hydrogeological modelling projections are not changed (Section 8.1 of the EIS).

Potential effects on water quality as a result of Project discharges to local receiving environments were assessed by way of numerical modeling. These predictions are generally considered conservative in nature because the assumptions on which they are based are conservative. For example:

- The assessment is based on a continuous (year-round) discharge at an expected average effluent rate of 0.0101 m^3/s (36.5 m^3/hr) throughout Construction, Operation, and Decommissioning, despite the likelihood that effluent discharge will not be continuous and will only discharge when site water balance requires, based on water storage capabilities.

- The constituents in effluent discharge have been estimated conservatively. Presented discharge concentrations provided herein include contingency factors of one to three times.

- Baseline water quality is defined by the 95th percentile concentrations of individual constituents. Such an assumption is conservative as it constrains the assimilative capacity associated with the receiving environment. By definition, the assimilative capacity of a receiving environment is equal to the incremental difference between the existing baseline condition and the assessment benchmark (i.e., water quality criterion) on which the evaluation is based. Use of the 95th percentile concentration, rather than a measure of central tendency (i.e., 50th percentile, geomean), means that the incremental change in a given constituent concentration that can be assimilated by the receiving environment (whereby use of the receiving environment is protected) is relatively small in magnitude.

Due to the conservative nature of the assumptions on which the numerical assumptions are based, a high degree of confidence can be assumed.

6.3 Summary of Project Related Residual Adverse Effects

The results of the characterizations for these residual effects are summarized in Table 10. The residual effects of the Project on the Wetland KIs were predicted to be **not significant**. Thus, the residual effects of the Project on the Wetlands VC are predicted to be **not significant**.

Table 10: Summary of Project-related Residual Effects

Valued Component	Residual Effect	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance
Wetlands	Change in Water Quality	C, O, D	A	L	L	LT	C	FR	L	L	NS
	Change in Water Level or Flow	C, O, D	A	L	L	MT	C	FR	L	L	NS
	Change in the Areal Extent of Wetlands	C, O, D	A	L	L	LT	F	PR	M	L	NS

[1] Direction: Adverse (A), Positive (P)

Magnitude: Low (L), Moderate (M), High (H)

Geographic Extent: Local (L), Regional (R), Beyond Regional (BR)

Duration: Short-term (ST), Medium-term (MT), Long-term (LT)

Frequency: Infrequent (IF), Frequent (F), Continuous (C)

Reversibility: Fully Reversible (FR), Partially Reversible (PR), Irreversible (IR)

Context: Low (L), Moderate (M), High (H)

Likelihood: Unlikely (U), Likely (L)

Significance: Not-Significant (NS), Significant (S)

Level of Confidence: High (H), Moderate (M), Low (L)

7.0 Cumulative Effects

The cumulative effects are discussed in detail in Section 9.2.7 of the EIS and are not re-examined herein.

8.0 Summary

Bogs are predicted to be the wetland class most affected by the Project, with 0.4 ha (less than 0.1%) of mapped bog ecosystems within the Terrestrial RSA expected to be disturbed within the Project Area during Construction. Fens are the next most affected, with 0.1 ha (0.1%) anticipated to be disturbed during Construction. Less than 0.1 ha (less than 0.1%) of shallow open water wetlands within the Terrestrial RSA are also anticipated to be affected by the Project.

Within these wetland classes, the wetland ecosite expected to be most affected is the willow shrubby rich fen (ecosite BS23) with direct disturbance to 0.1 ha predicted to occur within the Project Area (0.5% of the BS23 ecosite within the Terrestrial RSA). The remaining ecosites anticipated to be directly affected by the Project are locally abundant, with direct disturbance expected to affect <0.1% of these ecosites within the Terrestrial RSA.

Investigation of the potential overprinting of wetland features as a result of the Project it is evident that wetland loss is avoidable. The interaction of the Project with wetlands is relegated to those areas where stream crossings for access roads and hydro-line connections are proposed.

Avoidance through design as well as mitigation measures to control sedimentation to wetland features during construction, operation and decommissioning phases. Water quantity and quality are not expected to cause impacts to wetlands as the change in surface water feature levels and flow are nearly negligible and water will not be discharged to wetlands save for Whitefish Lake, for which effluent will not be released unless meeting criteria for the protection of aquatic life.

Residual effects on the Wetlands VC resulting from the Project were identified and assessed as **not significant**. Existing provincial legislation (Environmental Management and Protection Act [Government of Saskatchewan 2010] and the Water Security Agency Act [Government of Saskatchewan 2019b]) requires written approval (i.e., Aquatic Habitat Protection Permits) prior to any works within a wetland.

To further supplement existing information that exists for the LSA wetlands, Denison is committed to undertaking wetland surveys including the collection of water quality, sediment quality, benthic invertebrates and fish and fish habitat surveys prior to the construction of the operation to provide an updated baseline for assessing the success of mitigation measures and to assess potential effects of the project on wetlands. These locations will then be further considered as part of the EMP for continued monitoring for these media and biota.

9.0 References

Bannerman, S. 1998. *Biodiversity and Interior Habitats: The Need to Minimize Edge Effects*.

Part 6 of 7. Extension Note 21. Biodiversity: Management Concepts in Landscape Ecology. British Columbia Ministry of Forests Research Program. 8 pp.

Chen, J. 1991. *Edge effects: microclimatic pattern and biological responses in old-growth Douglas- fir forests*. PhD. University of Washington, Seattle, WA.

Ecometrix Incorporated. 2020. *Wheeler River Project: Baseline Aquatic Environment Study*.

Prepared for Denison Mines Corporation. Mississauga, Ontario. 948 pp.

EDI Environmental Dynamics Inc. (EDI) 2021. *Wheeler River Project Annex Report - Soil, Vegetation and Wildlife*. Prepared for Denison Mining Corp., Saskatoon, SK.

Enserink, M. 1999. Biological invaders sweep in. *Science* 285(5,435): 1,834–1,836.

Government of Saskatchewan. 2010. *Environmental Management and Protection Act*, 2010,

E-10.22. https://publications.saskatchewan.ca/#/products/31893 (accessed August 2021).

Government of Saskatchewan. 2019b. *The Water Security Agency Act*. Chapter W-8.1, formerly Chapter S-35.03 of the *Statutes of Saskatchewan, 2005* (effective May 27, 2005).

Kremsater, L., and F.L. Bunnell. 1999. Edge effects: Theory, evidence and implications to management of western North American forests. pp. 117–153. *Forest fragmentation: wildlife and management implications*. Brill, Leiden, Netherlands.

MacKenzie, W., and J. Shaw. 2000. Wetland classification and habitats at risk in British Columbia., *Proceedings of a Conference on the Biology and Management of Species and Habitats at Risk, 15–19 Feb. 1999*. Volume Two., 520 pp. BC Ministry of Environment, Lands and Parks, Victoria BC and University College of the Caribou, Kamloops, British Columbia.

McLaughlan, M. S., R. A. Wright, and R. D. Jiricka. 2010. *Field Guide to the Ecosites of Saskatchewan's Provincial Forests*. Saskatchewan Ministry of Environment, Forest Service, Prince Albert, SK. 343 pp.

Omnia Ecological Services (Omnia). 2020. *Terrestrial Environment Wildlife and Vegetation Baseline Inventory*. Prepared for Denison Mines. January 2020 Update. Calgary, AB. 265 pp.

Attachment IR-101 (Round 4)

<u>Kds</u>

As outlined in Section 2.2 of the IMPACT Model Report (Appendix A to Appendix 10-A), as constituents travel through a series of connected waterbodies such as lakes, concentrations in water can decrease as a result of mixing with natural inflows from the surrounding watershed and interactions with lake sediment. The sediment-water exchange of constituents is estimated using chemical-specific partitioning coefficients (Kds). The Kd describes the relationship between the concentration of a constituent in the solid (in this case sediment) and the aqueous phases (in this case surface water) for a system that is at equilibrium.

The sediment-water partitioning coefficients are based on regional data which includes the following:

- Environmental baseline studies at Key Lake from 1976 to 1978 which were presented in the Key Lake EIS (KLMC, 1979), including additional baseline data collected in 1982 (IES, 1983a,b), and 1999 (Conor Pacific, 2000). Since operations began in 1983 ongoing environmental monitoring data has been collected
- Environmental baseline studies at McArthur River from 1992 to 1994 (EMA, 1992; TAEM, 1993a,b; Golder 1994a,b) to support the 1995 EIS (Cameco, 1996). Since operations began in 2000 ongoing environmental monitoring data has been collected
- Environmental baseline studies for the proposed Millennium mine from 2006 to 2008 from Moon Lake, Slush Lake, Lake A, Lake B, and Lake C.

Monitoring data of this sort that can be used to derive Kds are particularly valuable. As noted above, in this context Kd describes the relationship between the concentration of a constituent in sediment and surface water. In order to define a reliable and predictive relationship there must be sufficient distribution of sediment and surface water quality and a relatively wide range. The data collected in the studies referenced above not only have regional relevance but include data collected under true baseline conditions (pre-operational conditions), operational conditions in areas the receive mill/mine effluents and reference areas during operational conditions that are uninfluenced by mill/mine effluents but provided a time series of data collected over time. Together these data meet the test of having sufficient distribution of sediment and surface water quality that are wide ranging and support Kd development. This is in contrast to developing Kds with baseline data only where many constituents in water and sediment are at or below laboratory detection and/or are not wide distributed enough to develop a predictive relationship.

The background water and sediment quality observed for Key Lake, McArthur River, and Millennium is shown on Figure IR-101-1 and Figure IR-101-2 below. Regional sediment to water partitioning coefficients were estimated through model calibration and comparison to literature values. Measured water and sediment concentrations were compared to approximate a Kd, and then further refined to achieve a best estimate of water and sediment concentrations. Limitations were found when data were below the detection limit. Kds have been refined over time when better detection limits were achieved in monitoring data (e.g., Pb-210 and Po-210 in 2015 based on McArthur River data). The sediment-water partitioning coefficients were applied to the

Wheeler River Project, and are shown in Table IR-101-1 below (Table 3-6 in the ERA Appendix 10-A). The source of the Kd has been added to the table.

When comparing the water and sediment quality data in Figure IR-101-1 and Figure IR-101-2 to the Wheeler River baseline data, the Wheeler River baseline data falls within the spread of the regional data used since the 1970s. The exception is where improved detection limits have been achieved, showing lower water quality data. Plots of the baseline water quality data that were provided in Appendix A of the ERA in Appendix 10-A are reproduced below for ease of comparison. A few examples are described below:

- Arsenic:
  - The regional data ranges from 0.0001 mg/L to 0.01 mg/L in water and 0.2 mg/kg to 11 mg/kg in sediment.
  - The Wheeler River data ranges from 0.0001 mg/L to 0.0003 mg/L in water and 0.4 mg/kg to 7.2 mg/kg in sediment.
- Cadmium
  - The regional data ranges from 0.0001 mg/L to 0.001 mg/L in water and 0.2 mg/kg to 10.5 mg/kg in sediment.
  - The Wheeler River data ranges from 0.00001 mg/L to 0.00007 mg/L in water and 0.1 mg/kg to 0.7 mg/kg in sediment.
  - The difference in water is related to improved detection limits in the Wheeler River baseline data compared to the regional data
- Copper
  - The regional data ranges from 0.0002 mg/L to 0.02 mg/L in water and 0.5 mg/kg to 11 mg/kg in sediment.
  - The Wheeler River data ranges from 0.0002 mg/L to 0.0008 mg/L in water and 0.5 mg/kg to 8.4 mg/kg in sediment.
- Selenium
  - The regional data ranges from 0.0001 mg/L to 0.001 mg/L in water and 0.008 mg/kg to 9 mg/kg in sediment.
  - The Wheeler River data ranges from 0.0001 mg/L to 0.0002 mg/L in water and 0.1 mg/kg to 1.8 mg/kg in sediment.

As the Wheeler River Project progresses through the licensing process, additional baseline data will be collected. The water and sediment data will continue to be validated against the regional Kds, to determine if the data are within the spread of the regional dataset, or if changes to the Kds are warranted.

Table IR-101-1: Distribution Coefficients (K_d) Used in the IMPACT Model

COPC	Distribution Coefficient	Source
	L/kg (dw)	
Arsenic	9.64E+04	Millennium (Ecometrix, 2013)
Cadmium	1.50E+04	Millennium (Ecometrix, 2013)
Chromium	1.16E+04	Calibrated for Wheeler River
Cobalt	2.50E+03	Millennium (Ecometrix, 2013)
Copper	3.00E+03	Millennium (Ecometrix, 2013)
Molybdenum	3.17E+03	Millennium (Ecometrix, 2013)
Selenium	2.00E+04	Millennium (Ecometrix, 2013)
Uranium	2.00E+04	Millennium (Ecometrix, 2013)
Vanadium	9.10E+04	Calibrated for Wheeler River
Zinc	1.50E+04	Millennium (Ecometrix, 2013)
Lead-210	1.20E+05	McArthur River (Ecometrix, 2015)
Polonium-210	1.20E+05	McArthur River (Ecometrix, 2015)
Radium-226	1.20E+04	Millennium (Ecometrix, 2013)
Thorium-230	2.30E+03	Millennium (Ecometrix, 2013)
Uranium-234	2.00E+04	Millennium (Ecometrix, 2013)
Uranium-238	2.00E+04	Millennium (Ecometrix, 2013)

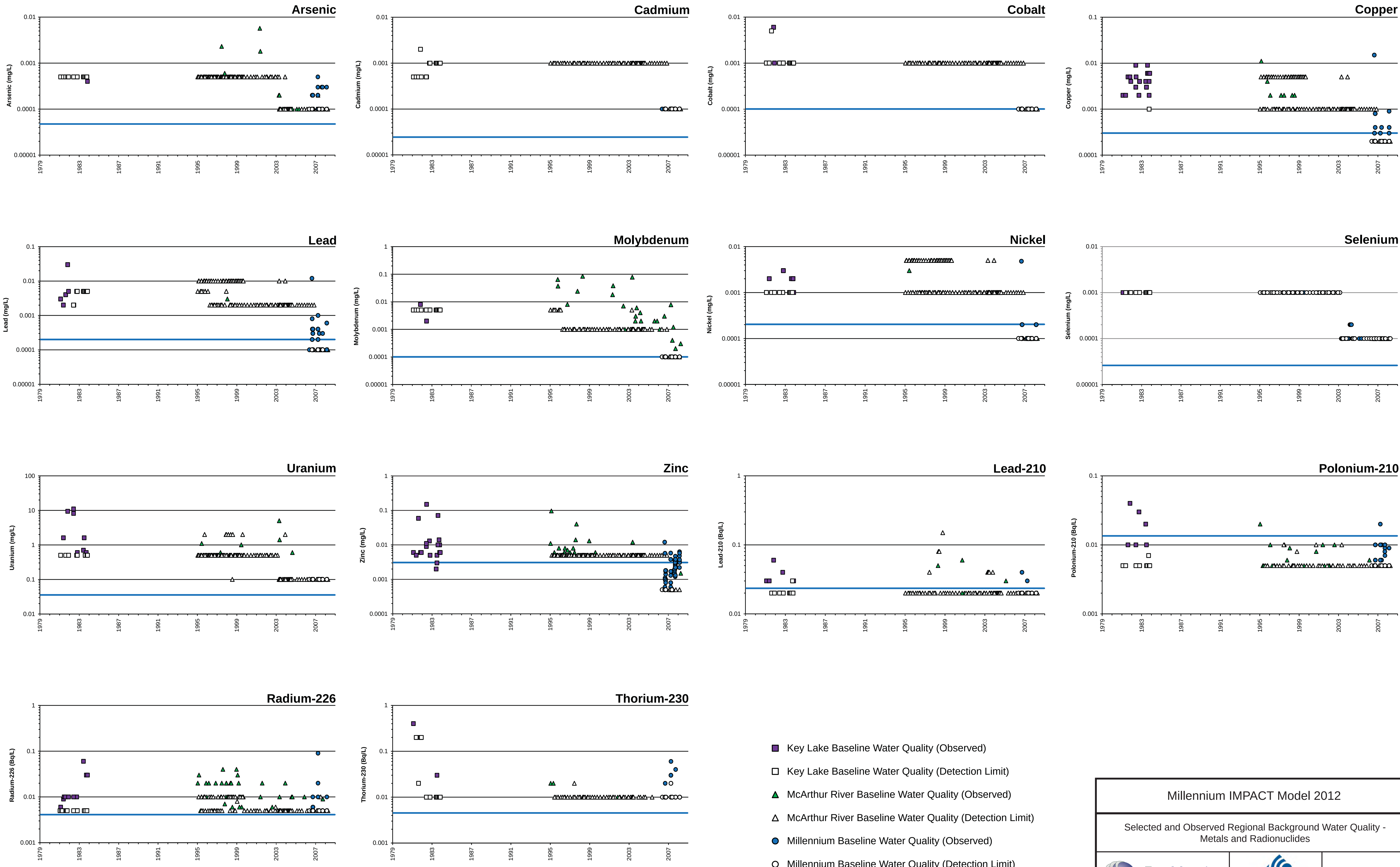
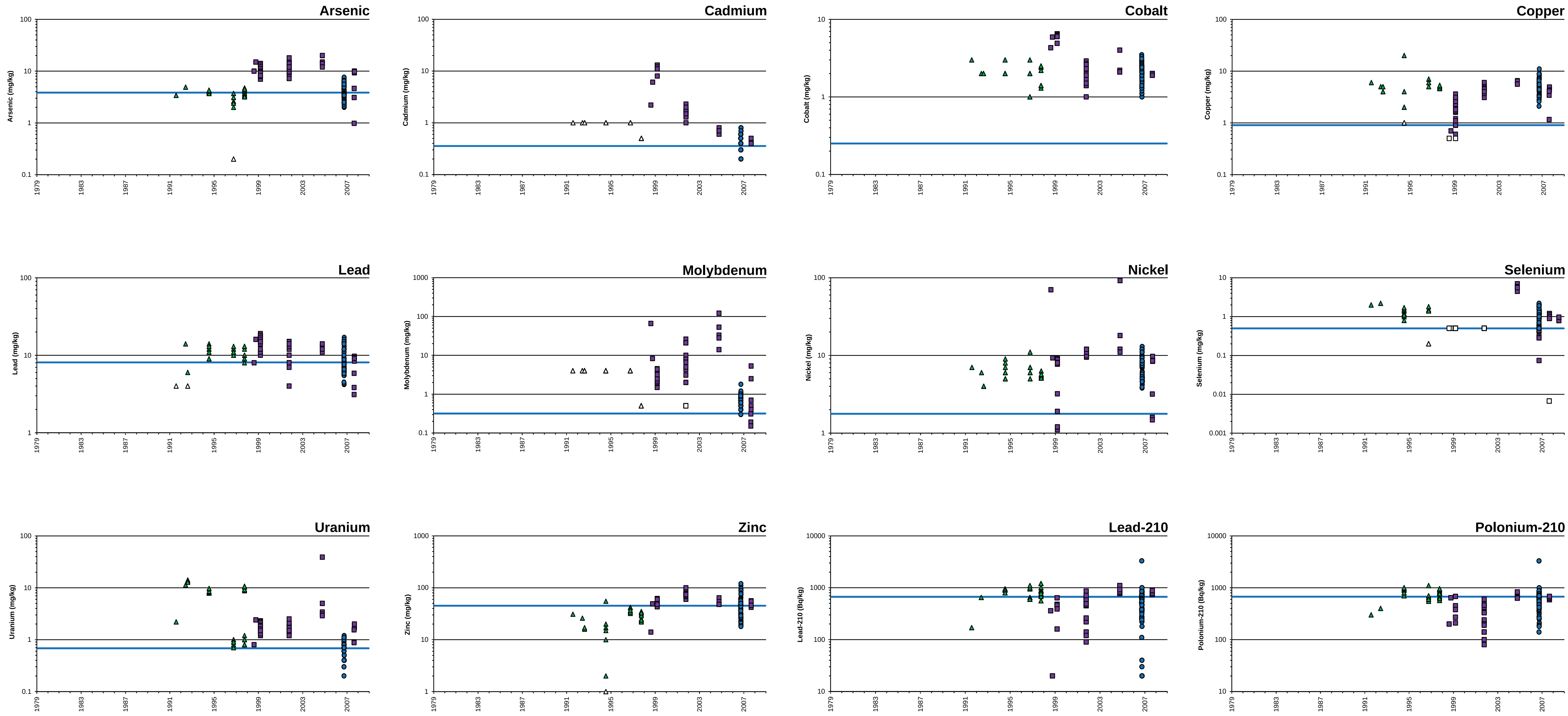


Figure IR-101-1: Selected and Observed Regional Water Quality



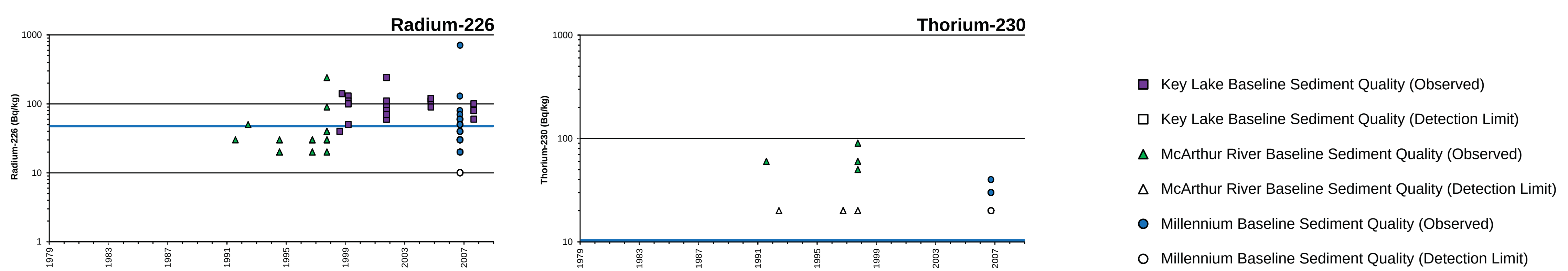


Figure IR-101-2: Selected and Observed Regional Sediment Quality

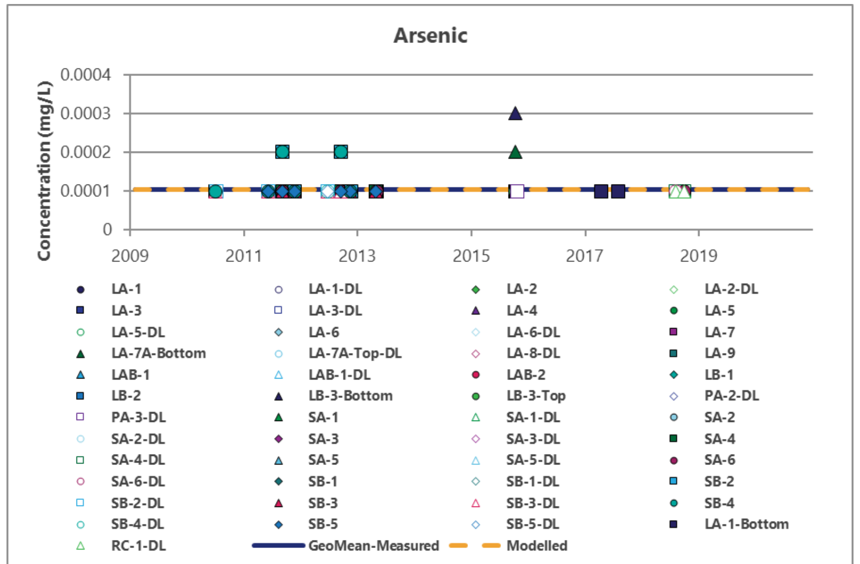
Millennium IMPACT Model 2012

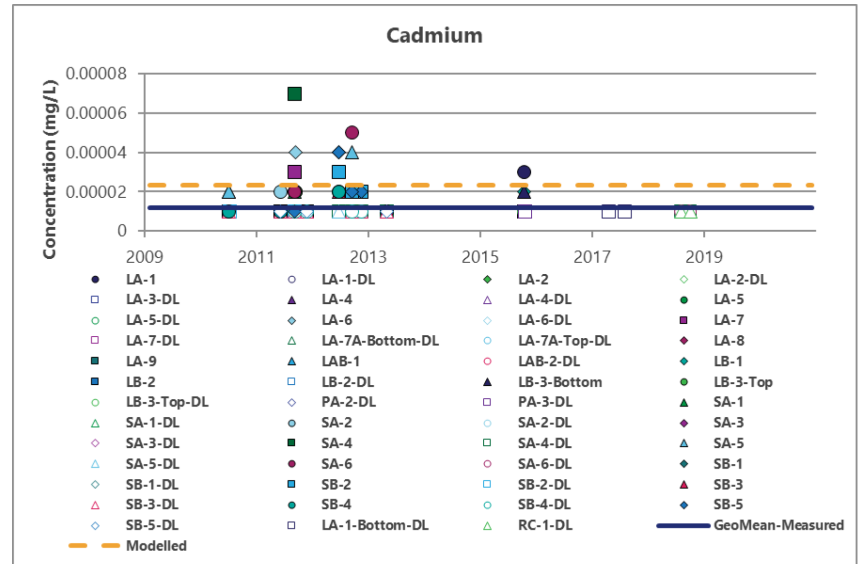
Selected and Observed Regional Background Sediment Quality - Metals and Radionuclides

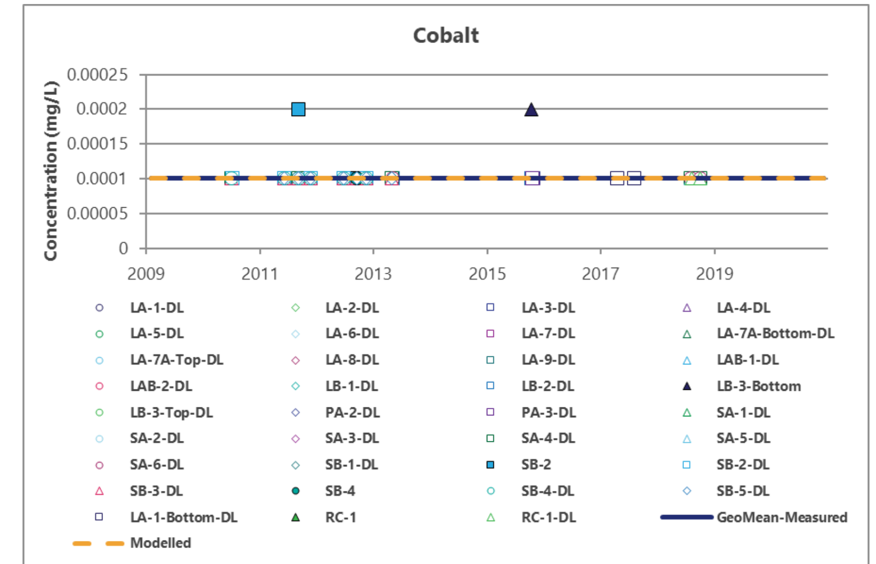
EcoMetrix INCORPORATED

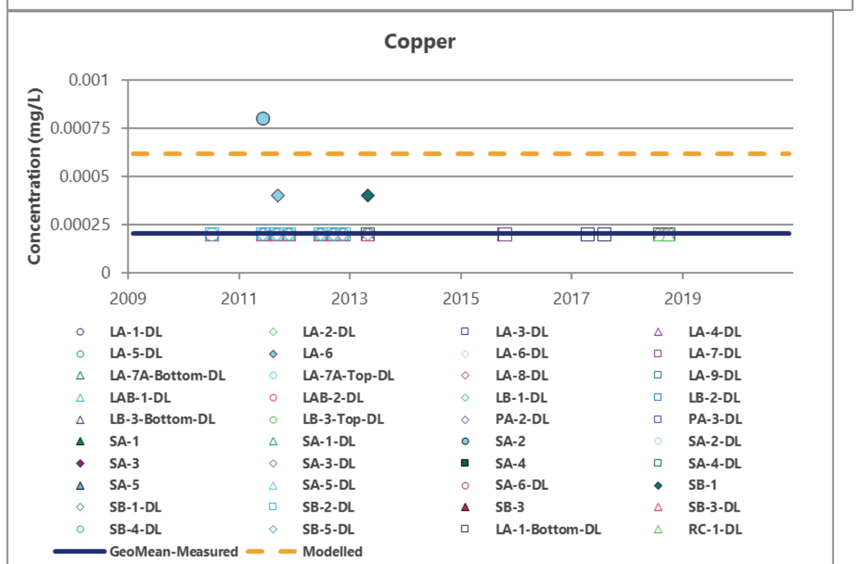
Cameco

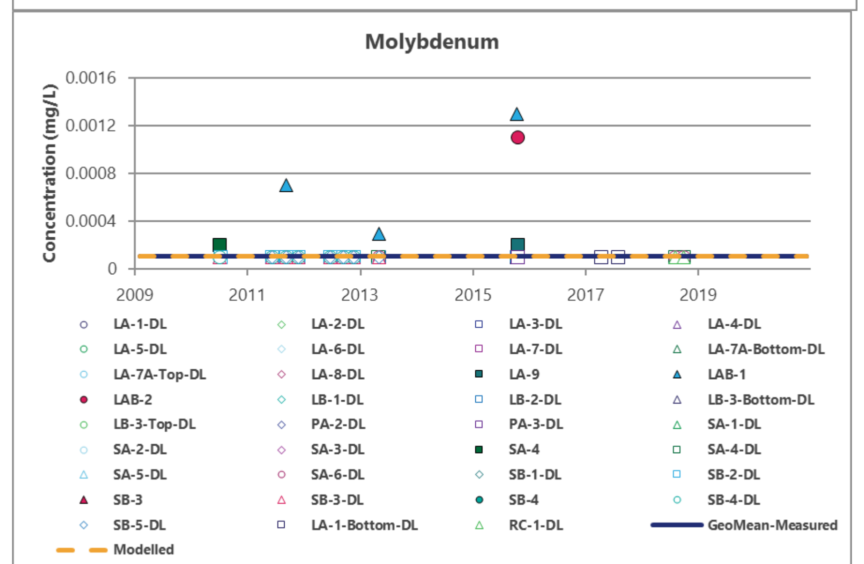
Figure 3.3-1

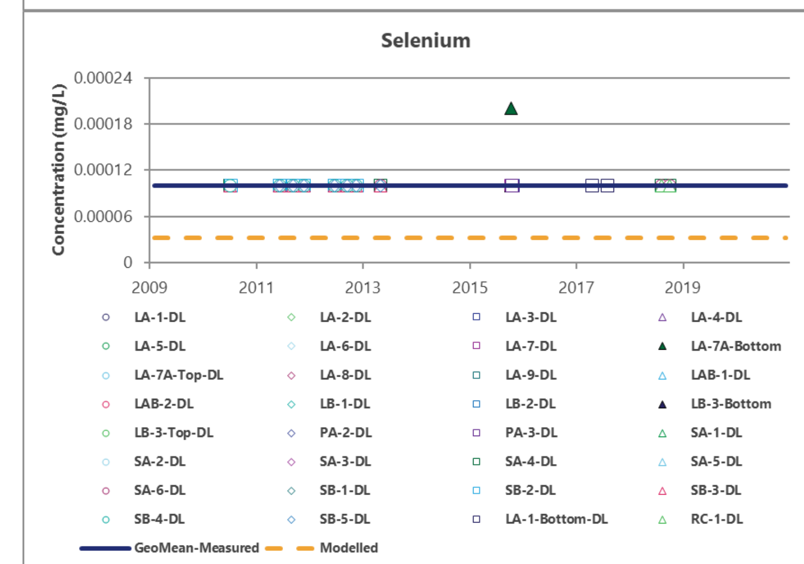

Arsenic
Concentration (mg/L)
0.0004
0.0003
0.0002
0.0001
0
2009
2011
2013
2015
2017
2019
LA-1
LA-1-DL
LA-2
LA-2-DL
LA-3
LA-3-DL
LA-4
LA-5
LA-5-DL
LA-6
LA-6-DL
LA-7
LA-7A-Bottom
LA-7A-Top-DL
LA-8-DL
LA-9
LAB-1
LAB-1-DL
LAB-2
LB-1
LB-2
LB-3-Bottom
LB-3-Top
PA-2-DL
PA-3-DL
SA-1
SA-1-DL
SA-2
SA-2-DL
SA-3
SA-3-DL
SA-4
SA-4-DL
SA-5
SA-5-DL
SA-6
SA-6-DL
SB-1
SB-1-DL
SB-2
SB-2-DL
SB-3
SB-3-DL
SB-4
SB-4-DL
SB-5
SB-5-DL
LA-1-Bottom
RC-1-DL
GeoMean-Measured
Modelled

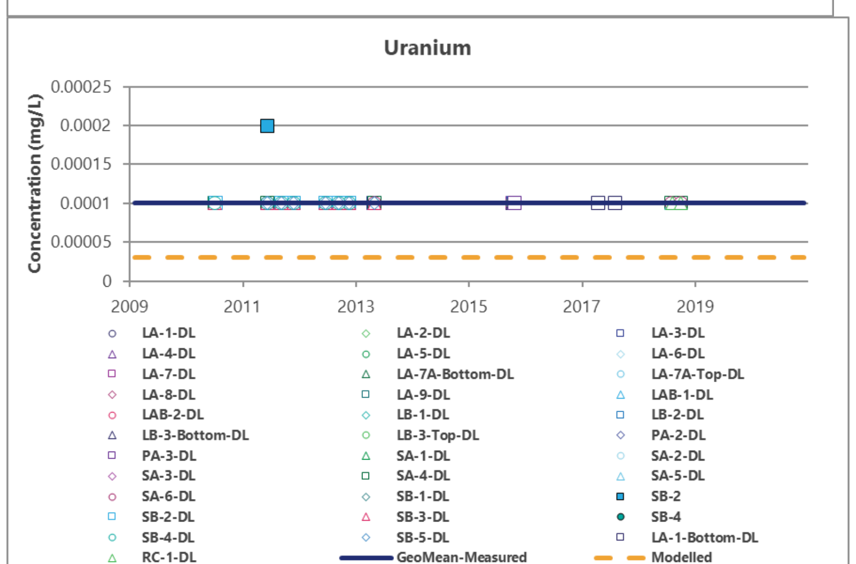

Cadmium
Concentration (mg/L)
0.00008
0.00006
0.00004
0.00002
0
2009
2011
2013
2015
2017
2019
LA-1
LA-1-DL
LA-2
LA-2-DL
LA-3-DL
LA-4
LA-4-DL
LA-5
LA-5-DL
LA-6
LA-6-DL
LA-7
LA-7-DL
LA-7A-Bottom-DL
LA-7A-Top-DL
LA-8
LA-9
LAB-1
LAB-2-DL
LB-1
LB-2
LB-2-DL
LB-3-Bottom
LB-3-Top
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1
SA-1-DL
SA-2
SA-2-DL
SA-3
SA-3-DL
SA-4
SA-4-DL
SA-5
SA-5-DL
SA-6
SA-6-DL
SB-1
SB-1-DL
SB-2
SB-2-DL
SB-3
SB-3-DL
SB-4
SB-4-DL
SB-5
SB-5-DL
LA-1-Bottom-DL
RC-1-DL
GeoMean-Measured
Modelled

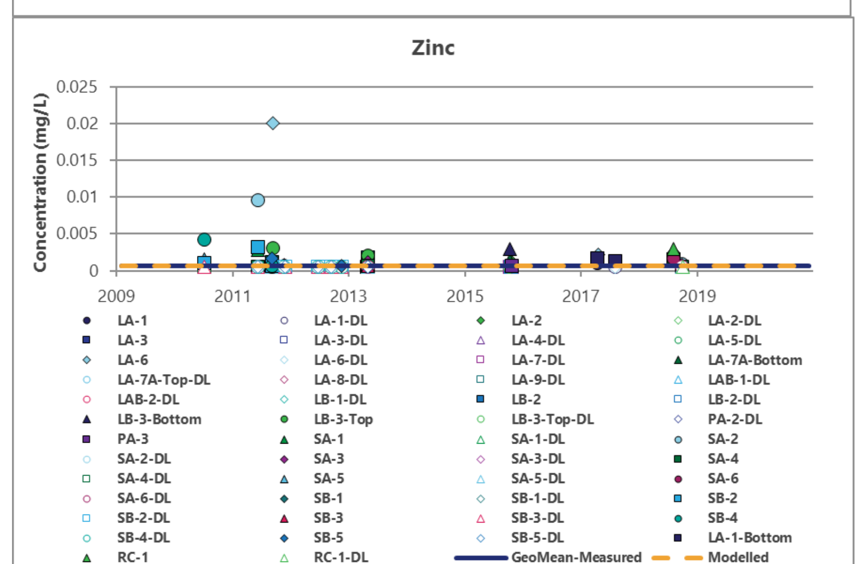

Cobalt
Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2009
2011
2013
2015
2017
2019
LA-1-DL
LA-2-DL
LA-3-DL
LA-4-DL
LA-5-DL
LA-6-DL
LA-7-DL
LA-7A-Bottom-DL
LA-7A-Top-DL
LA-8-DL
LA-9-DL
LAB-1-DL
LAB-2-DL
LB-1-DL
LB-2-DL
LB-3-Bottom
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1-DL
SA-2-DL
SA-3-DL
SA-4-DL
SA-5-DL
SA-6-DL
SB-1-DL
SB-2
SB-2-DL
SB-3-DL
SB-4
SB-4-DL
SB-5-DL
LA-1-Bottom-DL
RC-1
RC-1-DL
GeoMean-Measured
Modelled

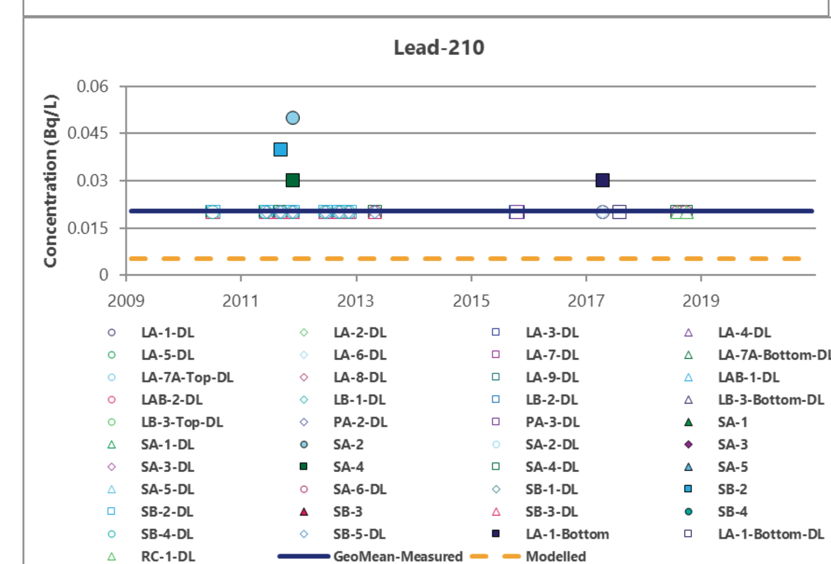

Copper
Concentration (mg/L)
0.001
0.00075
0.0005
0.00025
0
2009
2011
2013
2015
2017
2019
LA-1-DL
LA-2-DL
LA-3-DL
LA-4-DL
LA-5-DL
LA-6
LA-6-DL
LA-7-DL
LA-7A-Bottom-DL
LA-7A-Top-DL
LA-8-DL
LA-9-DL
LAB-1-DL
LAB-2-DL
LB-1-DL
LB-2-DL
LB-3-Bottom-DL
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1
SA-1-DL
SA-2
SA-2-DL
SA-3
SA-3-DL
SA-4
SA-4-DL
SA-5
SA-5-DL
SA-6-DL
SB-1
SB-1-DL
SB-2-DL
SB-3
SB-3-DL
SB-4-DL
SB-5-DL
LA-1-Bottom-DL
RC-1-DL
GeoMean-Measured
Modelled


Molybdenum
Concentration (mg/L)
0.0016
0.0012
0.0008
0.0004
0
2009
2011
2013
2015
2017
2019
LA-1-DL
LA-2-DL
LA-3-DL
LA-4-DL
LA-5-DL
LA-6-DL
LA-7-DL
LA-7A-Bottom-DL
LA-7A-Top-DL
LA-8-DL
LA-9
LAB-1
LAB-2
LB-1-DL
LB-2-DL
LB-3-Bottom-DL
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1-DL
SA-2-DL
SA-3-DL
SA-4
SA-4-DL
SA-5-DL
SA-6-DL
SB-1-DL
SB-2-DL
SB-3
SB-3-DL
SB-4
SB-4-DL
SB-5-DL
LA-1-Bottom-DL
RC-1-DL
GeoMean-Measured
Modelled


Selenium
Concentration (mg/L)
0.00024
0.00018
0.00012
0.00006
0
2009
2011
2013
2015
2017
2019
LA-1-DL
LA-2-DL
LA-3-DL
LA-4-DL
LA-5-DL
LA-6-DL
LA-7-DL
LA-7A-Bottom
LA-7A-Top-DL
LA-8-DL
LA-9-DL
LAB-1-DL
LAB-2-DL
LB-1-DL
LB-2-DL
LB-3-Bottom
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1-DL
SA-2-DL
SA-3-DL
SA-4-DL
SA-5-DL
SA-6-DL
SB-1-DL
SB-2-DL
SB-3-DL
SB-4-DL
SB-5-DL
LA-1-Bottom-DL
RC-1-DL
GeoMean-Measured
Modelled


Uranium
Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
2009
2011
2013
2015
2017
2019
LA-1-DL
LA-2-DL
LA-3-DL
LA-4-DL
LA-5-DL
LA-6-DL
LA-7-DL
LA-7A-Bottom-DL
LA-7A-Top-DL
LA-8-DL
LA-9-DL
LAB-1-DL
LAB-2-DL
LB-1-DL
LB-2-DL
LB-3-Bottom-DL
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1-DL
SA-2-DL
SA-3-DL
SA-4-DL
SA-5-DL
SA-6-DL
SB-1-DL
SB-2
SB-2-DL
SB-3-DL
SB-4
SB-4-DL
SB-5-DL
LA-1-Bottom-DL
RC-1-DL
GeoMean-Measured
Modelled


Zinc
Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
2009
2011
2013
2015
2017
2019
LA-1
LA-1-DL
LA-2
LA-2-DL
LA-3
LA-3-DL
LA-4-DL
LA-5-DL
LA-6
LA-6-DL
LA-7-DL
LA-7A-Bottom
LA-7A-Top-DL
LA-8-DL
LA-9-DL
LAB-1-DL
LAB-2-DL
LB-1-DL
LB-2
LB-2-DL
LB-3-Bottom
LB-3-Top
LB-3-Top-DL
PA-2-DL
PA-3
SA-1
SA-1-DL
SA-2
SA-2-DL
SA-3
SA-3-DL
SA-4
SA-4-DL
SA-5
SA-5-DL
SA-6
SA-6-DL
SB-1
SB-1-DL
SB-2
SB-2-DL
SB-3
SB-3-DL
SB-4
SB-4-DL
SB-5
SB-5-DL
LA-1-Bottom
RC-1
RC-1-DL
GeoMean-Measured
Modelled


Lead-210
Concentration (Bq/L)
0.06
0.045
0.03
0.015
0
2009
2011
2013
2015
2017
2019
LA-1-DL
LA-2-DL
LA-3-DL
LA-4-DL
LA-5-DL
LA-6-DL
LA-7-DL
LA-7A-Bottom-DL
LA-7A-Top-DL
LA-8-DL
LA-9-DL
LAB-1-DL
LAB-2-DL
LB-1-DL
LB-2-DL
LB-3-Bottom-DL
LB-3-Top-DL
PA-2-DL
PA-3-DL
SA-1
SA-1-DL
SA-2
SA-2-DL
SA-3
SA-3-DL
SA-4
SA-4-DL
SA-5
SA-5-DL
SA-6-DL
SB-1-DL
SB-2
SB-2-DL
SB-3
SB-3-DL
SB-4
SB-4-DL
SB-5-DL
LA-1-Bottom
LA-1-Bottom-DL
RC-1-DL
GeoMean-Measured
Modelled

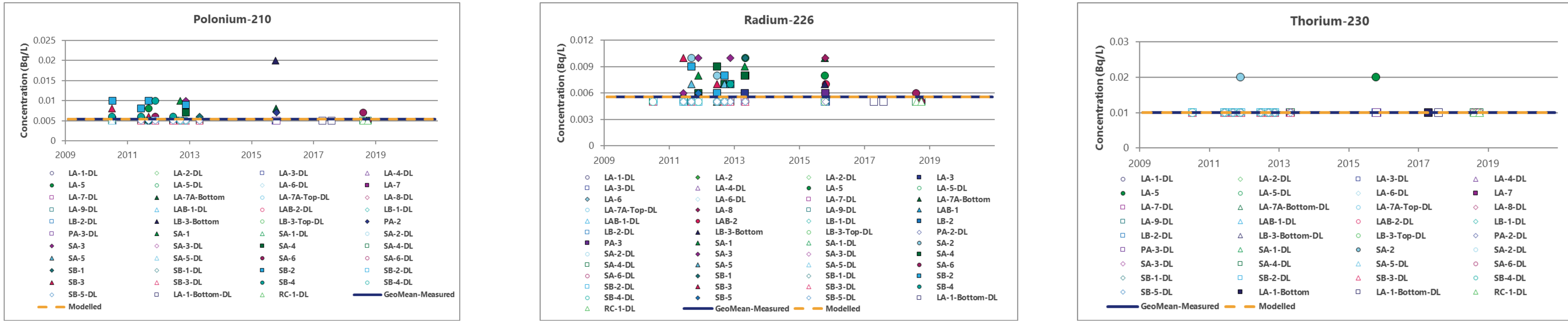
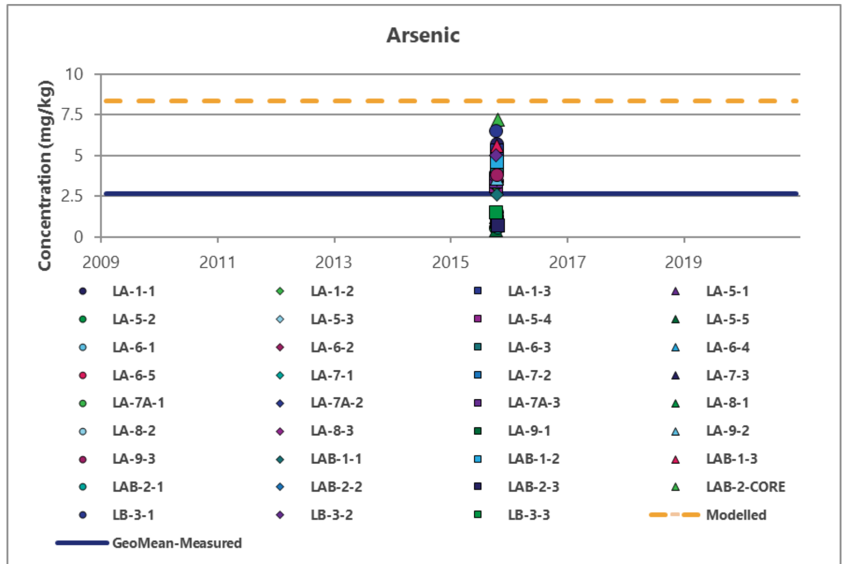
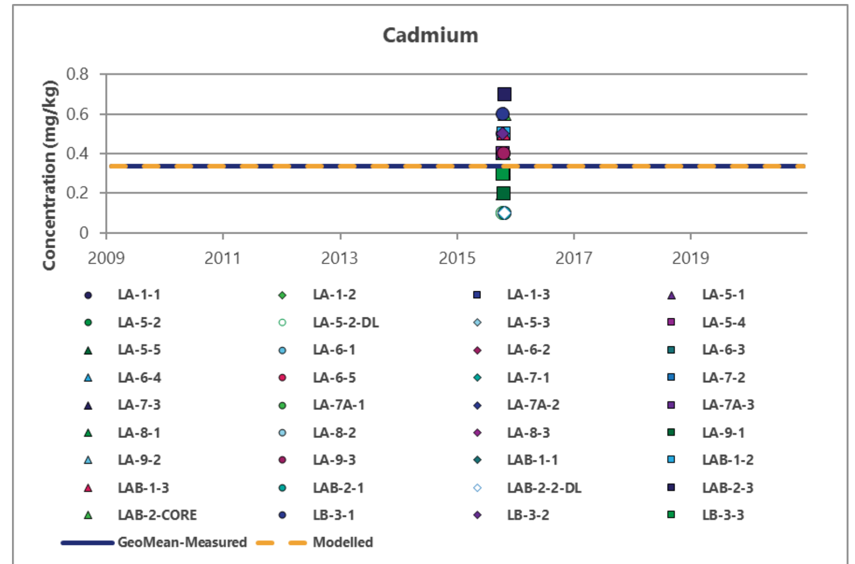
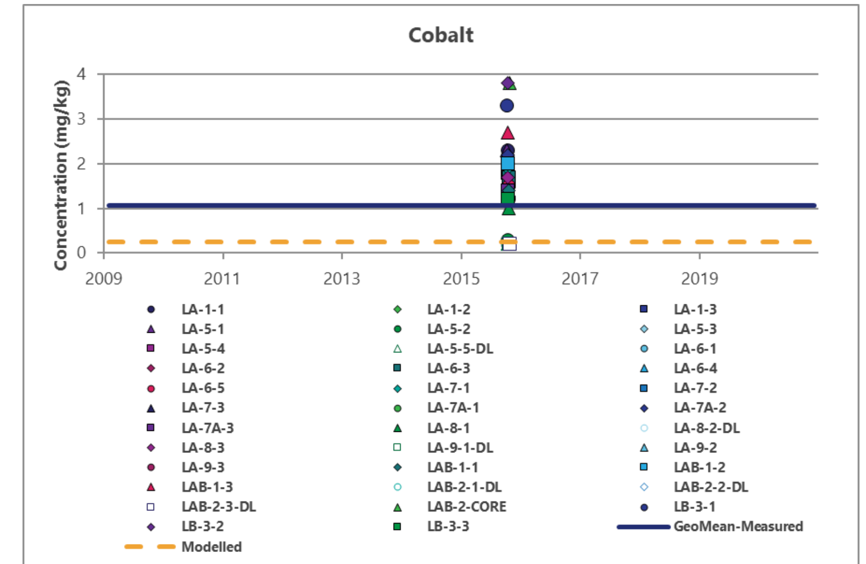
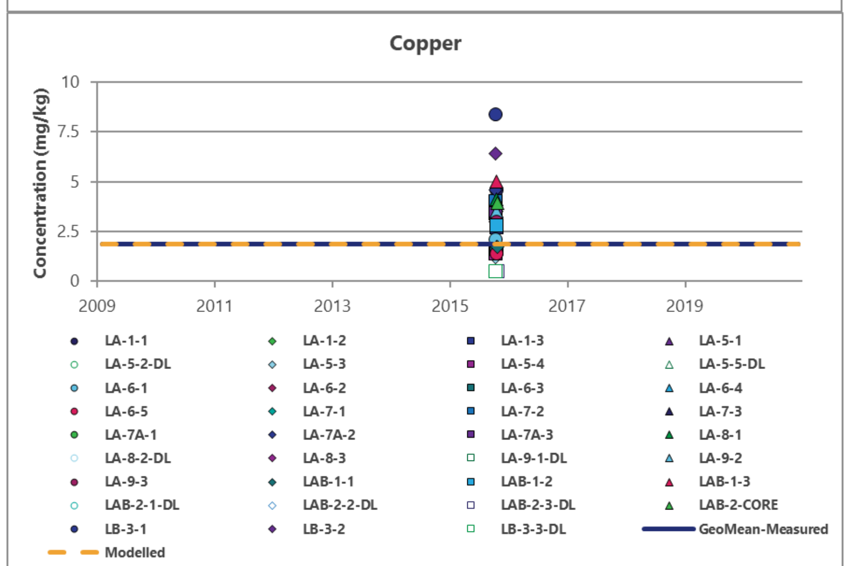


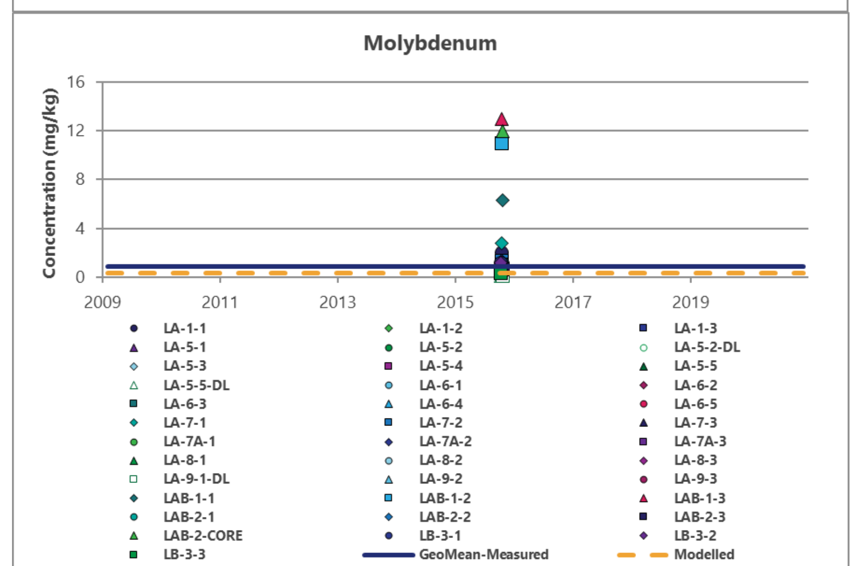
Figure IR-101-3: Selected and Observed Wheeler River Water Quality

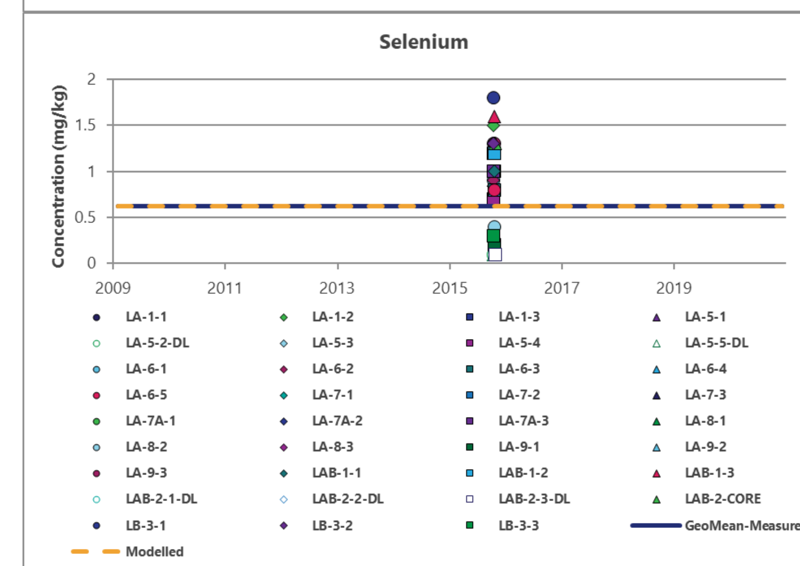

Arsenic
Concentration (mg/kg)
0
2.5
5
7.5
10
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3 LA-5-1
LA-5-2 LA-5-3 LA-5-4 LA-5-5
LA-6-1 LA-6-2 LA-6-3 LA-6-4
LA-6-5 LA-7-1 LA-7-2 LA-7-3
LA-7A-1 LA-7A-2 LA-7A-3 LA-8-1
LA-8-2 LA-8-3 LA-9-1 LA-9-2
LA-9-3 LAB-1-1 LAB-1-2 LAB-1-3
LAB-2-1 LAB-2-2 LAB-2-3 LAB-2-CORE
LB-3-1 LB-3-2 LB-3-3 Modelled
GeoMean-Measured

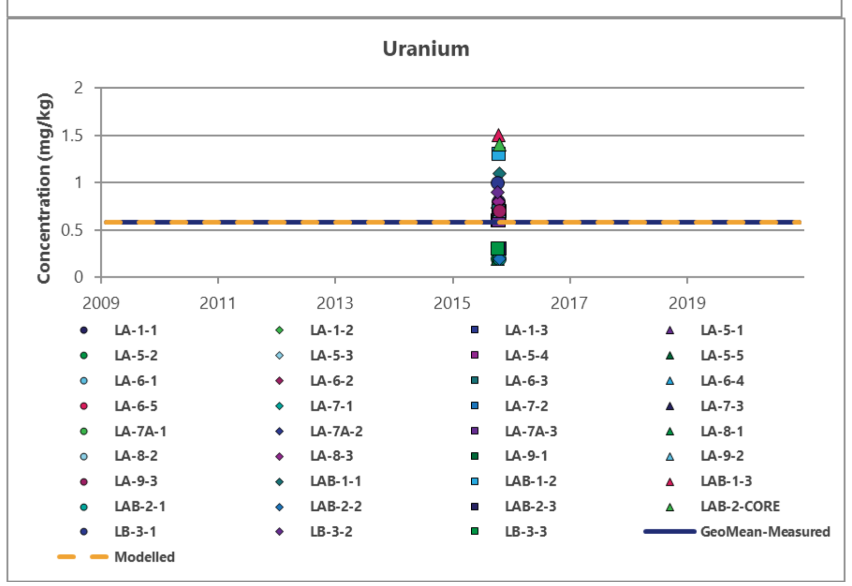

Cadmium
Concentration (mg/kg)
0
0.2
0.4
0.6
0.8
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3 LA-5-1
LA-5-2 LA-5-2-DL LA-5-3 LA-5-4
LA-5-5 LA-6-1 LA-6-2 LA-6-3
LA-6-4 LA-6-5 LA-7-1 LA-7-2
LA-7-3 LA-7A-1 LA-7A-2 LA-7A-3
LA-8-1 LA-8-2 LA-8-3 LA-9-1
LA-9-2 LA-9-3 LAB-1-1 LAB-1-2
LAB-1-3 LAB-2-1 LAB-2-2-DL LAB-2-3
LAB-2-CORE LB-3-1 LB-3-2 LB-3-3
GeoMean-Measured Modelled

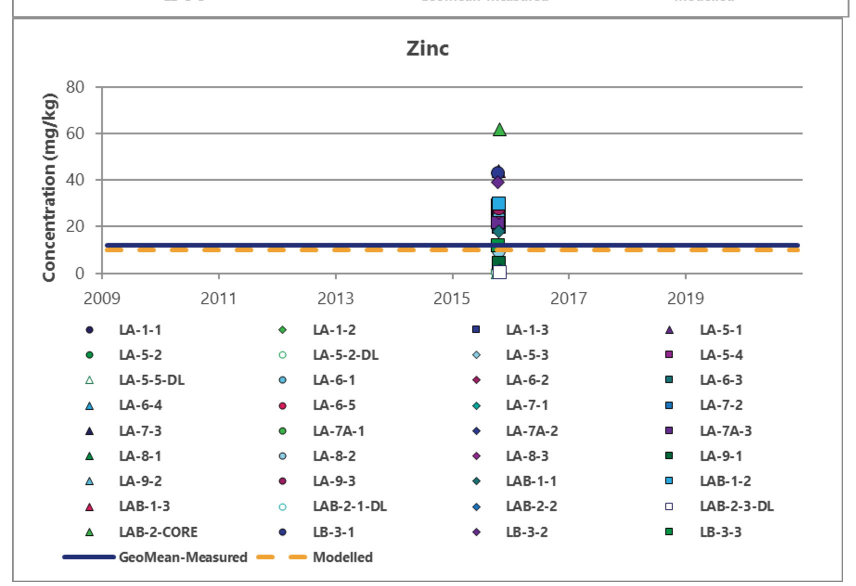

Cobalt
Concentration (mg/kg)
0
1
2
3
4
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3
LA-5-1 LA-5-2 LA-5-3
LA-5-4 LA-5-5-DL LA-6-1
LA-6-2 LA-6-3 LA-6-4
LA-6-5 LA-7-1 LA-7-2
LA-7-3 LA-7A-1 LA-7A-2
LA-7A-3 LA-8-1 LA-8-2-DL
LA-8-3 LA-9-1-DL LA-9-2
LA-9-3 LAB-1-1 LAB-1-2
LAB-1-3 LAB-2-1-DL LAB-2-2-DL
LAB-2-3-DL LAB-2-CORE LB-3-1
LB-3-2 LB-3-3 GeoMean-Measured
Modelled

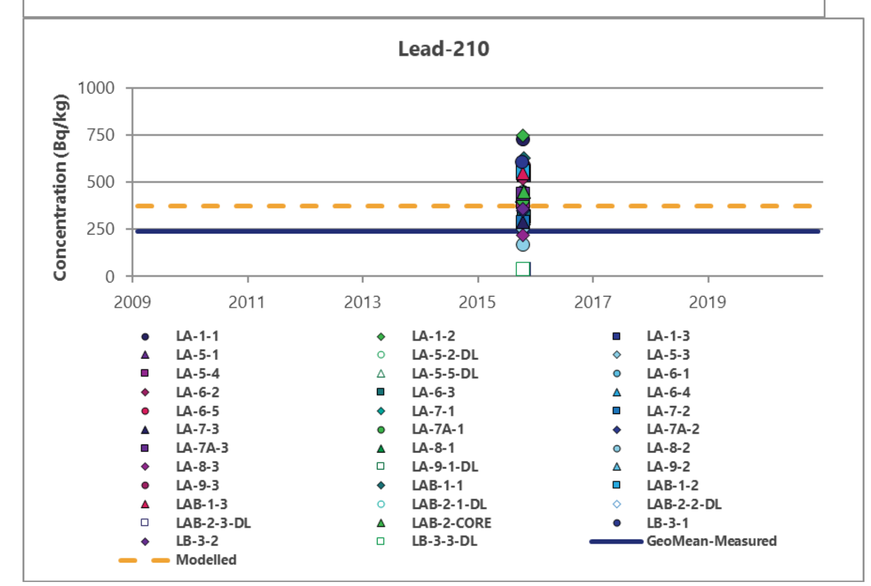

Copper
Concentration (mg/kg)
0
2.5
5
7.5
10
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3 LA-5-1
LA-5-2-DL LA-5-3 LA-5-4 LA-5-5-DL
LA-6-1 LA-6-2 LA-6-3 LA-6-4
LA-6-5 LA-7-1 LA-7-2 LA-7-3
LA-7A-1 LA-7A-2 LA-7A-3 LA-8-1
LA-8-2-DL LA-8-3 LA-9-1-DL LA-9-2
LA-9-3 LAB-1-1 LAB-1-2 LAB-1-3
LAB-2-1-DL LAB-2-2-DL LAB-2-3-DL LAB-2-CORE
LB-3-1 LB-3-2 LB-3-3-DL GeoMean-Measured
Modelled

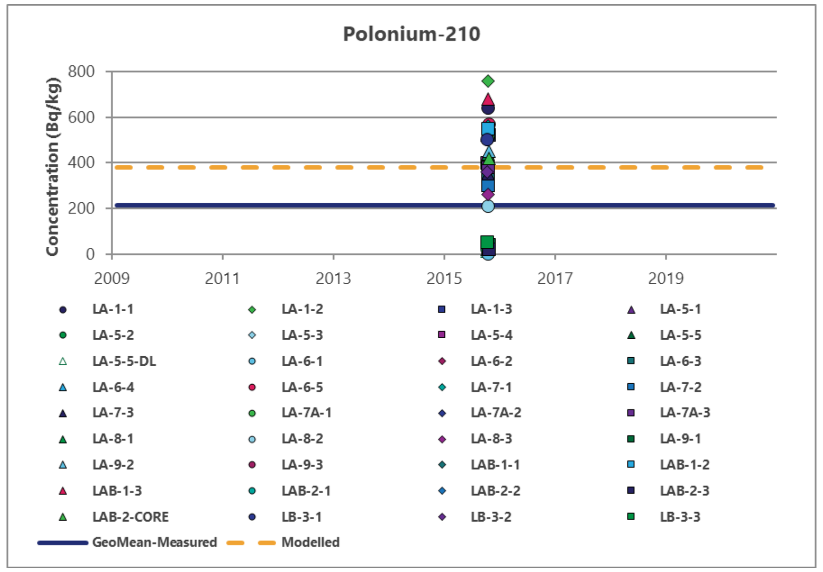

Molybdenum
Concentration (mg/kg)
0
4
8
12
16
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3
LA-5-1 LA-5-2 LA-5-2-DL
LA-5-3 LA-5-4 LA-5-5
LA-5-5-DL LA-6-1 LA-6-2
LA-6-3 LA-6-4 LA-6-5
LA-7-1 LA-7-2 LA-7-3
LA-7A-1 LA-7A-2 LA-7A-3
LA-8-1 LA-8-2 LA-8-3
LA-9-1-DL LA-9-2 LA-9-3
LAB-1-1 LAB-1-2 LAB-1-3
LAB-2-1 LAB-2-2 LAB-2-3
LAB-2-CORE LB-3-1 LB-3-2
LB-3-3 GeoMean-Measured Modelled

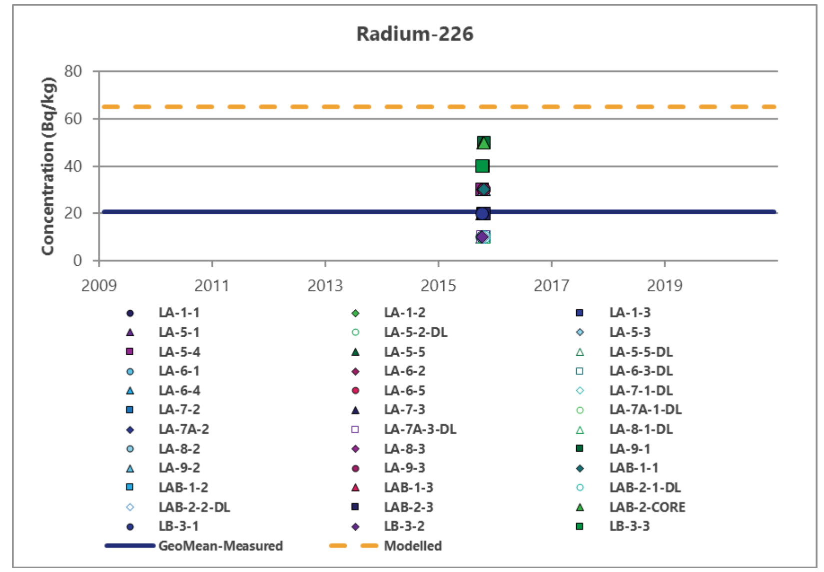

Selenium
Concentration (mg/kg)
0
0.5
1
1.5
2
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3 LA-5-1
LA-5-2-DL LA-5-3 LA-5-4 LA-5-5-DL
LA-6-1 LA-6-2 LA-6-3 LA-6-4
LA-6-5 LA-7-1 LA-7-2 LA-7-3
LA-7A-1 LA-7A-2 LA-7A-3 LA-8-1
LA-8-2 LA-8-3 LA-9-1 LA-9-2
LA-9-3 LAB-1-1 LAB-1-2 LAB-1-3
LAB-2-1-DL LAB-2-2-DL LAB-2-3-DL LAB-2-CORE
LB-3-1 LB-3-2 LB-3-3 GeoMean-Measured
Modelled


Uranium
Concentration (mg/kg)
0
0.5
1
1.5
2
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3 LA-5-1
LA-5-2 LA-5-3 LA-5-4 LA-5-5
LA-6-1 LA-6-2 LA-6-3 LA-6-4
LA-6-5 LA-7-1 LA-7-2 LA-7-3
LA-7A-1 LA-7A-2 LA-7A-3 LA-8-1
LA-8-2 LA-8-3 LA-9-1 LA-9-2
LA-9-3 LAB-1-1 LAB-1-2 LAB-1-3
LAB-2-1 LAB-2-2 LAB-2-3 LAB-2-CORE
LB-3-1 LB-3-2 LB-3-3 GeoMean-Measured
Modelled


Zinc
Concentration (mg/kg)
0
20
40
60
80
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3 LA-5-1
LA-5-2 LA-5-2-DL LA-5-3 LA-5-4
LA-5-5-DL LA-6-1 LA-6-2 LA-6-3
LA-6-4 LA-6-5 LA-7-1 LA-7-2
LA-7-3 LA-7A-1 LA-7A-2 LA-7A-3
LA-8-1 LA-8-2 LA-8-3 LA-9-1
LA-9-2 LA-9-3 LAB-1-1 LAB-1-2
LAB-1-3 LAB-2-1-DL LAB-2-2 LAB-2-3-DL
LAB-2-CORE LB-3-1 LB-3-2 LB-3-3
GeoMean-Measured Modelled


Lead-210
Concentration (Bq/kg)
0
250
500
750
1000
2009
2011
2013
2015
2017
2019
LA-1-1 LA-1-2 LA-1-3
LA-5-1 LA-5-2-DL LA-5-3
LA-5-4 LA-5-5-DL LA-6-1
LA-6-2 LA-6-3 LA-6-4
LA-6-5 LA-7-1 LA-7-2
LA-7-3 LA-7A-1 LA-7A-2
LA-7A-3 LA-8-1 LA-8-2
LA-8-3 LA-9-1-DL LA-9-2
LA-9-3 LAB-1-1 LAB-1-2
LAB-1-3 LAB-2-1-DL LAB-2-2-DL
LAB-2-3-DL LAB-2-CORE LB-3-1
LB-3-2 LB-3-3-DL GeoMean-Measured
Modelled





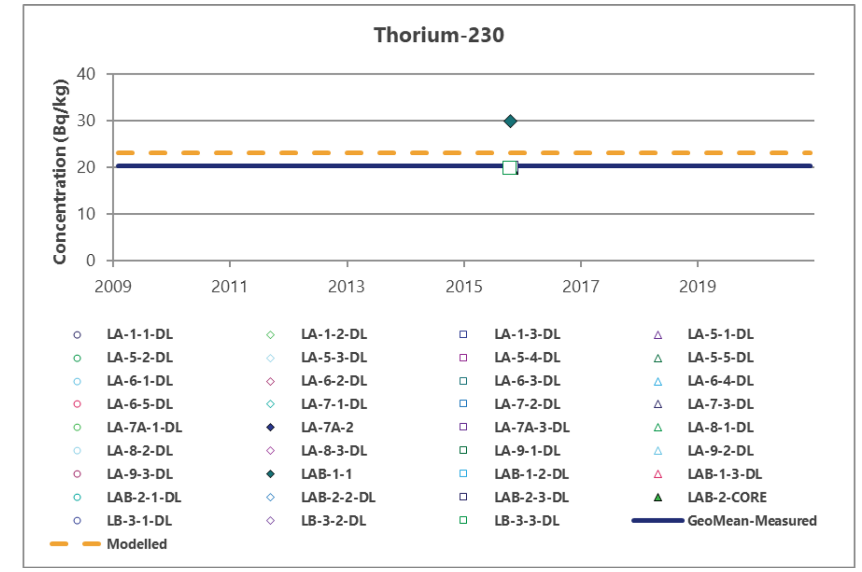


Figure IR-101-4: Selected and Observed Wheeler River Sediment Quality

Grain Size

EIS Section 8.4.3.2.1 states that grain size in the top 0-2 cm of sediment was predominantly clay-size fractions followed by silt (Whitefish Lake North, McGowan Lake, and Russell Lake). In Whitefish Lake South, grain size was predominantly clay, followed by sand and then silt. Data from the Key Lake Operation, located 35 km southwest of the Project, and McArthur River Operation, located 35 km northeast of the Project, were used as part of regional data for the Wheeler River Project. Based on the 2015 Environmental Performance Report (EPR) for the Key Lake Operation, sediment grain size in the top 0-2 cm, was predominantly silt followed by clay, and a small amount of sand (Figure IR-101-1). Based on the 2015 EPR for the McArthur River Operation, sediment grain size in the top 0-2 cm was predominantly silt and clay, followed by sand (Figure IR-101-2).

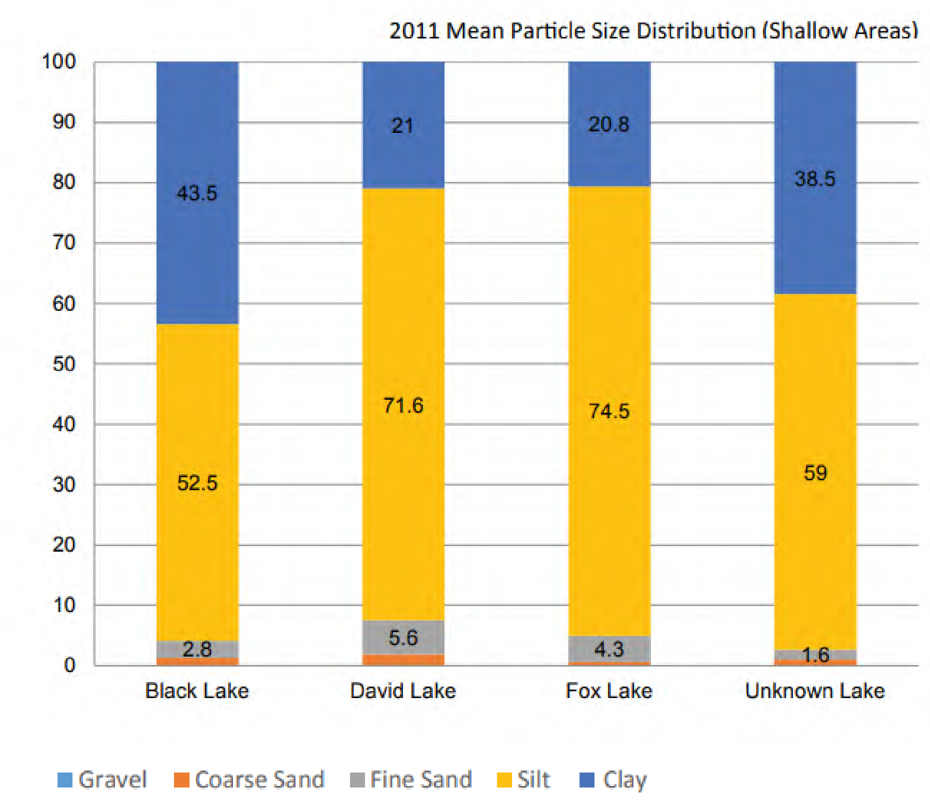


Figure IR-107-1: Grain Size Distribution in Shallow Areas in David Creek Drainage (Ecometrix, 2015a)

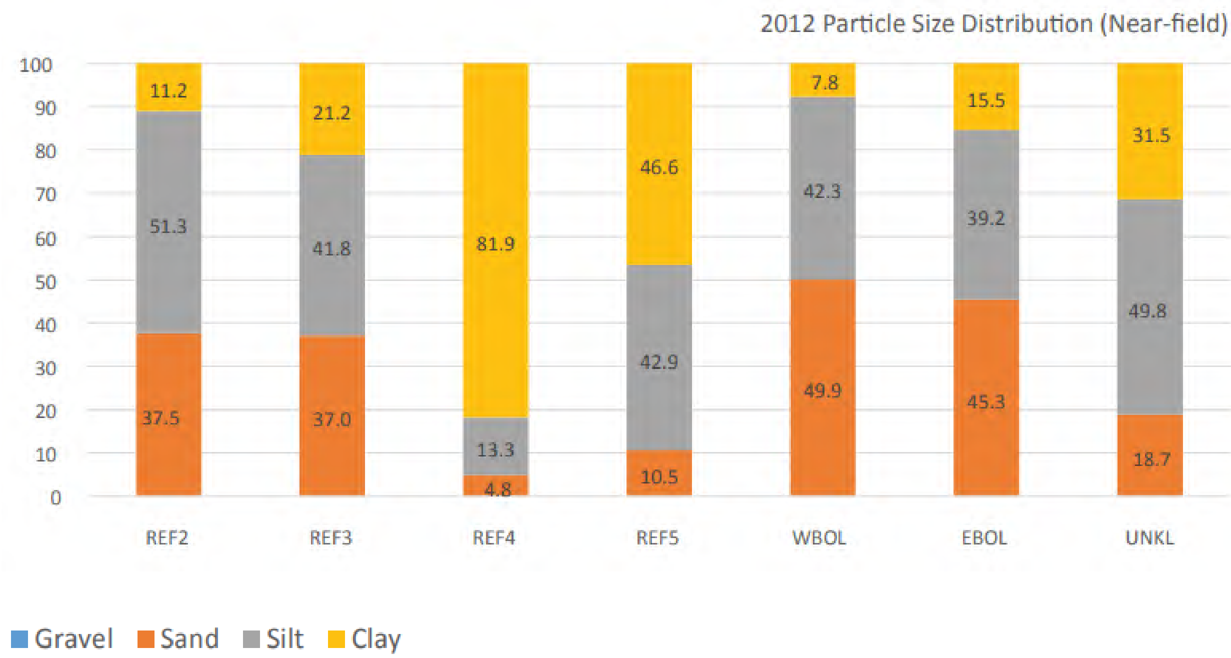


Figure IR-107-2: Grain Size Distribution in Shallow Areas in Reference and Exposure Sediment in McArthur River Operation Area (Ecometrix, 2015b)

References:

Cameco. 1996. McArthur River Project, Environmental Impact Statement. Addendum Report (including Appendices).

Conor Pacific (Conor Pacific Environmental Technologies Inc.). 2000. McArthur River Pre-milling Baseline for the Key Lake Study Area, 1998/1999. Prepared for Cameco Corporation, Saskatoon, SK.

EcoMetrix. 2013. Millennium IMPACT Model 2012. Report prepared for Cameco Corporation. In: Cameco. 2013. Millennium Project Environmental Impact Statement, Annex K.

EcoMetrix. 2015a. Key Lake IMPACT Model 2015 Update. Report prepared for Cameco Corporation. In: Cameco, 2015.

EcoMetrix. 2015b. McArthur River IMPACT Model 2015 Update. Report prepared for Cameco Corporation. In: Cameco. 2015.

EMA (Environmental Management Associates). 1992. McArthur River Project- Wildlife and Habitat Investigations 1991-1992. Prepared for Cameco Corporation, Saskatoon, Sask.

Golder (Golder Associates Ltd.). 1994a. McArthur River Study Area and Proposed McArthur River/Key Lake Haul Road Winter Wildlife Survey. Report prepared for Cameco Corporation, Saskatoon, Saskatchewan. March.

Golder. 1994b. McArthur River Terrestrial Studies, 1993. Report prepared for Cameco Corporation, Saskatoon, Saskatchewan.

IES (Integrated Environmental Sciences Inc.). 1983a. Baseline studies of aquatic sediments and macrophytes, fish, soil and terrestrial vegetation at Key Lake, Saskatchewan. Prepared for Key Lake Mining Corporation.

IES. 1983b. Additional baseline data for Delta Lake, Saskatchewan.

KLMC (Key Lake Mining Corporation). 1979. Key Lake Project Environmental Impact Statement. Volumes 1, 2 and 3, including Appendices.

TAEM (Terrestrial & Aquatic Environmental Managers Ltd.). 1993a. Aquatic Biological Resources of the McArthur River Uranium Project Area, Saskatchewan. A report prepared for Cameco Corporation, Saskatoon, Saskatchewan. Appendix 12C of the 1995 McArthur River EIS.

TAEM. 1993b. Surface Water Hydrology Baseline Investigations McArthur River Uranium Project. A report prepared for Cameco Corporation, Saskatoon, Saskatchewan. Appendix 6G of the 1995 McArthur River EIS.

TO:	FROM:
Denison Mines – Janna Switzer	Ecometrix
REF:	**DATE:**
Wheeler River Project EIS – Appendix 8-F: Wetland Effects Assessment Report	3 October 2024

1.0 Introduction

On October 21, 2022, Denison Mines Corp. (Denison) submitted a draft Environmental Impact Statement (EIS) for the proposed Wheeler River Project (the Project). Based on their initial review, the Canadian Nuclear Safety Commission indicated that the submission contained the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review of the draft EIS. On March 20, 2023, the FIRT provided Denison with a list of information requests (IRs) for Denison to respond to and eventually submit a final EIS document. Responses to these IRs were provided in July and August of 2023. Additional FIRT IRs were provided to Denison on December 5, 2024. Of these IR-101 was not adequately answered and additional information was requested. This appendix was initially included in the January 2024 revised draft EIS and has been updated in October 2024 in response to Round 4 IR-101.

This appendix provides additional information to address IR-101 provided by Environment Canada and Climate Change (ECCC) as part of the second and fourth round of FIRT comments. The comment included a request for a further summary of wetland characterization information from available sources, baseline information pertaining to water quality and sediment quality, and assessment of potential effects to wetlands within the LSA for all phases of the Project and provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.

2.0 Scope of the Assessment

This section addresses the potential effects of the Project on the Fish and Fish Habitat VC for which wetland habitats are considered a component. The purpose of this assessment is to assess potential changes to wetlands (as represented by the Fish and Fish Habitat VC) in consideration of all phases of the Project at the Project Area, local, and regional study area scales. Pathways affecting wetlands are directly associated with potential changes to the Surface Water Quantity (hydrology), Surface Water Quality, Sediment Quality, and Benthic Invertebrates VCs. Changes to hydrology, water quality, sediment quality, and benthic invertebrate communities may directly affect wetlands as both fish and wildlife habitat and food resources. The assessment approach reflects these connections within the environment, as the significance determination for the Surface Water Quantity and Surface Water Quality VCs was conducted at the receptor VC level.

The Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs are interrelated, to varying extents, and are linked to other VCs, including:

Surface Water Quality – surface water contributes to local moisture regimes, and surface water quality can influence the persistence of Vegetation and Ecosystems, Listed Plant Species, and Wetlands.

Surface Water Quantity – surface water contributes to local moisture regimes, and surface water quantity contributes to site drainage and discharge, which can influence the persistence of Vegetation and Ecosystems, Listed Plant Species, and Wetlands.

Sediment Quality – Vegetation and Ecosystems, Listed Plant Species, and Wetlands contribute to ecosystem form and function that stabilize riparian areas and influence quality of surface water runoff to aquatic systems.

This appendix will focus on the interrelations between these VCs as they apply to Wetland function.

Pathways that are of interest include those associated with site clearing and the potential for erosion-driven mobilization of suspended sediment into local surface waters; groundwater interactions with surface water features including wetlands; the establishment of new subwatershed boundaries and the resulting effects of effluent discharge to the receiving environment; and the potential overprinting of wetland habitat by Project infrastructure.

2.1 Key indicators and Measurable Parameters

The KIs for the wetland component of the Fish and Fish Habitat VC include potential changes in surface water quantity, surface water quality, and available wetland habitat from baseline conditions. The rationale for each KI and associated MPs is summarized in Table 1.

Table 1: Key Indicators and Measurable Parameters for the Wetlands Valued Component

Key Indicator	Rationale for Key Indicator	Measurable Parameter
Change in available wetland habitat from baseline conditions	• Project activities may result in a change in the extent of Wetlands. • Of provincial and federal management concern • Contributes to biodiversity and habitat for wildlife species and listed plant species. • Cultural importance. • Contributes to biodiversity, maintenance of hydrologic cycles, nutrient cycling, water quality, and carbon storage. • Sensitive to disturbance. • Historically addressed for other mining projects in northern Saskatchewan.	Aerial extent (m^2 or ha) of overprinted wetland habitat.
Change to water levels or flows from baseline conditions	Project activities are expected to result in changes to local hydrology. A reduction or increase in flows may result due to the elimination or redirection of subwatershed area and through Project water management (i.e., water taking, storage, and effluent discharge). These changes in flow to the environment may alter stream flows, lake levels and such feature interactions (inundation) with wetland features required for fish and wildlife during all life stages.	Changes in water levels (m) or percent changes to flow conditions (%).
Change in surface water quality from baseline conditions	Changes in water quality are regulated (subsection 36(1) of the *Fisheries Act* and the MDMER). Changes that may occur as a result of the Project include: • mobilization of solids into local watersheds; and • deposition of deleterious substances into the receiving environment as a result of mine effluent and/or surface runoff.	Change in the concentration of constituents that are directly related to Project activities, measured as a mass of a chemical per unit volume in water (e.g., mg/L).

2.2 Spatial and Temporal Boundaries

The areas used to assess the effects of the Project on the Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs are (Figure 1):

Project Area: the area within which the Project and all components/activities are located (i.e., the area of maximum physical disturbance). The Project Area is considered to be a conservative estimate of the area of direct disturbance effects on VCs in this assessment.

Vegetation LSA: the area that surrounds the Project Area where all direct effects and most indirect effects are likely to occur on the Vegetation and Ecosystems, Listed Plant Species, and

Wetlands VCs. The Vegetation LSA is defined as the Project Area plus a 250 m buffer along roads and a 500 m buffer around all other infrastructure (1,161.8 ha).

Terrestrial RSA: the area that surrounds and includes the Vegetation LSA, established to assess the potential, largely indirect effects of the Project on Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs in a regional context. The Terrestrial RSA (40,173.6 ha) is defined as a minimum 8 km buffer around the Vegetation LSA and has been delineated to capture all indirect effects of the Project on the Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs and provide context for the type, distribution, extent, and prevalence of plant species and ecosystems in the region. The Terrestrial RSA also defines the area within which cumulative effects are likely to occur (i.e., CEA boundary).

Temporal boundaries identify when an effect is expected to occur in relation to specific Project phases and activities. The temporal boundaries are based on the timing and duration of Project activities, with the associated interactions with each VC and KI (where applicable). In the EA, the temporal boundaries are described as appropriate for each activity and cumulatively for the life of the Project.

The temporal boundaries for the EA represent the timeframes that the Project is expected to interact with and potentially affect Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs. The temporal boundaries are aligned with the Project development schedule as described in the EIS: Construction; Operation; Decommissioning; and Post-Decommissioning.

3.0 Existing Conditions

Wetlands are defined as "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment" (National Wetlands Working Group 1997). As such, ecosites have been determined to be wetland ecosystems where these conditions are expected to occur. This includes both wetland ecosites and sparsely vegetated ecosites where the water table is within 50 cm of the ground surface (McLaughlan et al. 2010). No wetlands within the Terrestrial RSA have been designated as Ramsar Wetlands of International Importance (The RAMSAR Convention Secretariat 2022).

Project-specific investigations pertaining to the Terrestrial Environment were conducted by Omnia Ecological Consulting (Omnia; Calgary, AB) from 2017 to 2019. Details on the methods, survey parameters and assumptions, and comprehensive data summaries/findings are presented in the Project-specific baseline report (Omnia 2020; see Appendix 9-B of the EIS) and a supplementary baseline annex report completed in 2021 (EDI 2021; see Appendix 9-C of the EIS).

Project baseline studies for vegetation presented a description of the ecosystems/habitat types (i.e., ecosite classifications) within the Terrestrial RSA. Vegetation communities and ecosystems are represented by provincial ecosite classifications for the Boreal Shield Ecozone in accordance with the Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010). These ecosite classifications were summarized within a 1:20,000 interpreted ecosite mapping product compiled within the Terrestrial RSA with the use of the following inputs:

- 1:5,000 anthropogenic features mapping;
- historical fires data;
- provincial Predicted Ecosite Mapping;
- current and historical imagery; and
- field sampling/ground truthing sites (EIS Appendix 9-B).

As the Boreal Shield Ecozone experiences a largely natural fire regime, much of the vegetation within the Terrestrial RSA (70.6%) is comprised of post-fire regeneration (i.e., shrubby structural stages).Twenty (20) upland ecosites were identified within the RSA with relative percentages by area estimated for each ecosite code.

The assessment also identified fourteen (14) wetland ecosite types within the RSA which included swamps, bogs, fens and shallow open water ecosite codes. The area of these wetlands was also estimated to provide a relative -percent area of representation within the RSA.

This cataloguing of ecosite presence and relative area composition across the RSA provides the basis for understanding landscape change and succession over the course of the construction and operation of the Wheeler River Operation.

Waterbodies were conservatively included ~~here~~ as wetlands, as they have the potential to be classified as shallow open water wetlands (i.e., water bodies 2 m deep or less; Warner et al. 1997). Waterbodies represent the most common wetland ecosystem within the Vegetation LSA and the Terrestrial RSA, comprising 3.9% (44.9 ha) and 10.7% (4,101.9 ha), respectively. The black spruce treed bog is the second most common wetland ecosystem within the Vegetation LSA (18.2 ha, 1.6%) and the Terrestrial RSA (1,157.1 ha; 2.9%). The Labrador tea shrubby bog is the most common wetland ecosystem in the Vegetation LSA, comprising 2.0% (23.3 ha), and the second most common wetland ecosystem in the Terrestrial RSA (989.9 ha, 2.5%). All other wetland ecosites are relatively uncommon, each comprising less than 0.5% of the Vegetation LSA and Terrestrial RSA. The location, size and relative area composition of the wetland features is provided in Table 2 and Figure 1). The initial classification and subsequent assessment of wetlands in the Terrestrial Environment (EIS Section 9) took a conservative approach in that the area of wetlands within the terrestrial study areas was likely over-estimated to assess potential changes in areal extend of wetlands.

Table 2: Summary of Wetlands

Ecosite Code[1]	Ecosite Description[1]	Structure Code[2]	Vegetation LSA (ha)	Vegetation LSA (%)	Terrestrial RSA (ha)	Terrestrial RSA (%)
Swamps						
BS16	Black spruce / balsam poplar / river alder swamp	6	--	--	8.8	<0.1
Swamps Subtotal			**--**	**--**	**8.8**	**<0.1**
Bogs						
BS17	Black spruce treed bog	5	18.2	1.6	1,157.1	2.9
BS18	Labrador tea shrubby bog	3	23.3	2.0	967.6	2.4
		3a	--	--	20.3	0.1
		3b	--	--	2.0	<0.1
		Total	23.3	2.0	989.9	2.5
BS19	Graminoid bog	2	2.8	0.2	160.5	0.4
BS19/24[3]	Graminoid bog or graminoid fen	2	0.8	0.1	1.2	<0.1
BS20	Open bog	1	0.6	<0.1	65.5	0.2
Bogs Subtotal			**45.6**	**3.9**	**2,374.2**	**5.9**
Fens						
BS19/24[3]	Graminoid bog or graminoid fen	2	0.8	0.1	1.2	<0.1
BS21	Tamarack treed fen	5	1.9	0.2	66.5	0.2
BS22	Leatherleaf shrubby poor fen	3a	-	-	28.5	0.1
BS23	Willow shrubby rich fen	3b	0.6	<0.1	20.9	0.1
BS24	Graminoid fen	2	-	-	9.0	<0.1
BS25	Open fen	1	0.4	<0.1	5.7	<0.1

Ecosite Code[1]	Ecosite Description[1]	Structure Code[2]	Vegetation LSA (ha)	Vegetation LSA (%)	Terrestrial RSA (ha)	Terrestrial RSA (%)
Fens Subtotal			**3.6**	**0.3**	**131.8**	**0.3**
Shallow Open Water						
BS26	Rush sandy shore	2	-	-	15.1	<0.1
BS27	Sedge rocky shore	2	4.2	0.4	29.3	0.1
Waterbody[4]	--	0	44.9	3.9	4,101.9	10.7
Shallow Open Water Subtotal			**49.0**	**4.2**	**4,146.3**	**10.3**
Total Wetlands[5]			**98.3**	**8.5**	**6,661.1**	**16.6**

Notes:

1 Ecosystems are described in detail in the Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010).

2 Modified from the Field Manual for Describing Terrestrial Ecosystems (BC Ministry of Environment, Lands, and Parks, and BC Ministry of Forests 1998). 0 = unvegetated; 1 = sparse / bryophyte / lichen; 2 = herb/graminoid; 3a = low shrub; 3b = tall shrub; 5 = young forest, 6 = mature forest.

3 This ecosite type is an artifact of mapping uncertainty, as baseline mappers were unable to distinguish between these ecosites due to a lack of available information (e.g., soil information, vegetation field plots, water quality data). As such, this ecosite has conservatively been split between bog and fen classifications.

4 Areas of open water <2 m deep are defined as shallow open water wetland ecosystems (National Wetlands Working Group 1997); as such, unnamed waterbodies and areas of open water observed to exhibit an average depth of <2 m (Ecometrix Incorporated 2020) have been conservatively included as wetland ecosystems.

5 Some numbers are rounded for presentation purposes. Therefore, the totals may not equal the sum of the individual values.

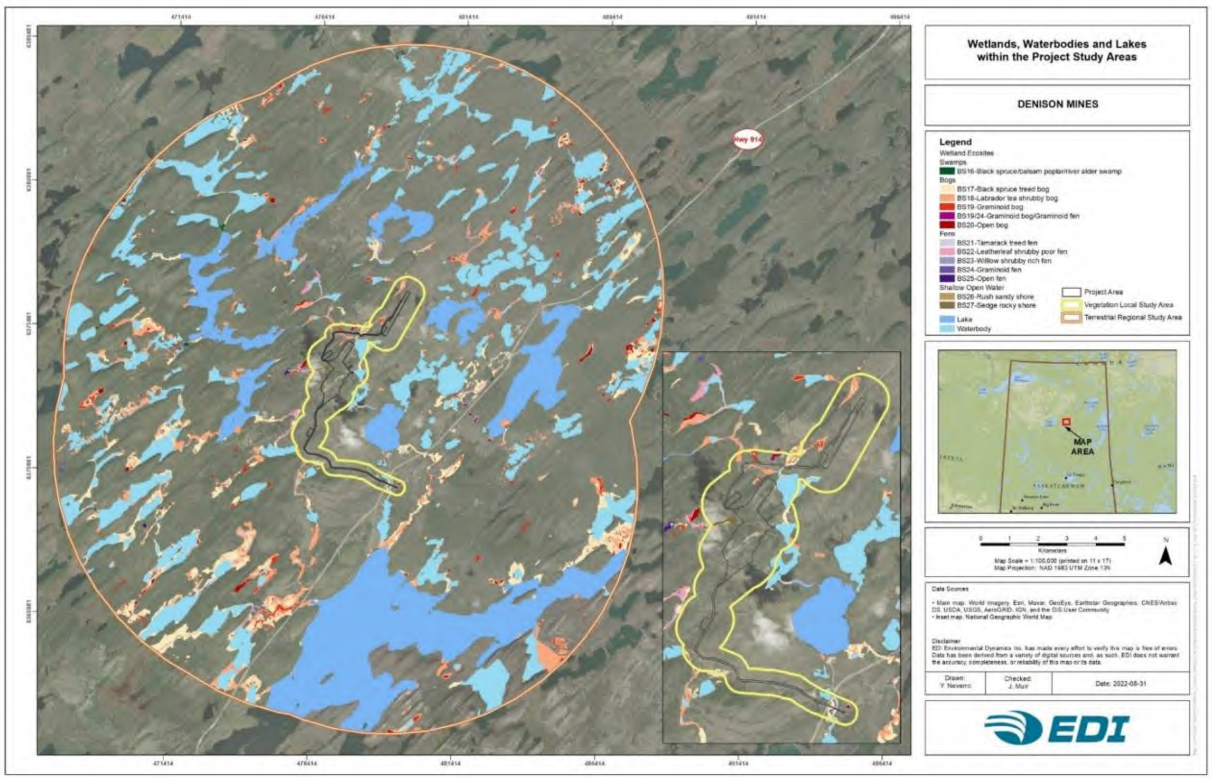


Figure 1: Wetlands, Waterbodies and Lakes within the Project Study Areas

Surface elevations for the wetland have been assessed and the information is summarized below and in the Figure 1-.

- Wetlands 1.5 km west of the Project Area range from 526-524 masl
- Waterbodies and their surrounding wetlands directly to the east of the SSA are at an elevation of between 506 and 500 masl
- Waterbodies and surrounding wetlands 2 km east of site are approximately between 499 and 497 masl
- Wetlands north of the Project Area and in the vicinity of the proposed air strip range from 514-508 masl.
- Wetlands situated further north of the Project Area in the LSA were at an elevation of approximately 526 masl
- Southern wetlands that will interact with the proposed hydro corridor extension for the mine have an elevation of 491masl
- Most wetland evaluated south of the Project Area had elevations ranging from 491-488 masl

Wetland depth, presence of fish or fish habitat, water quality and sediment quality are not currently available for the non-waterbody wetlands (i.e. those not identified as a lake or watercourse in Section 8 of the EIS). However, Denison is committed to conducting field surveys to collect this data prior to the initiation of construction of the Operation. This will allow for baseline information to be available to compare future changes and assess the success of mitigation measures and the predicted effects or lack thereof.

For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA. Refer to Appendix A below for additional information on the in-lake wetlands.

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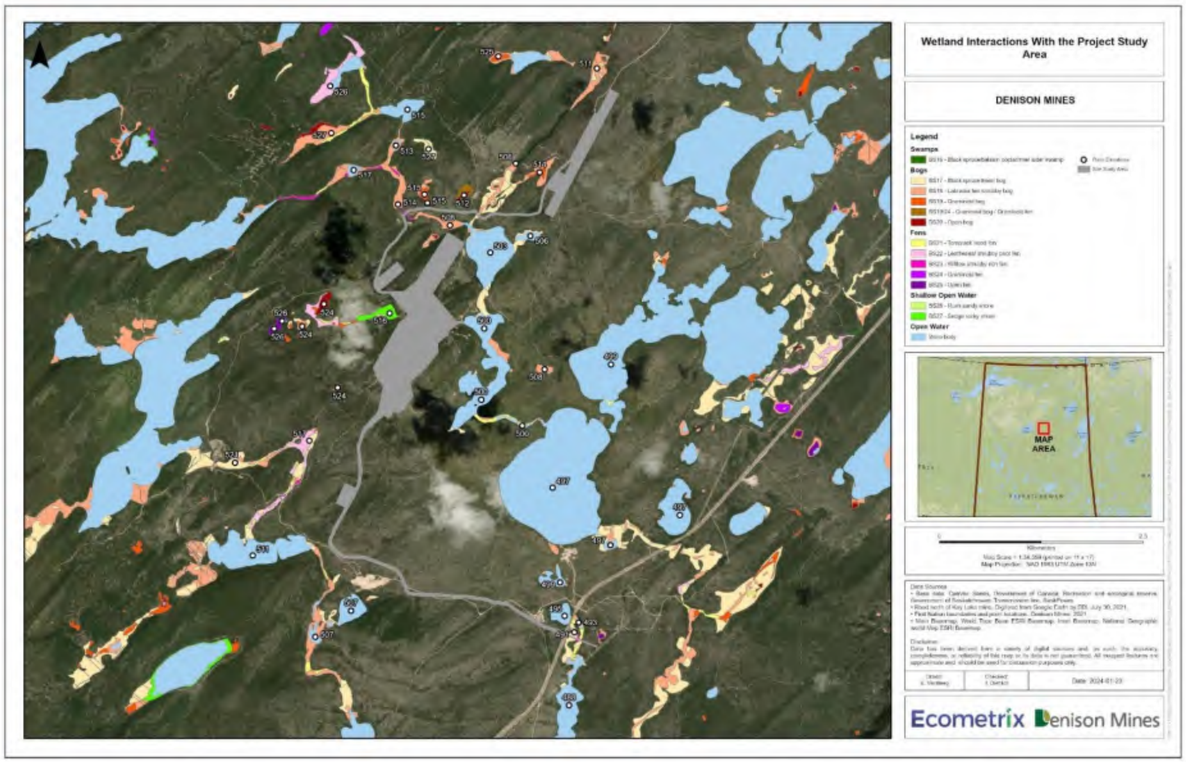

Figure 2: Elevations of wetland features in the LSA

4.0 Assessment of Project Related Effects

4.1 Potential Interactions Between the Project and Valued Component/Key Indicators

The Project will require the Construction, Operation, and Decommissioning of several components (as described in Section 2 of the EIS). Potential interactions between these Project components and activities and Fish and Fish Habitat in the form of Wetlands and their associated KIs are summarized by Project phase and activity in Table~~Table 4~~.

Potential interactions in Table~~Table 9.2-9~~ are ranked as:

Primary Interaction (✓): Project activity is expected to interact with the VC / KI which may result in an adverse effect on the VC (i.e., a measurable or detectable change in the MP) and is further considered in the effects assessment as the primary contributor to potential adverse effects.

Other Interaction (✓): Project activity is expected to interact with the VC / KI. While the interaction is further considered in the effects assessment, it is not expected to be a primary contributor to potential adverse effects.

No Interaction: Project activity is not expected to interact with the VC or the KI, no adverse effects are expected, and rationale is provided for not considering this potential interaction further.

Table 4: Potential Project Interactions for Wetlands Valued Component

Project Phase/Activity	Wetlands Valued Component and Key Indicator
Development of access roads and air strip	✓
Site preparation and earthworks; clearing, leveling and grading of the Project Area	✓
Power generation - generators	✓
Installation of main substation and distribution of power around site	✓
Wellfield and freeze hole drilling; ground freezing	✓
Batch plant operation (concrete); crusher at borrow area	✓
Development of surface infrastructure (camp, operations centre, plants, ponds, pads and support facilities)	✓
Waste management (composting, domestic and industrial landfill operation, recycling)	
Water management (including treatment and site runoff)	✓
Groundwater supply	✓

Project Phase/Activity	Wetlands Valued Component and Key Indicator
Surface water withdrawal	✓
Fuel management (e.g., propane for comfort heating; vehicle and aircraft fuel)	✓
On-site and off-site operation of vehicles and transportation of materials	✓
Air transportation for workers	✓
Regulatory site inspections	✓
Engagement – site visit from Interested Parties	✓
Operation of the ISR wellfield	
Wellfield and freeze wall drilling	✓
Operation and expansion of freeze wall	✓
Batch plant operation (grout and cement); crusher in borrow area	✓
Expansion of pond and pads	✓
Operation of the processing plant and production of uranium concentrate	
Water withdrawal from groundwater or surface water body	✓
Management of surface water (including seepage and site runoff)	✓
Water treatment, both domestic and industrial	
Water release to surface water body	✓
Waste management (composting, domestic and industrial landfill operation, recycling)	
Hazardous waste management (temporary storage, handling, and off-site transportation)	✓
Storage and disposal of drill waste rock, process precipitates and industrial wastewater treatment plant precipitates	✓
On-site and off-site operation of vehicles and transport of materials	✓
Power supply – primarily power from the grid, also generators and back-up generators	✓
Package and transport of nuclear substances	✓
Fuel management (e.g., propane for comfort heating; vehicle and aircraft fuel)	✓
Air transportation for workers	✓
Progressive decommissioning and reclamation	✓
Regulatory site inspections	✓

Project Phase/Activity	Wetlands Valued Component and Key Indicator
Engagement – site visit from Interested Parties	✓
Site water management, treatment, and release	✓
Mining horizon remediation and thawing of freeze wall	✓
Process water treatment and release	✓
Closure of ISR and freeze wells and related infrastructure	✓
Decontamination of surface facilities and injection, recovery and monitoring wells	
Asset removal (including site power transmission lines and electrical infrastructure)	✓
Demolition and disposal of non-salvageable surface infrastructure and materials	✓
Remediation of contaminated areas (wellfield, pads, ponds, domestic wastewater treatment location, and process plant area)	✓
Generators	✓
Waste management (composting and landfill operation)	
Decommissioning of landfills; hazardous materials management (temporary storage and off-site disposal)	✓
On-site and off-site operation of vehicles and transportation of materials	✓
Reclamation of disturbed areas	✓
Regulatory site inspections	✓
Engagement – site visit from Interested Parties	✓
Environmental monitoring	✓
Regulatory site inspections	✓
Engagement - Site visit from Interested Parties	✓

1 Operational activities include maintenance.

4.2 Potential Project-related Effects

Based on the timing and nature of the interactions identified in Table 4, the following adverse effects have a potential to occur on the Wetland VC (Table 5). The key indicator of effects to wetlands is the change in areal extent of wetlands in the study area.

Table 5: Potential Project-related Effects on Wetlands Valued Component During all Project Phases

Project Phase/Potential Effect	Wetlands Valued Component and Key Indicator
Construction	
Direct disturbance / Overprinting	✓
Mobilization of suspended materials	✓
Introduction and/or Proliferation of Invasive Plants	✓
Changes in Water Quantity (water levels or flow)	✓
Edge Effects	✓
Changes to Water Quantity and Quality	✓
Dust Deposition	✓
Operation	
Direct disturbance / Overprinting	✓
Mobilization of suspended materials	✓
Edge Effects	✓
Introduction and/or Proliferation of Invasive Plants	✓
Controlled Discharge	✓
Changes in Water Quantity (water levels or flow)	✓
Controlled Discharge / Water Quality	✓
Dust Deposition	✓
Decommissioning	
Direct disturbance / Overprinting	✓
Mobilization of suspended materials	✓
Edge Effects	✓
Introduction and/or Proliferation of Invasive Plants	✓
Controlled Discharge	✓
Changes in Water Quantity (water levels or flow)	✓
Controlled Discharge / Water Quality	✓
Dust Deposition	✓
Post-Decommissioning	

Project Phase/Potential Effect	Wetlands Valued Component and Key Indicator
Direct disturbance	✓
Introduction and/or Proliferation of Invasive Plants	✓
Edge Effects	✓
Changes to Water Quantity and Quality	✓
Dust Deposition	✓

4.3 Mobilization of Suspended Materials

Construction

The primary effect pathway during Construction relates to the mobilization of suspended material into natural surface water features including wetlands as a result of land disturbance and clearing. The mobilization of suspended material into natural surface water features is readily mitigatable by virtue of the mine development plan and through the implementation of standard water management and sediment control practices. Water management infrastructure (e.g., collection ditches, ponds, pumping stations) and various aspects of the water management and sediment control management systems will be put into place coincident with the initiation of construction activities. Waters (e.g., runoff) associated with areas under development will be collected and stored within management infrastructure (e.g., clean waste rock pond, see Figure 2.2-14 in Section 2 of the EIS). In the event that releases to the natural environment are necessary, they would only occur once it is safe to do so (i.e., suspended solid levels in the water would be at acceptable levels). No downstream effects on surface waters, natural sediments, fish and fish habitat including wetlands are expected.

Operation

During Operation, mobilization of suspended materials will be managed through the development and operation of water management infrastructure and implementation of surface water management through the Surface Water Management Program. Releases of contact water to the natural environment will be directed through applicable collection ponds, the IWWTP, and the Effluent Monitoring and Release Ponds. No specific discharge is expected to wetland features in the Project Area. Discharge will only occur once it is safe to do so (i.e., suspended solids levels in the water would be at acceptable levels). Denison may employ active means (e.g., filtering), if required, to achieve low TSS levels in discharge, in addition to passive means, such as settling and clarification in the IWWTP to manage TSS in the effluent stream to low levels. No downstream effects on surface waters, natural sediments, or fish and fish habitat including wetlands are expected.

Decommissioning and Post-Decommissioning

During Decommissioning and Post-Decommissioning, the site-wide water management system will continue to operate such that Denison will maintain control of the site aspect affected water through the IWWTP. Surface drainage during Decommissioning activities will continue to be directed to the system of collection ponds, the IWWTP, and the Effluent Monitoring and Release Ponds to facilitate the control of suspended solids and achieve low TSS levels in the discharge, thereby minimizing any potential for adverse changes to water quality, sediment quality, and fish and fish habitat including wetland features.

4.4 Overprinting of Wetlands as Fish Habitat

For the purposes of this assessment the bogs and fens within the area can be assumed to provide supporting fish habitat to the adjacent lake and river water bodies in the vicinity of the LSA.

Bogs are predicted to be the wetland class most affected by the Project, with 0.4 ha (less than 0.1%) of mapped bog ecosystems within the Terrestrial RSA expected to be disturbed within the Project Area during Construction. Fens are the next most affected, with 0.1 ha (0.1%) anticipated to be disturbed during Construction (Figure 3). Less than 0.1 ha (less than 0.1%) of shallow open water wetlands within the Terrestrial RSA are also anticipated to be affected by the Project.

Within these wetland classes, the wetland ecosite expected to be most affected is the willow shrubby rich fen (ecosite BS23) with direct disturbance to 0.1 ha predicted to occur within the Project Area (0.5% of the BS23 ecosite within the Terrestrial RSA). The remaining ecosites anticipated to be directly affected by the Project are locally abundant, with direct disturbance expected to affect <0.1% of these ecosites within the Terrestrial RSA (Table 2).

Investigation of the potential overprinting of wetland features as a result of the Project it is evident that wetland loss is avoidable. The interaction of the Project with wetlands is isolated to those areas where stream crossings for access roads and hydro-line connections are proposed (Figure 3). With the use of single span bridges and implementation of best management practices, direct wetland disturbance associated with the crossings of Kratchkowsky Creek and Hart Creek is expected to be avoided. It should be noted that SaskPower proposes to tap the existing I3P 138 kV line near Highway 914 and build approximately 4.5 km of new 138 kV line from the I3P tap to the Project site. SaskPower will be responsible for conducting activities such as line routing, environmental studies, and permitting, public consultation, and engineering design work as applicable to the load interconnection. As such, wetland disturbance related to the SaskPower Hydro Corridor is expected to be addressed through the SaskPower permitting process.

DATE: 3 October 2024

TO: Denison Mines – Janna Switzer

REF: Wheeler River Project EIS – Appendix 8-F: Wetland Effects Assessment Report

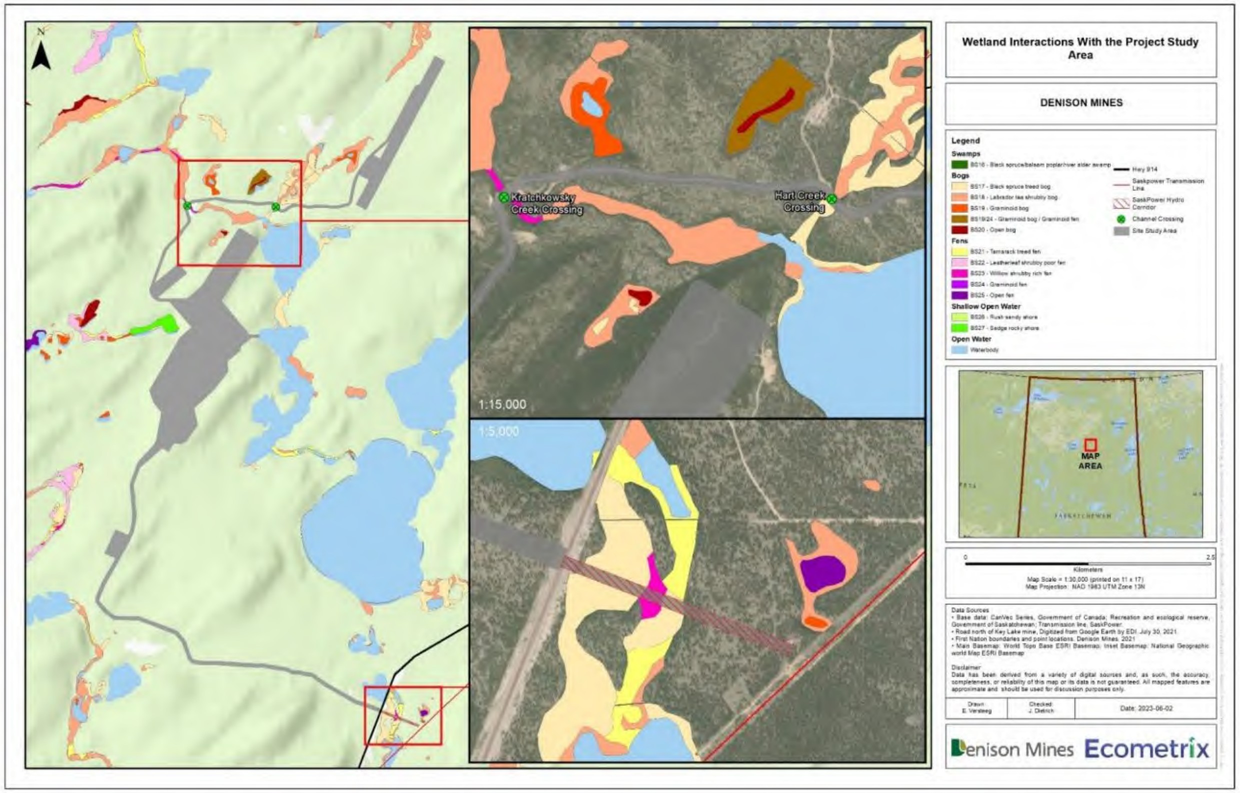

Figure 3: Denison Wheeler River Project Area and Wetland Feature Distribution

4.5 Controlled Discharge to Receiving Environments

According to the site water balance (Figure 2.2-14 in Section 2 of the EIS), there is no planned discharge to Whitefish Lake during Construction. Other than LA-5 (Whitefish Lake) no other controlled discharge will occur to the natural environment and no wetlands will be impacted as a result.

4.6 Change in Water Levels and Flow

As detailed in Section 8.1 of the EIS, the projected withdrawal and discharge rates proposed for the Project are the largest influence on the hydrological effects of the Project. The largest predicted change in streamflow rate is -3.1% at the LA-5 and SA-2 nodes (immediately downstream of the Project) during Operation and Decommissioning, as projected against the 5th percentile low flow dataset in March. Lake levels and wetlands are expected to deviate less than ±0.01 m due to all Project influences. All Project influences on the environment are expected to return to baseline conditions during Post-Decommissioning. These changes are within the range of fluctuation of environmental flows and water levels and are unlikely to affect fish passage or life history environmental cues.

4.7 Introduction and/or Proliferation of Invasive Plants

Vegetation clearing and soil disturbance during Construction are expected to create conditions suitable for the introduction and proliferation of invasive plants. Vehicles and construction equipment can inadvertently transport seeds and other invasive plant propagules in tires or the undercarriage to previously unaffected areas. The effects of invasive plants on native vegetation diversity are well documented and recognized as the second greatest threat to listed species after habitat loss (Enserink 1999). Competition with native species can lead to a reduction in the growth and vigour of native species (including Wetlands), as well as changes in the diversity, structure and function of ecosystems and habitats.

The potential for the introduction and proliferation of invasive plants by transport on vehicles and equipment is expected to continue throughout Operation during wellfield and freeze wall drilling, expansion of ponds and pads, drill waste rock, process precipitates and industrial wastewater treatment plant precipitates, on-site and off-site operation of vehicles and transport of materials, package and transport of nuclear substances, and air transportation for workers (i.e., landing and taking off of airplanes). Progressive decommissioning and reclamation has the potential to introduce invasive plants on vehicles and equipment and if seed used for revegetation is not supplied from a native seed source (Polster 2003) with a certificate of analysis indicating an absence of invasive plant seeds.

The potential for the introduction and proliferation of invasive plants is expected to continue throughout Decommissioning (e.g., during closure of the ISR and freeze wells and infrastructure, asset removal, demolition and disposal of non-salvageable surface infrastructure and materials, remediation of contaminated areas, reclamation of disturbed areas, and operation of vehicles and transportation of materials). The potential for the introduction and proliferation of invasive plants is expected to continue throughout Post-Decommissioning, but at lower levels due to reduced vehicle traffic.

4.8 Edge Effects

Edge habitat refers to an area on either side of a border between vegetation communities. Edges between vegetation communities often result in altered microclimatic conditions that can influence environmental conditions further away from the edge (Bannerman 1998). Edge effects are expected to extend into areas of native vegetation and habitats at the interface of disturbed areas and undisturbed native ecosystems, and could include altered microclimatic conditions that can influence quality in habitat away from the edge (Bannerman 1998). Where edge effects occur, Wetlands may experience changes in light intensity, temperature, wind, moisture, relative humidity, and patterns of snow accumulation and melt relative to undisturbed conditions. This can, in turn, affect plant health and alter natural disturbance regimes (e.g., blowdown), plant population persistence, and the structure and function of ecosystems and habitats. If changes to microclimatic conditions or vegetative structure at an edge exceed a species habitat preference or physiological tolerance, then edge habitat may result in lower occupancy or use, reduced survival, or lowered reproductive success.

Edge effects at the interface of disturbed areas and native ecosystems are expected to occur along the edges of the Project Area resulting from vegetation clearing during site preparation and earthworks during Construction. Edge effects are expected to continue throughout Operation, Decommissioning, and Post-Decommissioning, decreasing over time as revegetation and tree growth within reclaimed areas of the Project create a gradual structural transition at forest edges, aided by natural encroachment.

4.9 Long-Term Transport of Groundwater Solutes to Whitefish Lake in Future Centuries

During the ‘future centuries’ scenario as described in Section 8.3.1.3 of the EIS, remediation works will be completed and the site naturalized, thereby restoring drainage patterns to report to surface waterbodies. As indicated in Section 7 of the EIS, groundwater plumes may develop from residual mass remaining post-mining based on bench-scale lab tests of core flushing, and numerical modelling of reactive fate and transport. The results of this was described in Section 8.3.4.2.5 with respect to Fish and Fish Habitat and therefore wetlands.

The results of the numerical modelling (as provided in Section 7 and Appendix 10-A in Section 10 of the EIS) support the conclusion that with the implementation of appropriate mitigation during the decommissioning and restoration phases of the Project, the residual effects of the

Project on the intermediate Groundwater VC will not result in an adverse effect on surface water. Dissolved constituent concentrations emanating over hundreds to thousands of years in the future from the deep Ore Zone to Whitefish Lake are expected to remain below fresh water environmental quality criteria in Whitefish Lake.

Although the precise location of the groundwater discharge to the surface is somewhat uncertain, the groundwater transport scenarios that have been evaluated (Appendix 7-C of the EIS) to date suggest groundwater discharge impacted from mining will most likely be relegated to Whitefish Lake. The discharge to Whitefish Lake is generally predicted to occur along the eastern shore of the lake, as this is interpreted to be the eastern edge of the underlying desilicified zone. The Laborador Tea Shrubby Bog habitat located on the eastern shore of Whitefish Lake may be in the zone of influence of groundwater discharge, yet chemically will remain below freshwater environmental quality criteria. Groundwater impacts to other surrounding wetlands will be negligible as groundwater is not predicted to discharge within any area beyond the central portion of Whitefish Lake.

4.10 Indirect Effects

Indirect disturbance associated with the potential to adversely affect BS19/24 includes the introduction and/or proliferation of invasive plants, edge effects, changes to water quantity and quality, and dust deposition during all Project phases (as described in Section 9.2.4.2.1). Wetland ecosites BS19/24 (graminoid bog/fen) and BS25 (open fen) are peatland ecosystems typically characterized by high water tables (i.e., a very moist or very wet moisture regime), while ecosite BS27 (sedge rocky shore) is a sparsely vegetated ecosystem predominated by rocky substrates, typically occurring adjacent to lakes and ponds (McLaughlan et al. 2010). Because these ecosystems rely on high water tables and existing waterbodies, alteration of water quantity would be expected to have the highest potential to cause an adverse effect. Therefore, maintenance of wetland hydrology is expected to be the most effective mitigation to sustain these wetland ecosites within the Terrestrial LSA throughout the Project lifespan.

5.0 Mitigation Measures

Mitigation measures specific to the wetlands, discussed in the following subsection are applicable during all Operation phases and expected to be effective immediately following implementation and managed through the EMP.

Disturbance Reduction

- Wherever possible, wetlands will be avoided through Project design and instituting proper buffers.

- Disturbance to vegetation and soils will be avoided by clearly delineating Project Area boundaries (e.g., with the use of fencing, staking, or flagging), adhering to construction plans and schedules, and by restricting off-site machine use.
- Wetland boundaries in the proximity of planned disturbances will be clearly delineated (e.g., with the use of fencing, staking, or flagging) to facilitate avoidance to the extent practicable.
- Should they occur, areas prone to potential instability and areas in proximity to water bodies and drainage features will be identified and appropriate setbacks will be established and maintained.
- Temporary workspaces or laydown areas will be sited and constructed within existing disturbance or on previously compacted soils, where practicable. In areas requiring clearing only, grubbing will be avoided, and roots and groundcover will be retained to the extent feasible.
- Pre-construction listed plant surveys will be completed within the Project Area.
- Listed plants located adjacent to planned disturbances will be clearly delineated (e.g., with the use of fencing, staking, or flagging) to facilitate avoidance to the extent practicable and reduce the potential for accidental encroachment outside of the Project footprint.
- Should Listed Plants be identified within the Vegetation LSA prior to Construction, site- and species-specific mitigation measures to avoid and/or limit Project effects will be determined by a Qualified Vegetation Ecologist. Specific mitigation measures will depend on the species, its life history characteristics, time of year, and the location of the occurrence in relation to Project activities.
- Herbicide use will be avoided within 100 m of any known listed plant occurrences. Where herbicide use is unavoidable, use will be restricted to direct application instead of broadcast spraying and completed by qualified personnel.

Soil Handling and Reclamation

- Construction activities will be sequenced (i.e., site clearing, grading preparations, major earthworks and construction of infrastructure/facilities) so that surface vegetation, mineral soil and organic matter can be salvaged for later use in Project Decommissioning.
- Soil resources within the Project Area will be stripped/salvaged and stockpiled within the Project Area in accordance with relevant soil management BMPs, i.e., providing guidance on ground-truthing soil conditions, flagging potential hazards and sensitivities, and

modifying practices in relation to environmental conditions and avoiding or minimizing inadvertent/incidental disturbance.

- A soil monitoring program/protocol (or equivalent) will be undertaken to verify soil salvage volumes and reclamation suitability (Section 9.1.8.2).
- Soil stockpiling locations will be sited to reduce soil handling and travel distances and designed to minimize the potential for soil degradation and downgradient effects, e.g., having defined height and width that optimize soil storage and stockpile stability, and having integrated erosion control measures and surface water management features (if/where necessary). Sediment and erosion control measures will be implemented in accordance with BMPs and commensurate to site conditions and sensitivities.
- Sediment and erosion control measures and surface water management features will be installed and maintained at the Project. Erosion controls (e.g., sediment fencing, check-damns and/or sediment ponds) will be installed as necessary and at the discretion of construction personnel commensurate to site conditions and sensitivities to manage/mitigate erosion and sedimentation.
- Progressive reclamation and ecosystem-based revegetation will be conducted on disturbed areas as soon as practicable with the use of suitable native species and in accordance with the Reclamation and Closure Plan.

Surface Water Management

- Snow melt and runoff will be controlled within the Project Area to prevent the potential release of contaminated runoff from affecting vegetation in adjacent areas.
- Sediment and erosion control measures will be implemented in accordance with the EMS.
- Surface water management features (e.g., culverts and ditches) will constructed and maintained (as per Project design specification) along access roads and facility sites to facilitate surface drainage continuity and hydrologic connectivity—especially in proximity to wetlands, water crossings, and waterbodies.
- Hydrologic connectivity is expected to be maintained across the Project Area with the engineering, construction, and maintenance of surface water management features (e.g., culverts and ditches) as appropriate and as per Project design specifications along access roads and at facility sites.

Invasive Plant Management

- Equipment and vehicles will arrive at the Project Area clean, and will be inspected for soil, plant material, and seeds, and cleaned as appropriate, to limit the potential for the introduction of invasive plants and noxious weeds.
- Areas with a high risk for the potential spread of invasive plants and noxious weeds (i.e., within or adjacent to existing infestations) will be avoided to the extent practicable; if work must occur in these areas, invasive plant management will be implemented before starting work.
- Gravel, fill, straw matting, or similar materials to be used for erosion control will be inspected to minimize the potential for seeds or propagules of invasive plants being brought to site.
- All employees and contractors on the Project will receive an employee orientation appropriate to the work they are undertaking, including instruction on the definition of invasive plants and their potential effects, mitigation measures to avoid the introduction and spread of invasive plants, and training on the presence and identification of common invasive plant species and those known to occur within the Project Area.
- Invasive plant monitoring will be conducted periodically by personnel skilled in invasive plant identification during all Project phases to assess, evaluate, and document invasive plant occurrences within the Project Area. Invasive plant surveys will be completed during a biologically appropriate time of year (e.g., when invasive plants can be identified) within areas identified as most susceptible to invasive plant introduction and spread, including roads, ROW, debris and vegetation management areas (e.g., slash piles, timber decks, exposed soil or stockpiles) and other regularly disturbed habitats.
- Three general treatment options may be used alone or in combination to control of invasive plants in the Project Area:
    - mechanical control – involves the physical removal of the plants;
    - chemical control – involves application of synthetic and/or natural herbicides; and,
    - biological control measures – involves use of living organisms (e.g., rusts, insects) to control selected invasive plant species.
- The type of treatment option selected for an invasive plant occurrence will be based on a combination of specific information including the identity of the invasive plant species and its provincial designation, the size and extent of the occurrence, time of year, the proximity of the occurrence to other susceptible areas (e.g., rare plant occurrences, wetlands, waterbodies), and the available control options. Where possible, control of

invasive plants will be completed in consultation with a qualified professional to minimize potential effects on native vegetation, ecosystems and wetlands.

- Seed used during re-vegetation will be certified weed free, with a valid "Certificate of Seed Analysis".

6.0 Residual Effects Evaluation

6.1 Residual Effects Characterization

Residual effects on the Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs have been assessed in relation to the RSA, and characterized in terms of direction, magnitude, geographic extent, frequency, duration, reversibility, context, and likelihood (Table 6). Residual effect evaluation of residual effects are provided in Tables 7, 8 and 9.

Table 6: Definitions of Effect Characteristics Considered When Determining the Significance of Residual Effects

Residual Effect Characteristic	Definition	Rating
Direction	Identifies whether the residual effect will be adverse or positive.	**Adverse** – Negative effect or effect is not desirable. *Water Quantity* – Effect moves MPs (flow or water level) in a direction detrimental to water quantity relative to baseline conditions. A Project-related increase in surface water flows and levels during flooding, or a decrease in surface water flow below environmental flow requirements. *Water Quality* – An increase in constituent concentrations attributable to the Project in comparison to baseline conditions and trends. *Wetlands / Fish Habitat* – A physical loss of available fish habitat (extent of area) in comparison to baseline conditions. **Positive** – Beneficial effect or effect is desirable.
Magnitude	The amount of change in a measurable parameter relative to baseline conditions.	**Low** ▪ measurable decrease in the spatial extent of Wetlands, but less than a 10% loss; all original wetland classes are present. ▪ A measurable change that is not within the variability of baseline conditions but below relevant water quality objectives and criteria. A Project-related change in hydrology (flows or levels) compared to baseline conditions, but where the change is <5% from baseline conditions

Residual Effect Characteristic	Definition	Rating
		Moderate ▪ measurable decrease in the spatial extent of Wetlands between 10% and 30% loss; measurable changes in the diversity of wetland classes; some original wetland classes may be absent. ▪ A measurable change in water quality that is not within the variability of baseline conditions and not within applicable guidelines, legislated requirements, and/or federal and provincial management objectives. A Project-related change in hydrology (flows or levels) compared to baseline conditions, but where the change is >5% from baseline conditions, and could, therefore, have an adverse effect on Fish and Fish Habitat within the LSA. **High** ▪ measurable decrease in the spatial extent of Wetlands greater than 30% loss; some original wetland classes are absent. ▪ monthly flows (>10%), or lake surface elevation (m) in a waterbody or watercourse that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes. A measurable change in water quality that is not within the variability of baseline conditions and not within applicable guidelines, legislated requirements, and/or federal and provincial management objectives and is likely to have an adverse effect on Wetlands (Fish and Fish Habitat) within the LSA, with the effect extending beyond the LSA.
Geographic Extent	The geographic area within which the residual effect is expected to occur.	**Project Area** – Effect is limited to the Project Area. **Local** – Effect is limited to the Vegetation LSA. **Regional** – Effect extends beyond the Vegetation LSA into the Terrestrial RSA. **Beyond Regional** – Effect extends beyond the Terrestrial RSA.
Duration	Length of time over which the residual effect is expected to persist.	**Short-term** – Less than 3 years (i.e., effect happens during Construction only). **Medium-term** – 3 years to 38 years (i.e., effect happens from Construction through to the end of Post-Decommissioning). **Long-term** – More than 38 years (i.e., effect extends beyond Post-Decommissioning).
Frequency	How often the residual effect is expected to occur.	**Infrequent** – Effect occurs several times at sporadic intervals. **Frequent** – Effect occurs many times on a regular basis. **Continuous** – Effect occurs continuously.

Residual Effect Characteristic	Definition	Rating
Reversibility	Whether or not the residual effect can be reversed once the activity causing the residual effect ceases.	**Fully Reversible** – A residual effect that diminishes to baseline conditions. **Partially Reversible** – A residual effect that partially diminishes to baseline conditions. **Irreversible** – A residual effect that will not diminish to baseline conditions.
Context	The extent to which the VC or KI has been affected by past and present environmental and socio-economic processes and conditions, its potential sensitivity to the Project-related residual effect, and its ability to recover from that effect (i.e., resilience)	**Low** – VC/KI has high resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a lack of historic and ongoing anthropogenic or natural disturbance. No listed species present. **Moderate** – VC/KI has moderate resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or an intermediate level of historic or ongoing anthropogenic or natural disturbance with the capacity to assimilate more change. Presence of listed species **High** – VC/KI has weak resilience to stress or ecological change. This resilience can be a result of the ecological characteristics of the species or ecosystem, and/or a high level of historic or ongoing anthropogenic or natural disturbance. Presence of *SARA*-listed species
Likelihood	Likelihood that the residual effect will occur including consideration of the likelihood that the mitigation will be successful.	**Likely** – A moderate to high probability that the residual effect will occur. **Unlikely** – A low probability that the residual effect will occur.

Table 7: Wetland Fish and Fish Habitat – Summary of the Residual Effect Characteristics for Surface Water Quality

Residual Effect Characteristic	Rating	Summary Rationale for Rating
Direction	Adverse	The Project (specifically the discharge of effluent to the natural environment) will cause a change in the concentration of constituents, as measured as a mass of a chemical per unit volume in water (e.g., mg/L). Surface water quality in the local receiving environment will be adversely affected by effluent discharge to the aquatic environment, thereby providing a pathway to adversely affect surface waters. However, no discharge is planned to wetlands outside of Whitefish Lake.
Magnitude	Low	The magnitude of the residual effect is predicted to be low as constituents that may be introduced as part of Project activities are expected to remain below criteria for the protection of aquatic life and human health.
Geographic Extent	Local	The geographic extent of the residual effect is predicted to be confined to the immediate waterbody adjacent to the Project (i.e., Whitefish Lake). The estimated mixing zone is less than 5 m, implementing an effluent discharge configuration that promotes mixing.
Duration	Long-term	The residual effect is expected to last between 3 to 38 years (i.e., effect expected during Construction through to the end of Post-Decommissioning).
Frequency	Continuous	For the purposes of this EIS, a conservative scenario was identified, with effluent discharge being considered as continuous during Operation and Decommissioning.
Reversibility	Fully reversible	Surface water quality is expected to return to pre-development levels following Post-Decommissioning as Project-related sources will cease to operate.
Context	Low	Wetland health is expected to be resilient to changes in surface water quality in the context of this assessment, as COPC meet protective criteria even at the extreme low water scenario. Therefore, under applicable mitigative measures and average flow conditions, the contextual resilience of the aquatic system to respond to change is considered to be great.
Likelihood	Likely	A high probability exists that a change in water quality from background conditions will occur, but be restricted to Whitefish Lake and not other surrounding wetland features.

Table 8: Wetland Fish and Fish Habitat – Summary of the Residual Effect Characteristics for Change in Area Extent

Residual Effect Characteristic	Rating	Summary Rationale for Rating
Direction	Adverse	Impacts to wetlands in the LSA from physical disturbance or overprinting are expected to be minor in nature and relegated to wetlands located at stream crossings for access roads and the hydro-line corridor. In both cases the approach to design will be one of avoidance and minimal disturbance with clear span bridges and minimal clearing required for hydro-line installation where avoidance of open water areas can be met.
Magnitude	Low	The magnitude of the residual effect is predicted to be low. Less than 0.1% of Wetlands within the Terrestrial RSA are predicted to be directly affected as a result of Project Construction, and up to 1.5% may be indirectly affected during all Project phases.
Geographic Extent	Local	The residual effect is expected to be limited to the LSA, specifically to wetlands located at stream crossings for access roads and the hydro-line corridor
Duration	Long-term	Once natural drainage patterns are re-established following Operation, the structure and function of Wetlands altered as a result of indirect Project effects are expected to re-establish after Post-Decommissioning (more than 38 years).
Frequency	Frequent	While direct affects to specific Wetlands will occur over a short time period during Construction, Wetland alteration by indirect effects is anticipated to occur frequently throughout Construction, Operation, and Decommissioning, and infrequently during Post-Decommissioning.
Reversibility	Partially Reversible	Wetland effects are predicted to be partially reversible during Decommissioning once natural hydrologic conditions are reinstated. Alterations to wetland extent, structure and/or function as a result of indirect Project effects during all Project phases are predicted to be reversible over time once natural hydrologic conditions are reinstated and edge effects, dust, water quality changes, and invasive plant propagule pressure are reduced at the end of Decommissioning.
Context	Moderate	Wetlands can exhibit low resilience and high susceptibility to disturbance; however, disturbance is common within the Terrestrial RSA, and existing Wetlands have been historically disturbed by access roads and exploration activities.
Likelihood	Likely	The infrastructure associated with the bridges and the hydro-line are likely to affect the localized area for which they span in a limited way.

Table 9: Wetland Fish and Fish Habitat – Summary of the Residual Effect Characteristics for Change in Surface Water Quantity (Hydrology)

Residual Effect Characteristic	Rating	Summary Rationale for Rating
Direction	Adverse	Water quantity (flow and level) will be reduced in LA-5 as a result of the overprinting of its reporting drainage area by mine infrastructure and through site water balance. Water taking has an additional potential to reduce water levels in LA-5 and associated wetlands.
Magnitude	Low	The magnitude of the residual effect is predicted to be low. Under all scenarios, the Project-related change in hydrology (flows or levels) compared to baseline conditions is less than 5% of baseline conditions, and generally less than 3%.
Geographic Extent	Local	The residual effect is expected to be limited to the LSA, specifically the lakes and wetlands within proximity to the Project site (i.e., LA-5, LA-6, and LA-1).
Duration	Moderate	The residual effect is expected to last between 3 to 38 years (i.e., effect expected during Construction through to the end of Post-Decommissioning).
Frequency	Continuously	Although the mine is unlikely to require water taking on a continuous basis, this has been assessed as a bounding scenario and, as such, must be considered as a continuous effect.
Reversibility	Fully reversible	Surface water hydrology is expected to return to pre-development levels following Post-Decommissioning.
Context	Moderate	Surface water flow regimes are variable, and it is this variability that provides for morphological form to be maintained and for ecological reliance (i.e., wetlands, fish habitat). Some change to environmental flows is tolerated by wetland biota.
Likelihood	Low	Due to the localized nature and low magnitude of the effect on surface water hydrology, the likelihood of an effect is considered to be very low; therefore, the likelihood of an effect on Wetlands is expected to be low.

6.2 Significance and Confidence

The residual effect of change in the areal extent of the Wetlands VC as a result of the Project is not expected to result in a change to the wetlands KI that will alter its integrity within the Terrestrial RSA to the point where it is not sustainable or unavailable to contribute to ecological functions**.**

The threshold for significance for the Wetlands VC relates to predicted changes in the concentrations of water quality parameters, where changes could result in exceedances of relevant water quality benchmarks that are protective of aquatic biota in waterbodies that receive mine-affected drainage. The threshold for significance for Wetlands also includes predicted changes in surface water flows greater than baseline environmental flows and direct habitat loss.

The significance of the residual effects on the Wetlands VC has been deemed **not significant**. Following mitigation, the residual effects are not expected to cause a change in Wetland habitat (or associated KIs) to the extent that they might alter the ecological integrity of the VC in the LSA beyond an acceptable level.

The predicted confidence with respect to the Wetlands VC is high as the mobilization of suspended materials can be readily mitigated, making the effects prediction relative to this effect pathway easily understood.

Confidence in the assessment of predicted effects on water levels or flow is quite high due to available hydrological data for the LSA. Uncertainty is minimal with the assumptions that the water withdrawal and discharge scenarios presented herein represent the bounding case, and hydrogeological modelling projections are not changed (Section 8.1 of the EIS).

Potential effects on water quality as a result of Project discharges to local receiving environments were assessed by way of numerical modeling. The in-lake wetlands will be subject to the same processes by which constituents are expected to accumulate in all lake sediments. That is sediments are in dynamic equilibrium with the water with the relationship between the two defined by the Kd (partition coefficient). The Kds used in the EIS are not habitat specific; they are derived from years of water and sediment data collected in the Athabasca Basin. The Kds would include a variety of habitats (e.g., nearshore vegetated littoral zones, depositional habitats) from which water and sediment quality data have been collected. These predictions are generally considered conservative in nature because the assumptions on which they are based are conservative. For example:

- The assessment is based on a continuous (year-round) discharge at an expected average effluent rate of 0.0101 m^3/s (36.5 m^3/hr) throughout Construction, Operation, and Decommissioning, despite the likelihood that effluent discharge will not be continuous and will only discharge when site water balance requires, based on water storage capabilities.
- The constituents in effluent discharge have been estimated conservatively. Presented discharge concentrations provided herein include contingency factors of one to three times.

- Baseline water quality is defined by the 95th percentile concentrations of individual constituents. Such an assumption is conservative as it constrains the assimilative capacity associated with the receiving environment. By definition, the assimilative capacity of a receiving environment is equal to the incremental difference between the existing baseline condition and the assessment benchmark (i.e., water quality criterion) on which the evaluation is based. Use of the 95th percentile concentration, rather than a measure of central tendency (i.e., 50th percentile, geomean), means that the incremental change in a given constituent concentration that can be assimilated by the receiving environment (whereby use of the receiving environment is protected) is relatively small in magnitude.

Due to the conservative nature of the assumptions on which the numerical assumptions are based, a high degree of confidence can be assumed.

6.3 Summary of Project Related Residual Adverse Effects

The results of the characterizations for these residual effects are summarized in Table 10. The residual effects of the Project on the Wetland KIs were predicted to be **not significant**. Thus, the residual effects of the Project on the Wetlands VC are predicted to be **not significant**.

Table 10: Summary of Project-related Residual Effects

Valued Component	Residual Effect	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Context	Likelihood	Significance
Wetlands	Change in Water Quality	C, O, D	A	L	L	LT	C	FR	L	L	NS
	Change in Water Level or Flow	C, O, D	A	L	L	MT	C	FR	L	L	NS
	Change in the Areal Extent of Wetlands	C, O, D	A	L	L	LT	F	PR	M	L	NS

[1] Direction: Adverse (A), Positive (P)
Magnitude: Low (L), Moderate (M), High (H)
Geographic Extent: Local (L), Regional (R), Beyond Regional (BR)
Duration: Short-term (ST), Medium-term (MT), Long-term (LT)
Frequency: Infrequent (IF), Frequent (F), Continuous (C)
Reversibility: Fully Reversible (FR), Partially Reversible (PR), Irreversible (IR)
Context: Low (L), Moderate (M), High (H)
Likelihood: Unlikely (U), Likely (L)
Significance: Not-Significant (NS), Significant (S)
Level of Confidence: High (H), Moderate (M), Low (L)

7.0 Cumulative Effects

The cumulative effects are discussed in detail in Section 9.2.7 of the EIS and are not re-examined herein.

8.0 Summary

Bogs are predicted to be the wetland class most affected by the Project, with 0.4 ha (less than 0.1%) of mapped bog ecosystems within the Terrestrial RSA expected to be disturbed within the Project Area during Construction. Fens are the next most affected, with 0.1 ha (0.1%) anticipated to be disturbed during Construction. Less than 0.1 ha (less than 0.1%) of shallow open water wetlands within the Terrestrial RSA are also anticipated to be affected by the Project.

Within these wetland classes, the wetland ecosite expected to be most affected is the willow shrubby rich fen (ecosite BS23) with direct disturbance to 0.1 ha predicted to occur within the

Project Area (0.5% of the BS23 ecosite within the Terrestrial RSA). The remaining ecosites anticipated to be directly affected by the Project are locally abundant, with direct disturbance expected to affect <0.1% of these ecosites within the Terrestrial RSA.

Investigation of the potential overprinting of wetland features as a result of the Project it is evident that wetland loss is avoidable. The interaction of the Project with wetlands is relegated to those areas where stream crossings for access roads and hydro-line connections are proposed.

Avoidance through design as well as mitigation measures to control sedimentation to wetland features during construction, operation and decommissioning phases. Water quantity and quality are not expected to cause impacts to wetlands as the change in surface water feature levels and flow are nearly negligible and water will not be discharged to wetlands save for Whitefish Lake, for which effluent will not be released unless meeting criteria for the protection of aquatic life.

Residual effects on the Wetlands VC resulting from the Project were identified and assessed as **not significant**. Existing provincial legislation (Environmental Management and Protection Act [Government of Saskatchewan 2010] and the Water Security Agency Act [Government of Saskatchewan 2019b]) requires written approval (i.e., Aquatic Habitat Protection Permits) prior to any works within a wetland.

To further supplement existing information that exists for the LSA wetlands, Denison is committed to undertaking wetland surveys including the collection of water quality, sediment quality, benthic invertebrates and fish and fish habitat surveys prior to the construction of the operation to provide an updated baseline for assessing the success of mitigation measures and to assess potential effects of the project on wetlands. These locations will then be further considered as part of the EMP for continued monitoring for these media and biota.

9.0 References

Bannerman, S. 1998. *Biodiversity and Interior Habitats: The Need to Minimize Edge Effects*. Part 6 of 7. Extension Note 21. Biodiversity: Management Concepts in Landscape Ecology. British Columbia Ministry of Forests Research Program. 8 pp.

Chen, J. 1991. *Edge effects: microclimatic pattern and biological responses in old-growth Douglas-fir forests*. PhD. University of Washington, Seattle, WA.

Ecometrix Incorporated. 2020. *Wheeler River Project: Baseline Aquatic Environment Study*. Prepared for Denison Mines Corporation. Mississauga, Ontario. 948 pp.

EDI Environmental Dynamics Inc. (EDI) 2021. *Wheeler River Project Annex Report - Soil, Vegetation and Wildlife*. Prepared for Denison Mining Corp., Saskatoon, SK.

Enserink, M. 1999. Biological invaders sweep in. *Science* 285(5,435): 1,834–1,836.

Government of Saskatchewan. 2010. *Environmental Management and Protection Act*, 2010, E-10.22. https://publications.saskatchewan.ca/#/products/31893 (accessed August 2021).

Government of Saskatchewan. 2019b. *The Water Security Agency Act*. Chapter W-8.1, formerly Chapter S-35.03 of the *Statutes of Saskatchewan, 2005* (effective May 27, 2005).

Kremsater, L., and F.L. Bunnell. 1999. Edge effects: Theory, evidence and implications to management of western North American forests. pp. 117–153. *Forest fragmentation: wildlife and management implications*. Brill, Leiden, Netherlands.

MacKenzie, W., and J. Shaw. 2000. Wetland classification and habitats at risk in British Columbia., *Proceedings of a Conference on the Biology and Management of Species and Habitats at Risk, 15–19 Feb. 1999*. Volume Two., 520 pp. BC Ministry of Environment, Lands and Parks, Victoria BC and University College of the Caribou, Kamloops, British Columbia.

McLaughlan, M. S., R. A. Wright, and R. D. Jiricka. 2010. *Field Guide to the Ecosites of Saskatchewan's Provincial Forests*. Saskatchewan Ministry of Environment, Forest Service, Prince Albert, SK. 343 pp.

Omnia Ecological Services (Omnia). 2020. *Terrestrial Environment Wildlife and Vegetation Baseline Inventory*. Prepared for Denison Mines. January 2020 Update. Calgary, AB. 265 pp.

Appendix A Orientation for CNSC Round 4 IR reviewers: Whitefish Lake (middle basin) inflow to McGowan Lake inflow

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DATE: 3 October 2024

TO: Denison Mines – Janna Switzer

REF: Wheeler River Project EIS – Appendix 8-F: Wetland Effects Assessment Report

During a June 14, 2024 meeting to discuss Round 3 IR-101, the F~~f~~ederal-Indigenous R~~r~~eview tTeam indicated the wetlands of interest are those located within the nearshore environments of Whitefish Lake (Upper, Mid and Lower) as these lakes will directly receive treated effluent during operation.

The purpose of this appendix is to facilitate the CNSC's review of Denison's Round 4 response to IR-101 by summarizing information on the in-lake wetlands of interest.

While some of these in-lake areas were conservatively classified as wetlands in the terrestrial assessment (EIS Section 9), from an aquatic perspective, these in-lake wetlands of interest are littoral / nearshore zones in the lake and connecting channels. These in-lake wetland areas of interest are not cut-off from or isolated from the main basin of the lake. As such, it can be assumed that the lake environment is likely to be as depositional as the nearshore environment. The lakes of interests are very shallow (on average 1.5 m in depth) and therefore deposition may be as likely in the "offshore" environment as the nearshore.

This appendix provides a summary of four general areas (see marked up wetland map image below with areas circled and numbered in purple) from the inflow to Whitefish Lake (middle basin) to the inflow to McGowan Lake. An excerpt from Section 8~~'s~~ Figure 8.2-4 is also provided to orient the reviewer to the water quality, biota, and sediment sampling locations within these areas (refer to EIS Section 8 for details). The four areas shown in the wetland image are reviewed in the balance of this appendix with photographs and text / descriptive excerpts from the EIS to provide a general site orientation to the reviewers.

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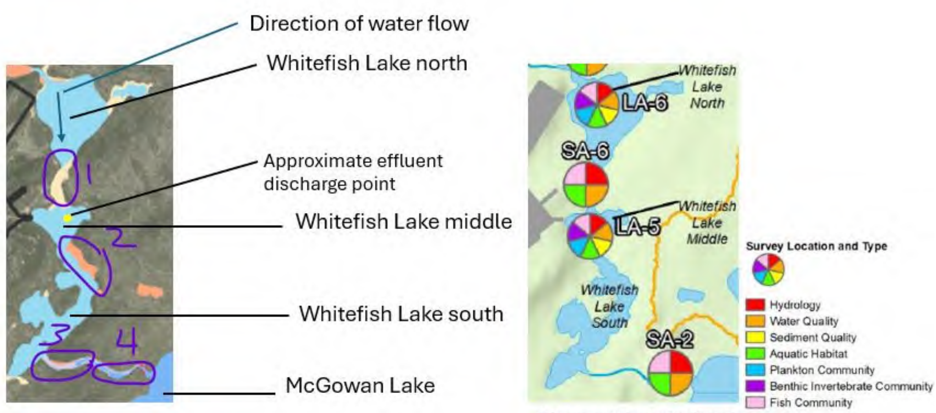

(Excerpt from EIS Figure 8.2-4)

Legend

Wetland Ecosites

Swamps

- BS16-Black spruce/balsam poplar/river alder swamp

Bogs

- BS17-Black spruce treed bog
- BS18-Labrador tea shrubby bog
- BS19-Graminoid bog
- BS19/24-Graminoid bog/Graminoid fen
- BS20-Open bog

Fens

- BS21-Tamarack treed fen
- BS22-Leatherleaf shrubby poor fen
- BS23-Willlow shrubby rich fen
- BS24-Graminoid fen
- BS25-Open fen

Shallow Open Water

- BS26-Rush sandy shore
- BS27-Sedge rocky shore

- Lake
- Waterbody

- Project Area
- Vegetation Local Study Area
- Terrestrial Regional Study Area

<table>
<tr>
<td>Notes from Appendix 8-B, Appendix F (2019):

SA-6 (Outflow from LA-6)
SA-6 is the outflow from LA-6 and is equipped with a stage recording datalogger. The sensor and sensor housing at this location were replaced in August. Stage and discharge data for SA-6 are presented in Table 6 and the rating curve is shown as Figure 6. The cross-section is shown in Photo 11 for the July field program and Photo 12 is from the August field program.</td>
<td>Photo 11: SA-6 - July Field Program
</td>
<td>Photo 12: SA-6 - August Field Program
</td>
</tr>
<tr>
<td colspan="3">Notes from Appendix 8-D (2016)

4.6 SA-6
Station SA-6 is situated on the connecting channel between the north and south basins of Whitefish Lake, LA-6 (upstream) and LA-5 (downstream), respectively (see Figure 1-8). At this location the watercourse is 3rd order.

4.6.3 Aquatic Habitat
The surveyed reach (390 m) included the entire length of stream between the two lake basins. Mean wetted channel width, water depth and water velocity were 14 m, 0.7 m and 0.2 m/s, respectively. The banks were stable and the channel was meandering (see Appendix C, Photo 11). The stream gradient was low and stream morphology was primarily runs (75%) and pools (20%), with some flats (5%). The canopy was partly open.Instream cover was diverse, afforded by deep pools, aquatic macrophytes, boulders, logs and trees, and undercut banks. Substrates were comprised of 85% sand, 10% boulder and 2% silt. Observed aquatic vegetation included sedges, pondweed and horsetail (see Appendix C, Photo 12). Moderate algae growth and slight sediment were observed overlying the substrate and no barriers to fish migration were observed. The surrounding terrain was 50% upland and 50% lowland forest and observed riparian vegetation included jack pine, black spruce, sweet gale, and Labrador tea. Snails (Gastropoda), mayfly nymphs (Hexagenia sp.) and dragonfly nymphs were observed. Stream habitat characteristics are detailed in Appendix A, Table A-15.

4.6.4 Fish Community
A summary of the fish community is presented in Table 4-4. Detailed fish catch data including fishing effort and numbers of each species collected are presented in Appendix A, Tables A-13, A-16. Within a 150-m stretch of the reach, 1,531 seconds of electrofishing effort was expended during the fall 2016 survey, resulting in the capture of 24 fish from species. Twelve YOY and 3 adult Spottail Shiner, 4 YOY and 2 juvenile Burbot, 2 adult Ninespine Stickleback and 1 YOY Longnose Sucker were captured. The CPUE was 0.94 fish/minute of electrofishing. Three adult White Sucker, 1 adult Walleye, and 3 juvenile and 3 adult Northern Pike were captured by gillnet during the spring 2017 survey. In addition, 6 adult Northern Pike and 2 adult White Sucker were observed. The list of fish species identified during baseline surveys was reviewed by Bobby John, and is considered inclusive and comprehensive (Denison, 2020).</td>
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Photo 11: Stream station SA-6 looking downstream (12 September 2016). This drainage area A station is situated on the connecting channel between lakes LA-6 (upstream) and LA-5 (downstream).

Photo 12: Stream station SA-6 looking downstream (12 September 2016). Suitable spawning habitat for Northern Pike occurred near the inlet to lake LA-5, and adult pike were observed in the vicinity during the May 2017 spawning survey.

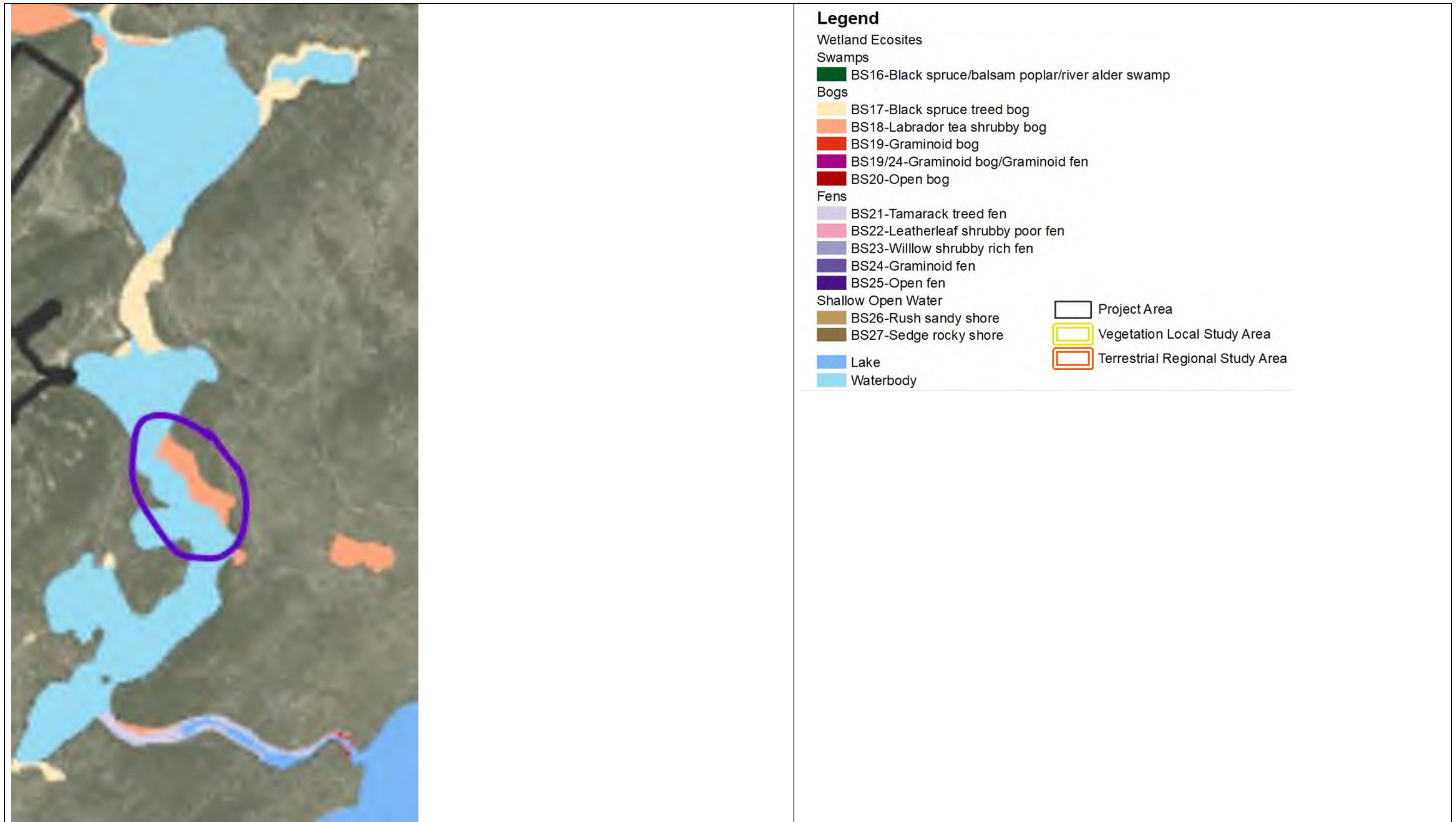
SA-6 facing upstream, March 2018.

Notes from Appendix 8-B, Appendix D (2011):

SA-6

Streamflow monitoring Station SA-6 drains from LA-6 and is upstream of SA-2. The stream section at this monitoring site is characterized by a sandy substrate, slow, deep, and laminar flow, and vertical banks. Although the right bank is well defined, high, and vegetated with trees, sand, and moss, the left bank is low lying with muskeg, shrubs and black spruce. The cross-section has a width of approximately 14 m. SA-6 produces a very good stage-discharge relationship and hydrograph.

Photo 6: SA-6 looking upstream. Photo taken May 13, 2011.



Legend
Wetland Ecosites
Swamps
BS16-Black spruce/balsam poplar/river alder swamp
Bogs
BS17-Black spruce treed bog
BS18-Labrador tea shrubby bog
BS19-Graminoid bog
BS19/24-Graminoid bog/Graminoid fen
BS20-Open bog
Fens
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BS22-Leatherleaf shrubby poor fen
BS23-Willlow shrubby rich fen
BS24-Graminoid fen
BS25-Open fen
Shallow Open Water
BS26-Rush sandy shore
BS27-Sedge rocky shore
Lake
Waterbody
Project Area
Vegetation Local Study Area
Terrestrial Regional Study Area

Area of interest in Whitefish Lake, August 16, 2024		

Appendix 8-D:

LA-5: 3.5.4 Aquatic Habitat

An aquatic habitat assessment was undertaken by Golder in August 2012 (Appendix F). Shoreline vegetation at LA-5 consisted mainly of shrubs and black spruce with upland jack pine forest. The typical substrate observed for LA-5 was sand and organic matter. Shoreline slopes ranged from shallow to steep. Cover types for aquatic biota included emergent and submergent vegetation, interstitial spaces in coarse substrate, overhanging vegetation and woody debris. Observations made during the 2016-19 baseline studies were similar, confirming the earlier survey data.

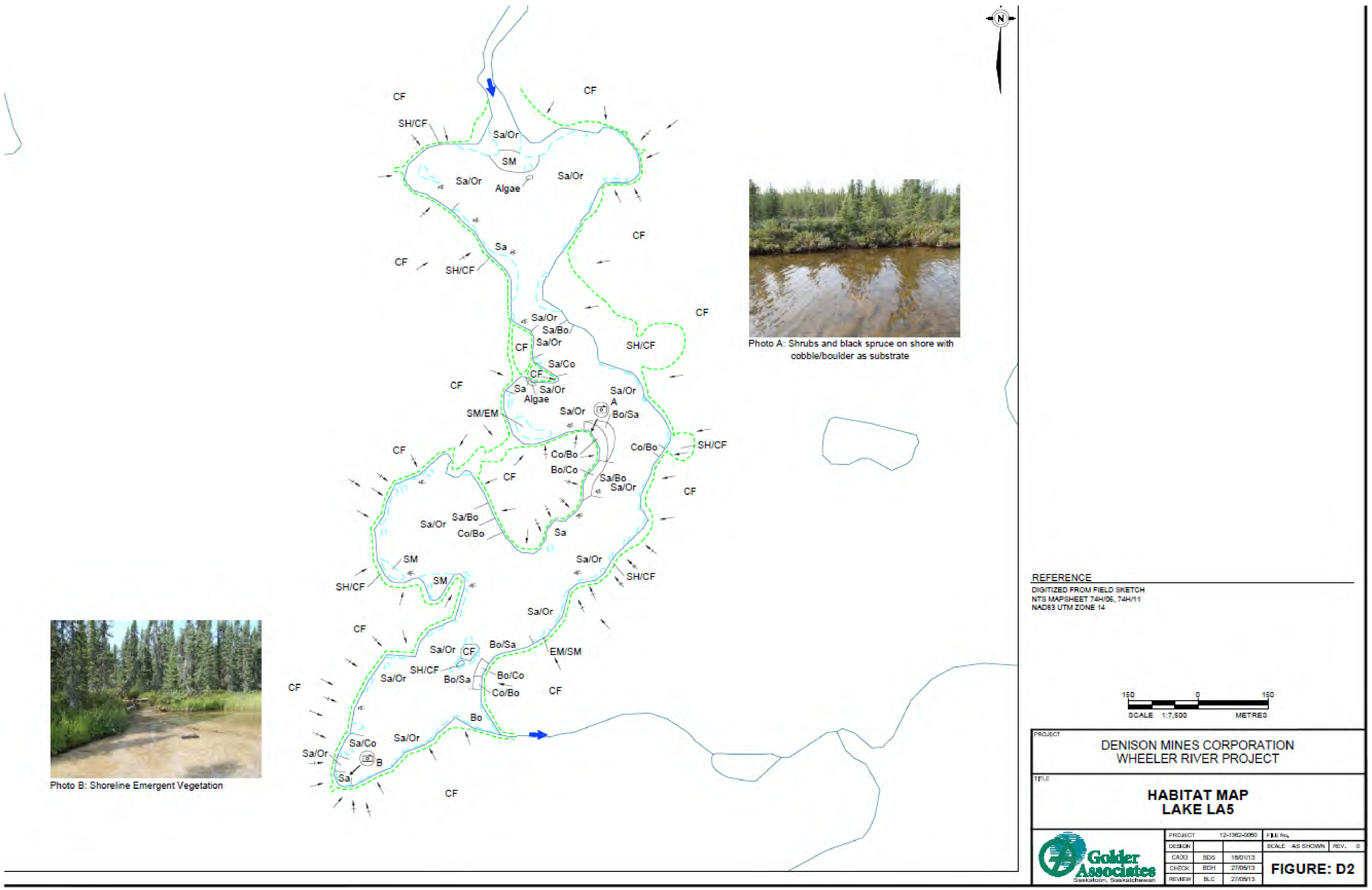


Photo A: Shrubs and black spruce on shore with cobble/boulder as substrate
Photo B: Shoreline Emergent Vegetation
REFERENCE
DIGITIZED FROM FIELD SKETCH
NTS MAPSHEET 74H/06, 74H/11
NAD83 UTM ZONE 14
SCALE 1:7,500 METRES
DENISON MINES CORPORATION
WHEELER RIVER PROJECT
HABITAT MAP
LAKE LA5
FIGURE: D2

DATE: 3 October 2024

TO: Denison Mines – Janna Switzer

REF: Wheeler River Project EIS – Appendix 8-F: Wetland Effects Assessment Report

Legend - Lakes, Wetlands, Ponds

Substrate Types	
Cl	Clay
Si	Silt
Sa	Sand
Gr	Gravel
Co	Cobble
Bo	Boulder
Bd	Bedrock
Or	Organic

Habitat Features		
XXXX	BD	Beaver Dam
	MD	Man-Made Dam
	BL	Beaver Lodge
	BG	Boulder Garden
		Bridge
		Culvert
	DP	Debris Pile
	EM	Emergent Vegetation
		Flow Direction
	ISC	Instream Cover
	IV	Instream Vegetation
	INV	Inundated Vegetation
	LWD	Large Woody Debris
	LE	Ledge
	LJ	Log Jam
	LS	Landslide
	MIL	Multiple Island
	OHV	Overhanging Vegetation
	OHC	Overhead Cover
	RW	Root Wad
		Sand Bar
	SIL	Singular Island
	SWD	Small Woody Debris
	SM	Submergent Vegetation
	UCB	Undercut Bank
	USB	Unstable Bank

Sample Type Symbols		
		Water
		Sediment
		Benthic
		Fish

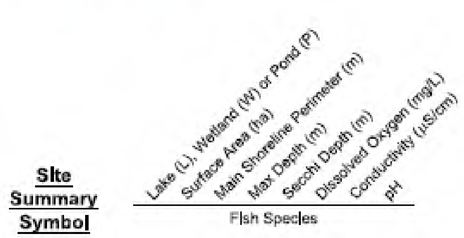
Bank/Upland Vegetation Types		
	BA	Bare Ground
	OT	Open Tundra
	MU	Muskeg/Bog
	DF	Deciduous Forest
	CF	Coniferous Forest
	MW	Mixedwood Forest
	GS	Grassland
	GF	Grass/Forbs
	GF/SH	Grass/Forbs/Shrubs
	SE	Sedge
	SH	Shrubs
	EM	Emergent Vegetation
	MO	Moss
	OR	Organic

Bank Slope	
	Shallow Slope (0-5%)
	Intermediate Slope (6-30%)
	Steep Slope (31-70%)
	Very Steep Slope (>70%)

Bank Instability Ratings	
A	Aggrading
E	Eroding
S	Slumping
G	Gullying

Capture Methods		
	BP	Electrofishing - Backpack
	EF	Electrofishing - Boat
	GN	Gill Net
	SN	Seine
	FF	Fish Fence
	MT	Minnow Trap
	AN	Angling
	HN/TN	Hoop Net/Trap Net

General	
C	Photo Location/Direction
	Habitat Type Divider
	Fish Bearing/Potential Bearing Watercourse
	Width
	Depth



Notes:
ha = hectares
m = metres
mg/L = milligrams per litre
µS/cm = microsiemens per centimetre
Max depth was the depth recorded at sampling locations.

Legend

Wetland Ecosites

Swamps
- BS16-Black spruce/balsam poplar/river alder swamp

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- BS27-Sedge rocky shore

- Lake
- Waterbody

- Project Area
- Vegetation Local Study Area
- Terrestrial Regional Study Area

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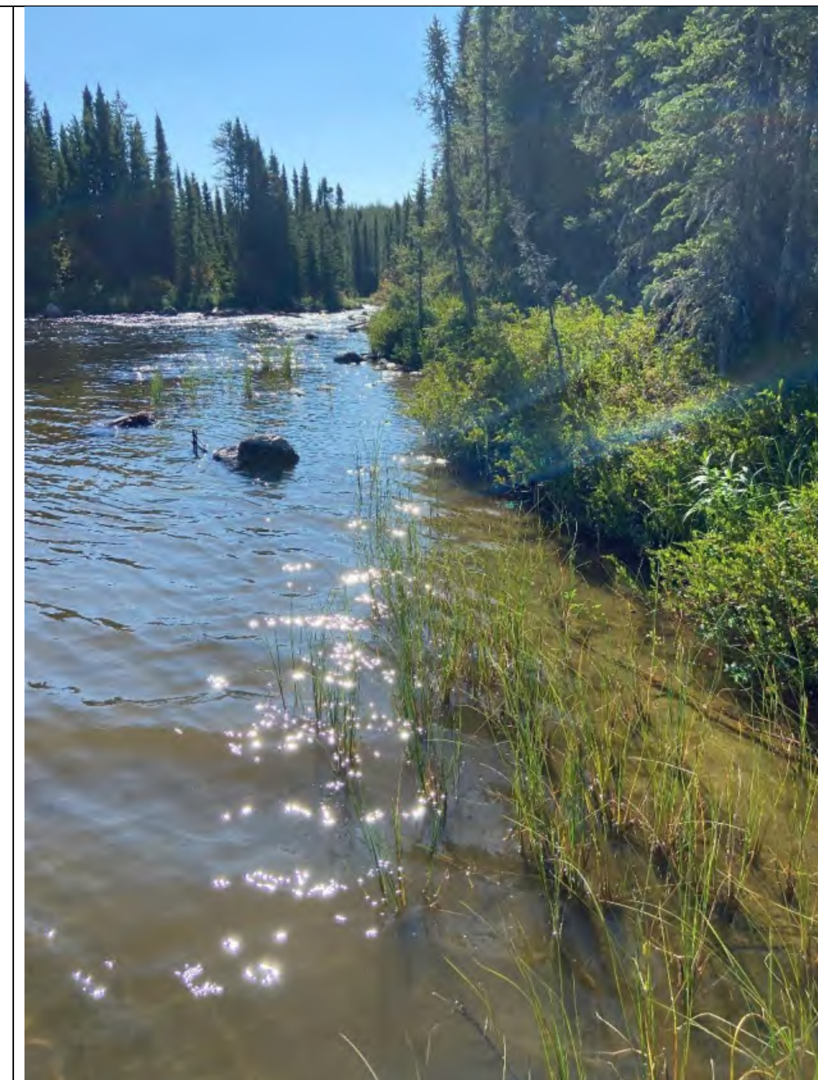
Area of interest at outlet of Whitefish Lake, August 16 2024: This area has stable banks and the substrate primarily composed of sand and detritus. The surrounding terrestrial vegetation was Black Spruce, Blue Spruce, and Jack Pine. The aquatic vegetation was Bur-reed and Potamogeton.		

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Notes from Appendix 8-B, Appendix F (2019):

SA-2 (Northwest Flow into McGowan Lake)
Station SA-2 is located to the northwest of McGowan Lake. A datalogger is not installed at this location. During the 2019 monitoring program it was learned that the cross-section had been moved in 2016 creating a discrepancy in water levels. The old cross-section was identified during the August field program and sufficient data are available to correct the July 2019 measurement (Table 2 and Figure 2). The original cross-section will be used for measurements in future field monitoring programs. Photo 3 is taken of the cross-section used during the July field program while Photo 4 is the original cross-section used in August.

Photo 3: SA-2 - July Field Program

Photo 4: SA-2 - August Field Program

Notes from Appendix 8-D (2016):

4.2 SA-2
Stream station SA-2 is situated within the Icelander River watershed, on the northwest tributary of McGowan Lake (LA-1), immediately upstream of the lake, approximately 800 m downstream of Whitefish Lake (LA-6) (see Figure 1-8). At this location the stream is 3rd order.

Aquatic Habitat
Mean wetted channel width, water depth and water velocity for the 285 m long surveyed reach were 9 m, 0.35 m and 1 m/s, respectively. The stream banks were stable and the channel was meandering with some braiding (see Appendix C, Photo 3). Within the surveyed reach, the stream gradient was mainly high to moderate. The stream morphology was mostly riffles (90%), with minor runs (5%) and pools (5%). The canopy was dense to partly open. Instream cover was primarily afforded by boulders and undercut banks, with minor contributions from logs and trees, deep pools and aquatic macrophytes. Substrates were comprised of 45% boulder, 40% cobble and 5% gravel, with trace amounts of sand and silt. Aquatic vegetation included sedges and horsetail (Equisetum sp.). Algal growth was moderate and no sediment were observed overlying the substrate. No barriers to fish migration were observed in the reach. The surrounding terrain was 90% upland and 10% lowland forest and observed riparian vegetation included jack pine, black spruce, alder (Alnus sp.), sweet gale, Labrador tea (Ledum groenlandicum) and willow. Stonefly nymphs and caddisfly larvae (Trichoptera) were observed. Stream habitat characteristics are detailed in Appendix A, Table A-15.

4.2.4 Fish Community
A summary of the fish community is presented in Table 4-4. Detailed fish catch data including fishing effort and numbers of each species collected are presented in Appendix A, Tables A-13, A-16. During the fall 2016 survey, 1,271 seconds of electrofishing effort was expended within a 285-m reach, resulting in the capture of 97 fish from 6 species. Slimy Sculpin were the most abundant species encountered, with 16 YOY, 19 juveniles and 35 adults collected. One YOY, 7 juvenile and 5 adult Lake Chub, 2 YOY and 5 juvenile Burbot, 2 YOY and 1 juvenile Northern Pike, 1 juvenile and 1 adult Arctic Grayling and 2 juvenile White Sucker were also captured. In addition, Walleye was observed but not captured. CPUE was 4.58 fish/minute of electrofishing. Eighteen adult White Suckers were captured by gillnet at this location during the spring 2017 survey. The list of fish species identified was reviewed by Bobby John, and is considered inclusive and comprehensive.

 Photo 3: Stream station SA-2 looking upstream (16 September 2016). This drainage area A station is situated on the northwest tributary of lake LA-1, immediately upstream of the lake, approximately 800 m downstream of lake LA-6.	 Photo 4: Stream station SA-2 looking downstream (16 September 2016). Use of the reach by White Sucker and Walleye for spawning was observed during the May 2017 spawning survey.	 **SA-2 facing upstream, March 2018.**

Notes from Appendix 8-B, Appendix D (2011): SA-2 Streamflow monitoring station SA-2 flows into the northwest end of LA-1. The monitoring station at SA-2 is located several meters downstream of the transition between an upstream meandering channel and a downstream riffle section. The monitoring site has a cross-section width of approximately 11 m, is relatively shallow with high velocity flow. The substrate is primarily composed of boulders and cobble, with well-defined and stable vertical banks vegetated with shrubs and trees. SA-2 produces a fair stage-discharge relationship; however the slope is nearly linear, so it may overestimate low and high flows. Further measurements at extreme flows would help verify the accuracy of this rating curve.	 Photo 2: SA-2 looking downstream. Photo taken July 30, 2011.

IR-107

- Department: CNSC, ECCC
- Project Effects Link: Aquatic environment
- Reference to EIS, appendices, or supporting documentation: Section 8.2.3.3, Existing Surface Water Quality

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, June 28, 2024)	IR (ROUND 4, Sept. 16, 2024)	Denison Response (ROUND 4, October 11, 2024)
IR-107	-	**Context:** Under the methodology and metrics section (8.2.3.1) it is stated baseline water quality was sampled in 2016, 2018, and 2019. Looking at the data in Appendix A of Appendix 8D it seems that some waterbodies have little data available for baseline characterization. For example, Whitefish Lake only has 3 and 5 samples taken between its two sample stations, with sampling frequency seeming intermittent. **Rationale:** The amount of data available for baseline water quality characterization does not seem sufficient to adequately characterize the baseline and the variation it would experience. An effective baseline characterization is vital to ensure water quality is indeed not being affected by the project. In addition, it is not clear if data quality objectives were applied to determine baseline information was adequate. To meet CEAA 2012 requirements, and CNSC expectations outlined in REGDOC 2.9.1, Environmental Principles Assessments and Protection Measures, the applicant is required to complete a characterization of the baseline environment. As described in REGDOC 2.9.1 Appendix B.2, Characterization of the Baseline Environment for Environmental Assessment Under CEAA 2012, the "baseline information should be sufficient to support the use of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity" In addition, the "applicant or licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed."	Please clarify what data quality objectives were used for the baseline characterization data. Please provide justification whether the number of datapoints collected with inconsistent frequency in baseline surface water characterization is sufficient to meet data quality objectives and to adequately characterize the baseline, and whether Denison is confident that the data collected is enough for a robust water quality baseline characterization. **Suggestions for mitigation and follow-up measures:** CNSC recommends that additional water samples are collected and analyzed at a consistent frequency to ensure a robust baseline	Surface water quality was sampled through 2016, 2018, and 2019 on a monthly basis which is generally consistent with federal requirements for assessing potential impacts through EA. Hydrological assessment has occurred from 2011 to 2019. Mean Annual Discharge (MAD) (m^3/s) as measured at the Water Survey Canada (WSC) Wheeler River Watershed Station (06DA005) during 2016, 2018 and 2019 was 17.07, 17.34 and 19.23, respectively, all of which were slightly above the 43 year (1977 to 2019) average of 16.82. The MAD in 2016 and 2018 can be considered near average, with 2019 being considered an average-high flow year, but well below the maximum observed for the timeseries (27.62 m^3/s). Since this period, there have been no land use changes within the area that would constitute a major change in water quality. Baseline water quality samples were collected during years of average to average-high flows in the Wheeler River system and therefore representative of background conditions for assessment of potential impacts in the EIS. Additional conservatism was included in the impact assessment by using the 95th percentile values for baseline parameter concentrations when modelling potential effluent effects. As such, the surface water quality data collected are suitable for the intended purpose of assessing potential impacts and the additional conservativisms that were included as part of the assessment were precautionary. Given the above, Denison feels strongly that the baseline water quality data collected are suitable for the purposes of the EIS and the application of additional conservatisms in the use of the data provide a conservative (i.e., protective) framework for evaluating potential effects. Denison commits to the collection of additional surface water quality baseline data prior to project development starting to ensure updated baseline information is available for identification of any changes that might influence estimates of Project impacts. These data will be used to support permitting and licensing through updates to the ERA.	This response has not been accepted. From the baseline water quality data table (Table A-1 of Appendix 8D) it remains unclear that water quality was sampled on a monthly basis in 2016, 2018, and 2019, mainly due to Table A-1 referring to specific sampling dates, instead of an mean value of 12 samples/year. It is also unclear which federal requirements Denison is referring to using in their response. Staff are supportive of continued baseline monitoring to maintain an accurate dataset of baseline conditions. CNSC and ECCC staff have the following expectations: 1. Provide the monthly monitoring data referenced in the response or indicate where it can be found within the EIS and its appendices. 2. Confirm which federal requirements were used when assessing potential impacts through EA. 3. Confirm which data quality objectives were used to establish the baseline, provide references if available 4. Incorporate the additional available baseline data collected into the analysis and conclusions of the finalized EIS and ERA to increase the robustness of the established baseline.	The response to this IR is provided in Attachment IR-107 (below).	Before this IR is accepted, the Proponent is requested to provide the statistical correlation analysis to confirm that data is correlated. Additionally, the four expectations set out in the rationale for status have not been adequately responded to. The Proponent should incorporate the following information into the EIS and ERA: 1. Provide raw baseline data (perhaps in an appendix). 2. Provide summary statistics for baseline datasets, which at a minimum should include: mean, standard deviation, 95th percentiles, minimum, maximum, and number of samples. Present summary statistics by season (i.e., freshet, summer, fall and under-ice), and include comparisons to relevant water quality guidelines. 3. Identify potential gaps in baseline datasets, and indicate how data gaps will be addressed. Describe the planned baseline monitoring to be conducted including, but not limited to, addressing any data gaps. 4. Demonstrate that the combined existing baseline data and planned baseline monitoring will yield dataset(s) that provide robust water quality baseline characterization of seasonal conditions (i.e., freshet, summer, fall, under-ice during winter), including a range of flow conditions. The Proponent should also incorporate the additional baseline data collected into the analysis and conclusions of the finalized EIS and ERA. Concerning the other aspects of the IR, these responses are accepted based on Denison's commitment to conduct periodic sampling prior to construction to strengthen existing environmental data. CNSC staff will review this information to ensure EA predictions remain valid and recommend collecting samples in the fall to spring timeframe, as samples from these seasons is sparse in the current dataset.	Information specific to the statistical correlation or consistency in data between waterbodies during baseline investigations is provided in Attachment IR-107-R3 (below). Additionally, the four expectations outlined by ECCC are discussed herein. 1. All raw baseline data was provided in Appendix A-1 of Appendix 8-D of the EIS. 2. Appendix A-1 of Appendix 8-D included the following: mean, SD, 75th percentile, 95th percentile, minimum, maximum, sample size (n) and screening against criteria by date. 3. Denison and its SME does not consider that there are data gaps per se, as it concerns the data used for the purpose of the EIS. Denison and its SME feel strongly that the baseline water quality data collected are suitable for the purposes of the EIS and the application of additional conservatisms in the use of the data provide a conservative (i.e., protective) framework for evaluating potential effects. The data are spatially robust (in that they cover various sampling nodes in potentially affected watersheds that at this time are all subject to the same land use (or lack thereof) and samples have been collected during multiple seasons. Denison is in agreement that regular water quality data collection should be instituted and commits (Commitment 8-48 to beginning such periodic sampling prior to construction to provide a more robust dataset and following the CCME Guidance Manual for Optimizing Water Quality Monitoring Program Design (2015). Sampling will be conducted monthly during the open water period and twice under ice. Any new water quality data will be integrated into Denison's application for a licence to operate, along with updated effluent quality data 4. As noted above, information specific to the statistical correlation or consistency in data between waterbodies during baseline investigations is provided in Attachment IR-107-R3 (below). Given the above (as well as the information provided in Attachment IR-107-R3), Denison and its SME do not feel additional analyses with additional baseline data are needed at this time, as suggested by ECCC, to inform EIS conclusions. Nevertheless, Denison will commit to update the analysis and predictions incorporating any new data collected during pre-construction baseline and licensing for operations, but there is no expectation that there would be any change to the EIS conclusions (see IRs 113, 114 and 115 for more detail in his regard).	Denison has addressed item 1 in the IR Round 3 requests, but has not adequately addressed items 2, 3 and 4. In Appendix A-1 of Appendix 8-D Denison has provided summary statistics; however, these summary statistics are for the pooled dataset and not for individual waterbodies and watercourses. Summary statistics should be provided for each individual waterbody/watercourse so that within and between-lake variation can be identified. Denison has not acknowledged or discussed current gaps and limitations in the baseline data and studies and has not demonstrated how the current baseline data is sufficiently robust to characterize natural variation. It is not clear how Denison meets the requirements of the Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012 (referred to as "The Guidelines" from this point forward). In The Guidelines Section 8.1 Baseline Environment, it states: "The EIS will include a description of the environment, including the components of the existing environment and environmental processes, their interrelations and interactions, and the variability in these components, processes, and interactions over time scales appropriate to the EIS. In characterizing the environmental effects of the project, the proponent will consider the current baseline environment and environmental trends within the project area." Denison currently has only conducted three water quality sampling events with one sample each in LA-5, on August 8th, 2012, April 1st, 2014, and September 10th, 2016. Not only is most of the data over 10 years old, but sampling was also only conducted in two seasons. It is not possible to adequately characterize environmental processes, trends and natural variation with the current dataset, and pooling data from multiple lakes further reduces the understanding of these factors. The correlation analysis that Denison provided in their supplemental information Round 3 response did not contain a statistical analysis comparing baseline data between sampled lakes in the LSA and RSA, therefore no determination could be made regarding the similarities between waterbodies. A comparison of mean percent differences between pooled datasets does not conclude that there is no significant difference without supporting statistical tests. Additionally, at no point was LA-5 the primary receiving waterbody compared individually to other waterbodies, LA-5 data continued to be pooled with data from other lakes to form the Key Assessed Lakes pooled dataset, which was then compared to the full LSA dataset. Pooling data, use of reference lake data with exposure lake data in pooled datasets, and use of the geometric mean are all uncertainties and data limitations that should be acknowledged and addressed as minimizing the ability to detect natural variation, including seasonal variation, within-lake	*Note: Denison and the CNSC had a number of meetings and discussions on this Round 4 IR between Sept. 16, 2024 and October 9, 2024. The response provided here is focused on the central questions coming out of these discussions.* Routine surface water quality sampling has started at the Wheeler River Project site. Denison made the commitment to collect additional pre-operational surface water quality data in commitment 8-48 and this work has been initiated. The list of surface water quality sampling stations, sample frequency, and analyte list is included in Attachment IR-107 (Round 4). For the CNSC's consideration, a comparison of June, July, August, and September 2024 water samples collected at Whitefish Lake (LA-5) is provided in Attachment IR-107 (Round 4) Table 1. As shown in the table, the results collected in 2024 are within the range (minimum to maximum) of pooled results for both the full LSA dataset and key assessed lakes. The majority of minor differences between recently collected samples and pooled datasets are related to differences in analytical detection limits. We note that a low-level trace metal analysis was used in 2024 and this resulted in lower detection limits for some parameters compared to previous results. We note that pooling of data to establish a background is not an uncommon approach. For example, such an approach is contemplated by Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives (CCME 2003). This procedure acknowledges the use of "regional" data to derive background concentrations assuming the sites from which data are used "… are generally located nearby the site under consideration but have not been adversely affected by human activities." This description is accurate for the Wheeler River Project aquatic LSA which is in an unimpacted, remote area of Saskatchewan's boreal forest. We refer the reviewer to Appendix 10-A, Appendix A Section 3.2 for consideration of modelled average water baseline concentrations of COPCs and a comparison to measured values. The plots show trends over time for selected COPCs and the generally good agreement between the measured and modelled concentrations. Based on the data presented and methodology provided in relevant guidance, the baseline water quality data collected are suitable for the purposes of the EIS and the application of additional conservatisms in the use of the data provide a conservative (i.e., protective) framework for evaluating potential effects. As shown in Attachment IR-107 (Round 4) Table 2, surface water quality sampling will be conducted monthly during the open water period and twice

									variation at sampling sub-stations, year-to-year variation and between-lake variation. The requests below will serve to satisfy the principles of the Precautionary Approach and address these deficiencies. <u>In order to resolve this IR, Denison are expected to:</u> 1. Meet the requirements of the CNSC's guiding principles for protection of the environment REGDOG 2.9.1 Section 2.1 that "the licensee's license application shall demonstrate (through performance assessments, monitoring or other assessments) that their environmental protection measures are assessed against performance indicators and targets that are based on sound science", Denison should provide a statistical analysis including a power analysis comparing LA-5 baseline water quality data individually to other waterbody water quality data to determine if there is a statistically significant difference between water quality at various sites in the LSA. Denison should provide the methodology they will use to conduct the statistical analysis and power analysis for CNSC review and acceptance prior to completing the analysis. Pending the results of the statistical analysis: a. If the statistical analysis demonstrates that there is not enough statistical power to detect a significant difference between waterbodies, or that there is enough power and a significant difference between LA-5 and other waterbodies in the LSA, Denison will be required to provide additional baseline data to update the modelling during the EA process and update risk and significance conclusions as needed. b. If the statistical analysis demonstrates that there is enough statistical power to detect a significant difference and that there is no statistical difference between LA-5 and the other waterbodies in the LSA, then Denison will not be required to provide further baseline data for the purposes of the EA, however Denison will still be expected to conduct further baseline characterization as per their commitments to collect more baseline data. Denison is also expected to still satisfy the other requirements in this IR. 2. If currently available, incorporate any existing new data (post-2019) into the baseline dataset and update the analysis for submission in the finalized	under ice. Per CNSC licensing requirements, the new water quality data along with updated effluent quality data will be integrated into the environmental risk assessment used to support Denison's application for a CNSC licence to operate and prior to effluent release to Whitefish Lake.

									EIS. Modelling should incorporate: a. Near-field modelling (LA-5) should utilize the 95th percentile values of data measured at LA-5 (i.e., not the pooled dataset); and b. Far-field modelling of the downstream environment should utilize the 95th percentile values of the pooled dataset. c. Water quality predictions should be updated accordingly. 3. Provide a commitment that, prior to the detailed design phase/ licensing to construct, the Proponent will: a. Conduct additional baseline monitoring to yield dataset(s) that provide robust water quality baseline characterization of seasonal conditions (i.e., freshet, summer, fall, under-ice during winter), including data collection for a range of flow conditions, at the receiver (LA-5) and downstream monitoring locations. At a minimum, data collection should prioritize collecting baseline water quality data for the immediate receiving environment (LA-5); b. Update the baseline water quality characterization of seasonal conditions for LA-5 using the 95th percentile values of data measured at LA-5 (i.e., not the pooled dataset) and downstream environment using the 95th percentile values of location-specific data instead of pooled data. c. Update the water quality modelling and predictions of risk as needed.	

Attachment IR-107 (included in Round 2 submission)

Denison's Response:

The water quality sampling for baseline was conducted over several years from 2011 to 2019. In years 2015 and 2017 sampling did not occur. Sampling occurred during the open water period and most consistently in May, June, August, September and October. The reviewer is correct in that sampling did not occur on a monthly basis at each of the sampling locations over all years. The table below provides a summary of the periodicity of sampling as it occurred over the described period at each station.

Station ID	2011		2012			2013		2014		2016	2018		2019		Total
	May	Jun	May	Aug	Oct	Aug	Oct	Mar	Apr	Sep	Mar	Jul	Jul	Aug	
Lakes															
LA-1		1		1				1		1	1	1			6
LA-2		1						1		1					3
LA-3		1						1		1					3
LA-4								1		1					2
LA-5				1					1	1					3
LA-6				1				1		1	1	1			5
LA-7				1				1		3					5
LA-8										1					1
LA-9										1					1
LAB-1				1				1		1					3
LAB-2										1					1
LB-1										1					1
LB-2									1	1					2
LB-3				1					1	2					4
LA-1											1	1			2
Sub-Total	*0*	*3*	*0*	*6*	*0*	*0*	*0*	*7*	*3*	*17*	*3*	*3*	*0*	*0*	*42*
Streams															
SA-1	1	1	1	1	1	1	1	1					1	1	10
SA-2	1	1	1	1	1	1	1	1					1	1	10
SA-3	1	1	1	1	1	1	1	1					1	1	10
SA-4	1	1	1	1	1	1	1	1					1	1	10
SA-5	1	1	1	1	1	1	1	1					1	1	10
SA-6	1		1	1	1	1	1		1				1	1	9
SB-1	1	1	1	1	1	1	1	1							8
SB-2	1	1	1	1	1	1	1								7
SB-3	1	1	1	1	1	1	1	1							8
SB-4	1	1	1	1	1	1	1								7
SB-5	1		1	1	1	1	1	1							7
Sub-Total	*11*	*9*	*11*	*11*	*11*	*11*	*11*	*8*	*1*	*0*	*0*	*0*	*6*	*6*	*96*
Total	11	12	11	17	11	11	11	15	4	17	3	3	6	6	138

1. The table above identifies that monthly sampling was not completed at each station on an annual basis.
2. For the purposes of the EA, a statistical analysis was conducted to identify the correlation between the water quality data for LA-1, LA-5, LA-6, and McGowen Lake and the full dataset for the LSA. Datasets were highly correlated and therefore the full dataset for the LSA was used as background concentrations in the IMPACT model. This approach was taken to meet the criteria of REGDOC 2.9.1 Appendix B.2, Characterization of the Baseline Environment for Environmental Assessment Under CEAA 2012, the "baseline information should be sufficient to support the use

of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity".

3. Samples were collected following applicable field protocols and analysis was conducted by CALA accredited laboratories. The conceptualization of sampling in this remote location loosely followed the CCME Guidance Manual for Optimizing Water Quality Monitoring Program Design (2015). However, due to the remote nature during the baseline sampling, monthly sampling was not deemed feasible.
4. There are no additional data to add to the analysis at this time for either the near-field or far-field water quality models. It is noted that some addition sampling occurred at Whitefish Lake offshore in the general, vicinity of the proposed discharge (diffuser) location in 2022 and continued in 2023. The concentration of constituents from samples collected in 2022 and 2023 were in the range of those measured previously and as a result no changes to the outcomes of the analyses presented in the Draft EIS and its supporting documents would be expected. Denison agrees that regular water quality data collection at a wider range of sampling stations should be instituted and commits to beginning such periodic sampling prior to construction to provide a more robust dataset and following the CCME Guidance Manual for Optimizing Water Quality Monitoring Program Design (2015). These data would be used to support the licensing process and contribute to the longer term data records for the site.

Attachment IR-107 (Round 3 submission)

Water quality of the waterbodies within the local study area (LSA) of the Wheeler River Project was surveyed over the period 2011 through 2019 as part of the aquatic environment baseline studies. Generally, surface waters within the LSA are soft and have typically low levels of alkalinity, nutrients (nitrate and phosphorus), total dissolved solids, and total suspended solids. The pH of surface waters within the LSA is slightly acidic to neutral. The concentrations of metals and metalloids are similar throughout the study area. Radionuclide concentrations are low, with the majority of measurements lower than their respective laboratory detection limits.

To determine which dataset was more appropriate to be used as baseline concentrations in the IMPACT model for the purposes of the Environmental Assessment, a statistical analysis of water quality data was undertaken to identify the correlation between the water quality data for only the key assessed lakes (LA-1, LA-5, LA-6, LA-7, and Russell Lake) and the full dataset for all waterbodies surveyed within the LSA.

For the purposes of the Environmental Assessment, a statistical analysis was undertaken to identify the correlation between water quality data from the key assessed lakes (LA-1, LA-5, LA-6, LA-7 and Russell Lake) and from the full dataset for the local study area (LSA), to determine which dataset was more appropriate for use as background concentrations in the IMPACT model.

The following provides methods and results and a summary of findings of this analysis.

Water quality data for lakes and creeks in the LSA were obtained for multiple monitoring events from June 2011 to September 2019. The data consisted of measurements of chemical parameters including physical tests (e.g., major ions and metals concentrations), nutrient tests (e.g., ammonia), and radionuclides (e.g., Pb-210). Data were inputted into the Ecometrix database software Environmental Monitoring Modeling Application (EMMA) and contained indicators for when measurements were less than the reported detection limit (RDL). The parameters examined herein are those chemicals of potential concern (COPC) for purposes of the Environmental Assessment (Table 1).

For the comparison, summary statistics were generated for two datasets: the full dataset and a subset of the key assessed lakes and creeks that link the key assessed lakes. The summary statistics including the number of measured samples (N), the number of measured samples below the reported detection limit (N<RDL), the minimum, the 95th percentiles, the maximum, and the geometric mean and standard deviation were calculated for both datasets using EMMA. For measurements below RDL, the detection limit value was used when generating summary statistics. Finally, the percent difference between geometric mean values of the two datasets were calculated per COPC.

The mean percent difference of key assessed lakes relative to the full LSA dataset across all COPC's was 0% (n = 24) with a minimum absolute percent difference of 0% and an absolute maximum percent difference of 16%. There were 20/24 (83%) with an absolute maximum percent difference of 5% and 22/24 (92%) with an absolute maximum percent difference of 10% (Table 1).

These low percent differences indicated that the datasets are highly correlated and because the full dataset also contained more datapoints and waterbodies, the full dataset for all waterbodies surveyed within the LSA was deemed most appropriate to be used as baseline concentrations in the IMPACT model.

Table 1 Summary statistics and percent difference calculations for COPC water quality parameters in the full LSA dataset (shaded) and key assessed lakes (unshaded).

Category	Parameter	Units	N	N <RDL	N	N <RDL	Minimum	Minimum	95th Percentile	95th Percentile	Maximum	Maximum	Geometric Mean	Geometric Mean	Geometric SD	Geometric SD	Δ% (Geometric Mean)
Physical Tests	Specific Conductivity	µS/cm	156	0	100	0	8	8	26	26.2	47	47	17.31	17.095	1.3065	1.3474	**-1**
	Calcium	mg/L	142	0	86	0	1	1.1	2.	2.075	3.9	3.9	1.4077	1.4296	1.2471	1.2782	**2**
	Chloride	mg/L	142	7	86	1	<0.1	<0.1	0.7	0.6	0.9	0.7	<0.3223	<0.38561	1.7409	1.4232	**16**
	Magnesium	mg/L	142	1	86	0	<0.1	0.2	0.6	0.575	0.7	0.7	<0.39237	0.39888	1.2924	1.2429	**2**
	Sodium	mg/L	142	0	86	0	0.9	1.2	1.8	1.8	2.1	2.1	1.4632	1.5212	1.1545	1.1145	**4**
	Sulphate	mg/L	142	1	86	1	<0.2	<0.2	1.1	0.9	8.3	8.3	<0.68732	<0.67743	1.6206	1.7778	**-1**
	Arsenic	mg/L	142	53	86	33	<0.0001	<0.0001	0.0001	0.0001	0.0003	0.0002	<0.00010327	<0.00010081	1.1697	1.0776	**-2**
	Cadmium	mg/L	142	90	86	58	<1.00E-05	<1.00E-05	0.00003	0.00003	0.00007	0.00007	<0.000012007	<0.000012025	1.4949	1.5272	**0**
	Chromium	mg/L	142	142	86	86	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	1.	1.	**0**
	Cobalt	mg/L	142	138	86	86	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.00010098	<0.0001	1.0854	1.	**-1**
	Copper	mg/L	142	139	86	84	<0.0002	<0.0002	<0.0002	<0.0002	0.0008	0.0008	<0.00020394	<0.00020489	1.1522	1.181	**0**
	Lead	mg/L	142	135	86	83	<0.0001	<0.0001	<0.0001	<0.0001	0.0012	0.0012	<0.0001055	<0.00010595	1.3574	1.385	**0**
	Molybdenum	mg/L	142	136	86	81	<0.0001	<0.0001	<0.0001	<0.000175	0.0013	0.0013	<0.00010684	<0.00011065	1.4246	1.5624	**3**
	Nickel	mg/L	142	101	86	79	<0.0001	<0.0001	<0.0003	<0.0001	0.0006	0.0004	<0.00011447	<0.00010376	1.4116	1.2247	**-10**
	Selenium	mg/L	142	140	86	85	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0002	<0.00010049	<0.00010081	1.0599	1.0776	**0**
	Uranium	mg/L	142	141	86	86	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.00010049	<0.0001	1.0599	1.	**0**
	Vanadium	mg/L	142	110	86	78	<0.0001	<0.0001	<0.0002	<0.0001	0.0005	0.0003	<0.00010733	<0.00010129	1.2805	1.1258	**-6**
	Zinc	mg/L	142	95	86	58	<0.0005	<0.0005	<0.00278	<0.00235	0.02	0.02	<0.00068059	<0.00069751	1.8847	1.9699	**2**
Nutrients	Ammonia as N	mg/L	142	104	86	59	<0.01	<0.01	<0.0595	<0.05	1.2	0.91	<0.014626	<0.014875	2.2367	2.1715	**2**
	Nitrate	mg/L	103	70	63	45	<0.04	<0.04	<0.436	<0.35	0.66	0.6	<0.067313	<0.0661	2.4855	2.4298	**-2**
Radionuclides	Lead-210	Bq/L	142	136	86	81	<0.02	<0.02	<0.02	<0.02	0.05	0.05	<0.020402	<0.020502	1.1181	1.1306	**0**
	Polonium-210	Bq/L	142	112	86	75	<0.005	<0.005	<0.008	<0.007	0.02	0.01	<0.0053637	<0.0051995	1.2182	1.1453	**-3**
	Radium-226	Bq/L	142	98	86	59	<0.005	<0.005	<0.00995	<0.00975	0.01	0.01	<0.0055717	<0.0055727	1.2272	1.2315	**0**
	Thorium-230	Bq/L	142	138	86	82	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.010098	<0.010163	1.0854	1.1108	**1**

(shaded)	Full LSA dataset
(unshaded)	Key assessed lakes dataset

Notes: N is number of lakes/creek sampling locations; SD is standard deviation.

Attachment IR-107 (Round 4 submission):

Attachment IR-107 (Round 4) Table 1: Summary statistics and percent difference calculations for COPC water quality parameters in the full LSA dataset (shaded) and key assessed lakes (unshaded) (from IR-107 Round 3) and updated at Round 4 to include water quality results from water samples collected at Whitefish Lake (LA-5) in June, July, August, and September 2024.

Category	Parameter	Units	N	N <RDL	N	N <RDL	Minimum	Minimum	95th Percentile	95th Percentile	Maximum	Maximum	Geometric Mean	Geometric Mean	Geometric SD	Geometric SD	Δ% (Geometric Mean)	Whitefish Lake (LA-5) June 22, 2024		Whitefish Lake (LA-5) July 18, 2024		Whitefish Lake (LA-5) August 16, 2024		Whitefish Lake (LA-5) September 10, 2024	
																		Result	Within range of previous samples	Result	Within range of previous samples	Result	Within range of previous samples	Result	Within range of previous samples
Physical Tests	Specific Conductivity	µS/cm	156	0	100	0	8	8	26	26.2	47	47	17.31	17.095	1.3065	1.3474	**-1**	**20**	**Yes**	**15**	**Yes**	**16**	**Yes**	**14**	**Y**
	Calcium	mg/L	142	0	86	0	1	1.1	2.	2.075	3.9	3.9	1.4077	1.4296	1.2471	1.2782	**2**	**1.12**	**Yes**	**1.3**	**Yes**	**1.3**	**Yes**	**1.3**	**Y**
	Chloride	mg/L	142	7	86	1	<0.1	<0.1	0.7	0.6	0.9	0.7	<0.3223	<0.38561	1.7409	1.4232	**16**	**<1.0**	**Higher than max[1]**	**<1.0**	**Higher than max[1]**	**<1.0**	**Higher than max[1]**	**<1.0**	**Higher than max[1]**
	Magnesium	mg/L	142	1	86	0	<0.1	0.2	0.6	0.575	0.7	0.7	<0.39237	0.39888	1.2924	1.2429	**2**	**0.32**	**Yes**	**0.4**	**Yes**	**0.4**	**Yes**	**0.4**	**Y**
	Sodium	mg/L	142	0	86	0	0.9	1.2	1.8	1.8	2.1	2.1	1.4632	1.5212	1.1545	1.1145	**4**	**1.37**	**Yes**	**1.6**	**Yes**	**1.6**	**Yes**	**1.6**	**Y**
	Sulphate	mg/L	142	1	86	1	<0.2	<0.2	1.1	0.9	8.3	8.3	<0.68732	<0.67743	1.6206	1.7778	**-1**	**9.2**	**Higher than max but an order of magnitude below long-term benchmark (EIS Table 8.2-2). Additionally, compared to the pooled max, this result is within the range of method variability**	**0.5**	**Yes**	**0.4**	**Yes**	**0.5**	**Y**
	Arsenic	mg/L	142	53	86	33	<0.0001	<0.0001	0.0001	0.0001	0.0003	0.0002	<0.00010327	<0.00010081	1.1697	1.0776	**-2**	**0.000094**	**Lower than min**	**0.00011**	**Yes**	**0.00014**	**Yes**	**0.0001**	**Y**
	Cadmium	mg/L	142	90	86	58	<1.00E-05	<1.00E-05	0.00003	0.00003	0.00007	0.00007	<0.000012007	<0.000012025	1.4949	1.5272	**0**	**0.000005**	**Lower than min**	**<0.00002**	**Lower than min**	**0.000003**	**Lower than min**	**0.000002**	**Lower than min**
	Chromium	mg/L	142	142	86	86	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	1.	1.	**0**	**0.0002**	**Lower than min**	**0.00009**	**Lower than min**	**0.00064**	**Higher than max but below long-term benchmark (EIS Table 8.2-2). The concentration of dissolved Cr in the same sample was 0.0001 mg/L, suggesting an issue with particulates**	**0.0001**	**Lower than min**
	Cobalt	mg/L	142	138	86	86	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.00010098	<0.0001	1.0854	1.	**-1**	**0.00001**	**Lower than min**	**0.000011**	**Lower than min**	**0.000035**	**Lower than min**	**0.000014**	**Lower than min**
	Copper	mg/L	142	139	86	84	<0.0002	<0.0002	<0.0002	<0.0002	0.0008	0.0008	<0.00020394	<0.00020489	1.1522	1.181	**0**	**0.0001**	**Lower than min**	**<0.00007**	**Lower than min**	**<0.00007**	**Lower than min**	**<0.00007**	**Lower than min**
	Lead	mg/L	142	135	86	83	<0.0001	<0.0001	<0.0001	<0.0001	0.0012	0.0012	<0.0001055	<0.00010595	1.3574	1.385	**0**	**<0.00002**	**Lower than min**	**<0.00001**	**Lower than min**	**0.00002**	**Lower than min**	**<0.00001**	**Lower than min**
	Molybdenum	mg/L	142	136	86	81	<0.0001	<0.0001	<0.0001	<0.000175	0.0013	0.0013	<0.00010684	<0.00011065	1.4246	1.5624	**3**	**< 0.00005**	**Lower than min**	**0.00002**	**Lower than min**	**0.00002**	**Lower than min**	**0.00002**	**Lower than min**
	Nickel	mg/L	142	101	86	79	<0.0001	<0.0001	<0.0003	<0.0001	0.0006	0.0004	<0.00011447	<0.00010376	1.4116	1.2247	**-10**	**0.00019**	**Yes**	**0.00005**	**Lower than min**	**0.00009**	**Lower than min**	**0.00006**	**Lower than min**
	Selenium	mg/L	142	140	86	85	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0002	<0.00010049	<0.00010081	1.0599	1.0776	**0**	**< 0.00004**	**Lower than min**	**0.00002**	**Lower than min**	**0.00003**	**Lower than min**	**<0.00002**	**Lower than min**
	Uranium	mg/L	142	141	86	86	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.00010049	<0.0001	1.0599	1.	**0**	**<0.000005**	**Lower than min**	**0.000005**	**Lower than min**	**0.000005**	**Lower than min**	**0.000016**	**Lower than min**
	Vanadium	mg/L	142	110	86	78	<0.0001	<0.0001	<0.0002	<0.0001	0.0005	0.0003	<0.00010733	<0.00010129	1.2805	1.1258	**-6**	**<0.0002**	**Yes**	**<0.0001**	**Yes**	**<0.0001**	**Yes**	**<0.0001**	**Y**
	Zinc	mg/L	142	95	86	58	<0.0005	<0.0005	<0.00278	<0.00235	0.02	0.02	<0.00068059	<0.00069751	1.8847	1.9699	**2**	**<0.001**	**Yes**	**0.0003**	**Lower than min**	**0.0005**	**Yes**	**0.0004**	**Lower than min**
Nutrients	Ammonia as N	mg/L	142	104	86	59	<0.01	<0.01	<0.0595	<0.05	1.2	0.91	<0.014626	<0.014875	2.2367	2.1715	**2**	**<0.05**	**Yes**	**<0.01**	**Yes**	**<0.01**	**Yes**	**<0.01**	**Y**
	Nitrate	mg/L	103	70	63	45	<0.04	<0.04	<0.436	<0.35	0.66	0.6	<0.067313	<0.0661	2.4855	2.4298	**-2**	**<0.10**	**Yes**	**<0.04**	**Yes**	**<0.04**	**Yes**	**<0.04**	**Y**
Radionuclides	Lead-210	Bq/L	142	136	86	81	<0.02	<0.02	<0.02	<0.02	0.05	0.05	<0.020402	<0.020502	1.1181	1.1306	**0**	**<1**	**Higher than max[1]**	**<0.02**	**Yes**	**<0.02**	**Yes**	**<0.02**	**Y**
	Polonium-210	Bq/L	142	112	86	75	<0.005	<0.005	<0.008	<0.007	0.02	0.01	<0.0053637	<0.0051995	1.2182	1.1453	**-3**	**<0.010**	**Yes**	**<0.005**	**Yes**	**0.007**	**Yes**	**0.008**	**Y**
	Radium-226	Bq/L	142	98	86	59	<0.005	<0.005	<0.00995	<0.00975	0.01	0.01	<0.0055717	<0.0055727	1.2272	1.2315	**0**	**<0.010**	**Yes**	**<0.005**	**Yes**	**<0.005**	**Yes**	**0.005**	**Y**
	Thorium-230	Bq/L	142	138	86	82	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.010098	<0.010163	1.0854	1.1108	**1**	**<0.010**	**Yes**	**0.01**	**Yes**	**<0.01**	**Yes**	**<0.01**	**Y**

(shaded)	Full LSA dataset
(unshaded)	Key assessed lakes dataset

Notes: N is number of lakes/creek sampling locations; SD is standard deviation.

Analysis of 2024 samples included low-level trace metal analysis, resulting in lower detection limits for some parameters compared to previous results.

[1] These 2024 results were higher than pooled maximum value because of a higher detection limit.

Attachment IR-107 (Round 4) Table 2: Wheeler River Project sampling locations, frequencies, and parameters for the pre-operational surface water monitoring program

Station ID	Description	Sampling frequency	Water quality and water chemistry parameters
SA4	LA6 inlet tributary	Monthly during the open water period and twice under ice.	Field water quality measurements (dissolved oxygen, pH, conductivity, temperature) and water chemistry laboratory analysis (the following analytes are currently included in surface water quality monitoring: Bicarbonate; Carbonate; Chloride; Chloride, dissolved; Hydroxide; P. alkalinity; pH; Specific conductivity; Sum of ions; Total alkalinity; Total hardness; Ammonia as nitrogen; Nitrate; Total Kjeldahl nitrogen; Mercury; Methylmercury; Organic carbon; Organic carbon, dissolved; Fluoride; Total dissolved solids; Lead-210; Polonium-210; Radium-226; Thorium-228; Thorium-230; Thorium-232; Calcium; Calcium, dissolved; Magnesium; Magnesium, dissolved; Potassium; Potassium, dissolved; Sodium; Sulfate; Sulfate, dissolved; Aluminum; Aluminum, dissolved; Antimony; Antimony, dissolved; Arsenic; Arsenic, dissolved; Barium; Barium, dissolved; Beryllium; Beryllium, dissolved; Bismuth; Bismuth, dissolved; Boron; Boron, dissolved; Cadmium; Cadmium, dissolved; Chromium; Chromium, dissolved; Cobalt; Cobalt, dissolved; Copper; Copper, dissolved; Iron; Iron, dissolved; Lead; Lead, dissolved; Lithium; Lithium, dissolved; Manganese; Manganese, dissolved; Molybdenum; Molybdenum, dissolved; Nickel; Nickel, dissolved; Rubidium; Rubidium, dissolved; Selenium; Selenium, dissolved; Silicon, soluble; Silicon, soluble, dissolved; Silver; Silver, dissolved; Strontium; Strontium, dissolved; Sulfur; Sulfur, dissolved; Thallium; Thallium, dissolved; Tin; Tin, dissolved; Titanium; Titanium, dissolved; Uranium; Uranium, dissolved; Vanadium; Vanadium, dissolved; Zinc; Zinc, dissolved; Zirconium; Zirconium, dissolved; Phosphorus; Phosphorus, dissolved. Note that metal analysis (both total and dissolved) are being done using a low-level analytical techniques)
SA5	LA6 inlet tributary		
LA6	Whitefish Lake (north)		
LA5	Whitefish Lake (south)		
LA1	McGowan Lake		
LAB1	Russell Lake		

IR- 114

- Department: ECCC, CNSC
- Project Effects Link Change to an environmental component due to hazardous contaminants
- Reference to EIS, appendices, or supporting documentation: Section 8.2.4.2.3 and Section 8.2.4.2.4

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 5, 2024)	IR (ROUND 4, Sept. 6, 2024)	Denison Response (ROUND 4, October 15 2024)
IR-114	-	**Context:** Tables 8.2-9, 8.2-10 and 8.2-13 demonstrate predicted maximum effluent concentrations of COPCs and maximum predicted receiving environment concentrations in the near- and far-field. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, TSS and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. For zinc, it is unclear how guidelines have been calculated when CCME thresholds can only be derived with hardness values <250 mg/L. Additionally, water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. Mercury has been identified as a COPC of interest to Indigenous groups for the proposed Project. Table 8.2-8 indicates that background concentrations of mercury in LA-5 are low, and predicted effluent concentrations are also low. However, no information has been provided on background methylmercury concentrations or expected atmospheric deposition of mercury from Project related emissions. Predicted effluent concentrations of 3915 mg/L of sulphate are quite high, and sulphate is known to increase mercury methylation rates in aquatic environments. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment. ECCC recommends the use of the most stringent guidelines for the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds. Increased sulphate availability can lead to increased methylation rates of mercury and methylmercury in sediment and surface water. Methylmercury is a toxin that can bioaccumulate within the food chain and present risks to aquatic biota and wildlife consuming aquatic biota. Potential changes to methylmercury concentrations in water quality, sediment and fish tissues should be assessed due to the proposed sulphate loadings in effluent. Additionally, in accordance with the MDMERs, Denison will be required to demonstrate that their effluent quality meets the limits in the MDMER. Denison is expected to provide the predicted effluent quality for lead, nickel, and un-ionized ammonia to demonstrate compliance with the MDMERs.	1. Update all tables to include all COPCs with required monitoring under the MDMER including acute and chronic thresholds. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. 3. Provide baseline data on the concentrations of methylmercury in surface water, sediment and fish tissues (i.e., large- bodied sports fish and small-bodied forage fish) in the LSA and RSA receiving environment to establish a baseline prior to potential Project impacts. 4. Provide an assessment of risk from methylmercury to ecological receptors due to changes in sulphate concentrations in effluent, and potential deposition of mercury from Project related atmospheric emissions in the receiving environment.	See response in Attachment IR-114.	This response has not been accepted. The Proponent has not updated all tables to include missing data for mercury, aluminum, total suspended solids, iron, thallium, manganese, nitrate, and phosphorous, all of which are COPCs with monitoring requirements under the MDMER. The Proponent has not updated tables to include predictions of total hardness concentration in effluent and the receiving environment or acute water quality thresholds, and water quality thresholds have not been derived using baseline receiving environment concentrations. All water quality thresholds should be derived from receiving environment parameters to determine if any baseline receiving environment and effluent COPCs exceed water quality thresholds. Please: 1. Update all tables to include missing data for mercury, aluminum, total suspended solids, iron, thallium, manganese, nitrate and phosphorus. 2. Update tables to include predictions of total hardness concentrations (in mg/L CaCO3) in effluent and the receiving environment. 3. Update tables to include acute water quality thresholds to ensure COPCs do not have the potential to be acutely lethal at the end-of-pipe. 4. Ensure that all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota.	Please see Attachment IR-114. Briefly, Tables 8.2-9, 8.2-10 and 8.2-13 have been updated in the revised Draft EIS as requested.	In response to the FIRT's previous review, Denison provided responses to the following outstanding requests from ECCC: 1. Update all tables to include missing data for mercury, aluminum, total suspended solids, iron, thallium, manganese, nitrate and phosphorus. 2. Update tables to include predictions of total hardness concentrations (in mg/L CaCO3) in effluent and the receiving environment. 3. Update tables to include acute water quality thresholds to ensure COPCs do not have the potential to be acutely lethal at the end-of-pipe. 4. Ensure that all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. The Proponent has resolved item two and four of the above, but items one and three require additional follow up. Regarding item one, further corrections to Table 8.2-13 are necessary: • There are several inconsistencies in the footnotes: ○ numbers 2 & 3 are missing in the footnotes at the bottom; ○ there is no reference to footnote 2 in the table; and ○ The asterisk "*", which is sometimes used to qualify the source of screening concentration, is not defined. • Screening criteria are missing for aluminum and iron, and should be sourced from CCME or SEQG rather than the MDMER as listed in the table. • Uranium-234 and uranium-238 are missing from the table, even though they have been identified as contaminants of potential concern. • Proposed screening criteria for cobalt, copper, manganese, nickel, phosphorous and un-ionized ammonia are inadequate, see comment in IR-108 & IR-108-R1.	Item 1 – further corrections to Table 8.2-13 have been made (please see updated Table 8.2-13 in Attachment IR-114-R3) as follows: • Footnotes were restructured and are provided in Attachment IR-114-R3 for each of the tables that were updated. • Screening criteria were added for aluminum and iron, and sourced from CCME or SEQG. • Uranium-234 and uranium-238 were added to the table. • Proposed screening criteria for cobalt, copper, manganese, nickel, phosphorous and un-ionized ammonia were changed as applicable and are consistent with other tables as associated with IR-108 & IR-108-R1. • Un-ionized ammonia is updated to only be provided in one line. The first line provided previously was associated with a miscalculation of the un-ionized ammonia value and was the unionized ammonia-N value. The values provided as part of Attachment IR-114-R3 should be considered correct for unionized ammonia for comparison against the guideline. • The column with screening values now is consistent across all tables that are presented as part of Section 8 and in Attachments for IRs 108/108-R1, 114 and 115. • Table 8.2-14 was updated with corrections to screening criteria necessary for this IR as well as for IR-108 and IR-115 (please see Attachment IR-114-R3). • Table 8.2-10 was updated to include the source for the short-term screening criteria value for arsenic (please see Attachment IR-114-R3 for updated Table 8.2-10.	In a supplementary submission provided on July 5th, Denison provided corrections to some tables. However, errors and conflicting information remain within and between tables. In order to resolve this IR, Denison are expected to correct the following issues: 1) Provide the following updates to Tables 8.2-8, 8.2-10, 8.2-13, and 8.2-14 to correct the errors outlined. Additionally, in Table 8.2-13 MDMER Schedule 4, the maximum authorized effluent concentration limits are not appropriate for use as short-term benchmark water quality guidelines. The Schedule 4 limits are only applicable to effluent and represent concentrations in effluent that cannot be exceeded at end-of-pipe, not to receiving environment surface water concentrations, and are not a reliable indicator of acutely lethal concentrations of constituents in receiving environment surface water. • Tables 8.2-8 and 8.2-10: A)Temperature: long-term screening criteria is "ambient temp" and should be updated to "narrative", as has been used in updated Tables 8.2-2. The narrative is already included in the footnotes of Table 8.2-8 and 8.2-10, so the tables should be updated as well. • Table 8.2-13: A) Cadmium: both short-and long-term benchmarks are erroneous and should be corrected to values found in updated Table 8.2-2. B) Chloride: long-term benchmark is erroneous and should be corrected to value found in updated Table 8.2-2. C) Iron, Lead-210, and Uranium-234 & -238: long-term benchmarks are missing and should be the same values found in updated Table 8.2-2 or Table 8.2-8. Alkalinity and nitrate have been added to the table as requested, however predicted maximum concentrations are only presented for Whitefish Lake Middle and South. The proponent should describe why there are no estimates for these parameters in other lakes, and how they intend to fill these gaps. •Table 8.2-14: A.The removal of constituents of potential concern from future centuries review need to be justified by the proponent. Otherwise, all parameters included in Table 8.2-13 should also be included in Table 8.2-14. Presently alkalinity, nitrate, uranium-234 & -238 are missing. B.Uranium: the long-term screening concentration is erroneous and should be corrected to the value found in all other tables. •Footnotes: A.The footnotes for each table should reflect what is in the table. B.All tables: acronyms used in the references that need explanations in the footnotes include: "CCME", "HC", "BC MOE", "FEQG" and "MDMER". C.All tables: explanations in the footnotes for acronyms that were not used in the tables: "SSWQO", "TKN", and "TOC".	1) The updates were completed as requested. In Table 8.2-13 MDMER Schedule 4 maximum authorized effluent limits were removed and tables updated. Tables 8.2-8 and 8.2-10 A) Table were updated to include "narrative" rather than "ambient temp" as requested. Table 8.2-13: A) Cadmium values were checked and were correct, however, chloride values were incorrect and had the cadmium footnote associated with them. This was corrected. B) Chloride long term benchmark was corrected to the value found in Table 8.2-2. C) Iron, Lead-210 and Uranium-234 and Uranium-238 long-term benchmarks were missing but have been added as per the values consistent with Table 8.2-2 and 8.2-8. D) Alkalinity and nitrate were not collected for other locations during baseline assessments. It is intended that these constituents will be added to the pre-construction water sampling suite of parameters to ensure consistency and completeness for additional analysis conducted for licencing. Table 8.2-14 A) **Nitrate**: Nitrate was not included in the Geochemical Reactive Transport Model (Appendix 7C of the Final EIS) as it is not considered a COPC associated with the ISR mining process for this project. Nitrate concentrations were below laboratory reported detection limits in the metallurgical testing, where tested, as shown in Table F-2 of Appendix 7C of the EIS. Further, nitrate concentrations are, with one exception for a groundwater monitoring well in overburden (GWR-036), below or very close to the laboratory reported detection limit, as shown in Table D-2 of Appendix 7C of the Final EIS. Baseline nitrate concentrations are low (< 0.5 mg/L) in surface water bodies assessed for the

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 5, 2024)	IR (ROUND 4, Sept. 6, 2024)	Denison Response (ROUND 4, October 15 2024)
							• Alkalinity and nitrate have been added to the table as requested, however predicted maximum concentrations are only presented for Whitefish Lake Middle and South. The proponent should describe why there are no estimates for these parameters in other lakes, and how they intend to fill these gaps. • Un-ionized ammonia appears in two separate lines in the table with concentrations differing by 3-4 orders of magnitude and different screening values. A single line entry with accurate values should be retained. The Proponent should provide an explanation for the error in order to give the reviewer confidence that the correct values are retained. • The column with screening values does not always use the most conservative value from Table 8.2-8. See comment IR-115 for request to provide justifications. Table 8.2-14 should be updated with corrections to screening criteria necessary for this IR as well as for IR-108 and IR-115. Additional follow up for Table 8.2-10 can be found under IR-108 and IR-108-R1. In the Proponent's response to item three of the IR, Table 8.2-10 is missing the source for the short-term screening criteria value for arsenic. The Proponent should update Table 8.2-10 to include the source for the short-term screening criteria value for arsenic.		Removing these would increase clarity. D.Footnote "*" should be removed. It explains how ammonia concentration is calculated and is not referred to in Tables 8.2-8, 8.2-10 & 8.2-13. In Table 8.2-14 it is associated by cadmium, which does not make sense. E. Footnote (4) should be removed. It states the short-term screening criterion for chloride limit is "*Based on water hardness >0 to <17 mg/L*". This appears erroneous since neither the CCME guideline nor the SEQG is hardness based. F. Tables 8.2-13 & 8.2-14 do not refer to the footnotes "TDS", "narrative", (4) and (7), and removing them would help clarity. 2) CNSC/ECCC staff agree that the minor baseline exceedances of copper concentrations in water do not constitute the use of a guideline that is a magnitude of order greater than the copper FEQG. The copper FEQG guideline is the most restrictive guideline and based on current science and site-specific conditions, whereas the CCME guideline is quite dated and does not incorporate the use of site-specific environmental modifying factors. As there are background concentrations of copper that do exceed the copper FEQG, there is the potential that biota may already be stressed due to these exceedances. However, there is not currently enough baseline characterization data within the immediate receiving environment to conclude the level of risk to receptors and if there are consistent exceedances of water quality guidelines. Following the principles of the Precautionary Approach, to be conservative Denison are expected to: A) Update the screening criteria used for the EIS and ERA (and all relevant tables) to utilize the more stringent FEQG guideline of 0.0002 mg/L as calculated using the currently available baseline data. B) Update the ERA effects assessment for copper to utilize the FEQG with regards to selected Toxicity Reference Values (TRVs) and risk characterization to receptors. C) Collect further baseline data in the immediate receiving environment (LA-5) to adequately characterize copper concentrations in water and sediment quality and any potential exceedances of baseline water quality guidelines.	project, as reported in Table 8.2.2 of Chapter 8 of the final EIS. Nitrate concentrations are thus expected to remain at baseline levels in future centuries. A note has been added to Table 8.2-14 to indicate that nitrate is not a COPC in the future centuries and as such is expected to remain at baseline levels. **Alkalinity:** was included in the Geochemical Reactive Transport Model (Appendix 7C of the Final EIS) but not included in the future centuries assessment in IMPACT. Using the output from the geochemical reactive transport model (i.e., the mass flux of alkalinity, reported as "C" in Table 4-4 of Appendix 7C of the Final EIS), the approach and input parameters used in the IMPACT model (described in Appendix A to Appendix 10-A of the Final EIS), and assuming that alkalinity (as bicarbonate ion primarily at the circumneutral pH value Whitefish Lake) does not interact with the sediments, maximum alkalinity values in Whitefish Lake (LA-5) were calculated to be 8.1 mg/L as CaCO3 versus the mean baseline value of 7.7 mg/L as CaCO3 (Table 8.2-2 of Chapter 8 of the Final EIS). This value has been included in Table 8-2.14, is within the range of baseline alkalinity values observed in that lake (3-15 mg/L as CaCO3 in Whitefish Lake South (LA-5)) and represents a 5.2 % increase from mean baseline concentrations. The alkalinity in the future centuries was not calculated for the other lakes as changes with respect to baseline conditions will be negligible (i.e., not outside of the range of values in each lake observed at baseline). **U-234 and U-238**: Uranium was modelled in the future centuries scenario and U-234 and U-238 (Bq/L) were calculated. The results have been added to Table 8.2-14. B) Uranium long-term screening value was

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 5, 2024)	IR (ROUND 4, Sept. 6, 2024)	Denison Response (ROUND 4, October 15 2024)
										updated to be consistent with all other tables Footnotes: A) Footnotes for each table have been updated B) All table acronyms have been explained as applicable. C) Acronyms that were not used in a table were removed from the footnotes D) "*" has been removed from the document where explaining ammonia concentration calculation. E) Confirmed that this statement was correct. Footnote 4 was removed from all tables, and all footnote numbering adjusted to reflect changes. F) TDS and "Narrative" footnotes were removed. Footnote 7 was missing in the table, so was added. Footnote 4 removed from all tables. 2) A) The screening criteria used for the EIS and ERA (and all relevant tables) has been updated to utilize the more stringent FEQG guideline of 0.0002 mg/L. See Attachment IR-114 Round 4. B) The TRVs have been re-evaluated using the FEQG Biotic Ligand Model. See Attachment IR-114 Round 4. C) Denison is committed to collection of further baseline data in the immediate receiving environment (LA-5) to adequately characterize copper concentrations in water (refer to response to Round 4 IR-107 for water quality results from Whitefish Lake from June to September 2024) and sediment quality and any potential exceedances of water quality guidelines and this information will be further presented and analyzed as part of licencing.

Attachment: IR-114 (included in Round 1 Submission)

1) Please see updated Tables 8.2-9 and 8.2-10 from the draft EIS below. Water quality predictions for the well mixed portion of LA-5 for each of the three flow scenarios (described in Section 8.2.4.2.3 and Table 8.2-7 of the draft EIS) are provided in the updated Table 8.2-10 below. Predicted site discharge concentrations that exceed respective receiver WQOs are bolded. Chloride, sulphate, TDS, arsenic, cadmium, chromium, cobalt, copper, selenium, and uranium, thorium-230, radium-226, lead-210, and polonium-210 predicted discharge concentrations are above receiver WQOs. However, under all three flow scenarios, the predicted water quality for all constituents is below respective WQOs within the well mixed portion of LA-5, indicating that sufficient dilution is present within LA-5 to meet objectives. Updated Table 8.2-13 is provided below. Water quality predictions have been added for MDMER constituents listed under Schedule 4 and Schedule 5. There are no predicted exceedances of water quality guidelines for any of the COPCs during Construction, Operation, or Decommissioning

2) The predictive water quality analysis considered the effects of toxicity modifying factors, such as hardness, on water quality. Specifically, the analysis considered induced hardness - that is hardness that is derived from or includes contributions from on site sources and in this case discharge from the IWWTP. It is a reasonable in this case to utilize induced hardness since the water quality assessment directly considers the potential effect of IWWTP discharge on the receiving environment. The hardness added to the receiver from the discharge represents a constant source during periods of discharge. The effluent hardness value used in the analysis was derived from bench scale testing and is considered to be a reasonable estimate of expected hardness in effluent. With that in mind, the predictive water quality analysis reflects the water quality conditions that are anticipated to prevail in the receiver and therefore presents an appropriate platform on which to base the effects assessment.

3) The table below (IR-114 Table 1) shows a summary of baseline concentrations of total mercury in surface water within the LSA. Sediment was not analyzed for mercury during previous baseline surveys. Baseline water quality in the LSA and RSA showed no indication of total mercury present above detectable limits and as such, the potential for methyl-mercury to be detected was unlikely. Generally, 60 to 95% of total mercury concentrations in fish muscle tissues are present in the form of methyl-mercury. Table 8.5-2 of Section 8.5 of the EIS provides a full summary of tissue constituent concentrations for key species from the Icelander River and Russell Lake. A conservative approach of assuming 95% of mercury in the tissues is present in the methylated form could be used for comparative purposes. These data supplemented with more current baseline data for water, sediment and fish tissues specific to total and methyl-mercury prior to the onset of site development will provide a robust database for comparative purposes during the subsequent development and operation on site.

4) Consistent with CSA N288.1-20, Clause 5.1.5, atmospheric depositions to large water bodies such as lakes, are considered negligible; therefore, the air to surface water pathway has been excluded for the ecological risk assessment. The rationale for exclusion of atmospheric deposition to lakes and rivers is explained in detail in Section G9, Appendix G of the COG DRL Guidance Document (Hart, 2019). Typical transfer parameters from source to air and source to water are on a similar magnitude to each other. The transfer parameter from air to water is orders of magnitude lower indicating that atmospheric deposition to the lake would have a negligible effect. Rationale on the exclusion of the air to water pathway can be included in the ERA in Appendix 10-A. The

following statement will be added to Section 2.2 in Appendix A to Appendix 10-A "Atmospheric deposition to Whitefish Lake is considered negligible. This is consistent with the COG DRL guidance (COG, 2019) which shows (assuming a modest flow rate for a lake of 0.1 m/s and an assumed water depth of 10 m) that the transfer of constituents from the atmosphere to large bodies of water (including lakes and rivers) is considered negligible."

As baseline surface water did not identify measurable concentrations of total mercury in the LSA or RSA (See IR-114 Table 1 below) and deposition to large water bodies such as lakes is not likely to contribute to the methyl mercury concentration in the Wheeler River receiving waters, it is most reasonable to conclude that changes in total and methyl mercury can be adequately monitored in relation to sulphate inputs. Denison will undertake monitoring of total and methyl mercury as it relates to the discharge of sulphate to Whitefish Lake.

References: Hart, D. 2019. Derived Release Limits Guidance. COG-06-3090R4-I

Table 8.2-9: Predicted Effluent Water Quality (Updated to include MDMER Constituents)

Constituent	Unit	Discharge Concentration (max predicted)
Chloride	mg/L	**600**
Sulphate (Hardness)	mg/L	**3915**
Sulphate	mg/L	**3915**
TDS	mg/L	**6420**
TSS	mg/L	6
Arsenic	mg/L	**0.006**
Cadmium	mg/L	**0.0018**
Chromium	mg/L	**0.025**
Cobalt	mg/L	**0.0030**
Copper	mg/L	**0.022**
Lead	mg/L	0.0003
Molybdenum	mg/L	2.5
Nickel	mg/L	0.014
Selenium	mg/L	**0.042**
Uranium	mg/L	**0.057**
Vanadium	mg/L	0.059
Zinc	mg/L	0.042
Mercury	mg/L	0.000001
Ammonia (as N)	mg/L	3.9
Un-ionized Ammonia*	mg/L	0.0078
Phosphorus	mg/L	N/A
Thorium-230	Bq/L	**0.9**
Radium-226	Bq/L	**0.15**
Lead-210	Bq/L	**0.419**
Polonium-210	Bq/L	**0.15**

Note: * - Calculated value

Table 8.2-10: Near-field Receiving Water Quality Results (Updated to include MDMER Constituents)

Constituent	Unit	Screening Concentration	Source of Screening Concentration	Predicted Site Discharge Concentration	LA-5 Well Mixed (7Q10)	LA-5 Well Mixed (Monthly Low)	LA-5 Well Mixed (Average)
Chloride	mg/L	120	SEQG/CCME	**600**	10.06	6.18	4.69
Sulphate (Hardness)	mg/L	429	BC MOE*	**3915**	63.83	38.51	28.76
Sulphate	mg/L	128	BC MOE	**3915**	63.83	38.51	28.76
TDS	mg/L	500	SEQG	**6420**	131.41	90.06	74.13
TSS	mg/L	15	Schd 4 - MDMER	6	3.9	3.9	3.9
Arsenic	mg/L	0.01	SEQG/CCME	**0.006**	0.00020	0.00016	0.00014
Cadmium	mg/L	0.0003	SEQG/CCME*	**0.0018**	0.00005	0.00004	0.00003
Chromium	mg/L	0.001	SEQG/CCME	**0.025**	0.00090	0.001	0.00068
Cobalt	mg/L	0.0003	FEQG	**0.0030**	0.00015	0.00013	0.00012
Copper	mg/L	0.004	SEQG/CCME*	**0.022**	0.00055	0.00041	0.00036
Lead	mg/L	0.005	CCME	0.0003	0.0001	0.0001	0.0001
Molybdenum	mg/L	0.07	WHO	2.5	0.040	0.024	0.018
Nickel	mg/L	0.07	WHO	0.014	0.0003	0.0002	0.0002
Selenium	mg/L	0.001	SEQG/CCME	**0.042**	0.0008	0.001	0.0004
Uranium	mg/L	0.02	SEQG/CCME	**0.057**	0.0010	0.0006	0.0005
Vanadium	mg/L	0.12	FEQG	0.059	0.0011	0.0007	0.0005
Zinc	mg/L	0.1	FEQG**	0.042	0.0018	0.0015	0.0014
Mercury	mg/L	0.000026	SEQG/CCME	0.000001	0.00001	0.00001	0.00001
Ammonia (as N)	mg/L	5.74	SEQG/CCME	3.9	0.13	0.11	0.10
Un-ionized Ammonia	mg/L	1.00	MDMER Sched 4	0.0078	0.00008	0.00006	0.00006
Phosphorus	mg/L	0.015	BC MOE	N/A	0.01	0.01	0.01
Thorium-230	Bq/L	0.6	HC	**0.9**	0.024	0.019	0.016
Radium-226	Bq/L	0.11	SEQG	**0.15**	0.008	0.007	0.007
Lead-210	Bq/L	0.2	HC	**0.419**	0.026	0.024	0.023
Polonium-210	Bq/L	0.1	HC	**0.15**	0.007	0.006	0.006

Notes
(1) **Bolded values** are those that exceed the screening concentrations
Un-ionized ammonia calculated value
* Hardness induced guideline, assuming hardness >250 mg/L
** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L

Table 8.2-13: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water (Updated to include available MDMER Constituents)

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Screening Concentration	Source of Screening Concentration
Chloride	mg/L	0.32	0.32	6.14	6.11	4.20	4.16	3.26	120	SEQG/CCME
Sulphate	mg/L	0.69	0.69	38.66	38.49	26.03	25.75	19.88	128	BC MOE
Arsenic	mg/L	0.00012	0.00011	0.00015	0.00015	0.00013	0.00013	0.00012	0.01	SEQG/CCME
Cadmium	mg/L	0.000024	0.000023	0.000040	0.000039	0.000033	0.000033	0.000030	0.0003	SEQG/CCME*
Chromium	mg/L	0.000530	0.0005	0.0007	0.0007	0.0007	0.0007	0.0006	0.001	SEQG/CCME
Cobalt	mg/L	0.000101	0.000101	0.000129	0.000128	0.000119	0.000119	0.000114	0.0003	FEQG
Copper	mg/L	0.00062	0.00062	0.00082	0.00082	0.00075	0.00075	0.00072	0.004	SEQG/CCME*
Lead	mg/L	0.000124	0.000114	0.000118	0.000130	0.000114	0.000114	0.000116	0.005	CCME
Molybdenum	mg/L	0.0001	0.0001	0.0243	0.0240	0.0158	0.0156	0.0118	0.07	WHO
Nickel	mg/L	0.00039	0.00038	0.00051	0.00050	0.00046	0.00046	0.00044	0.07	WHO
Selenium	mg/L	0.000034	0.00003	0.00043	0.00041	0.00026	0.00026	0.00020	0.001	SEQG/CCME
Uranium	mg/L	0.00003	0.00003	0.00057	0.00055	0.00034	0.00033	0.00025	0.02	SEQG/CCME
Vanadium	mg/L	0.00017	0.00015	0.00067	0.00056	0.00033	0.00033	0.00027	0.12	FEQG
Zinc	mg/L	0.00070	0.00069	0.00106	0.00103	0.00090	0.00090	0.00084	0.1	FEQG**
Ammonia (as N)	mg/L	0.01463	0.01463	0.05232	0.05215	0.03978	0.03950	0.03368	5.74	SEQG/CCME
Un-ionized Ammonia	mg/L	0.0000086	0.0000086	0.0000309	0.0000308	0.0000235	0.0000233	0.0000199	1.00	MDMER Sched 4
Thorium-230	Bq/L	0.01014	0.01012	0.01868	0.01854	0.01569	0.01563	0.01430	0.6	HC
Radium-226	Bq/L	0.0057	0.0056	0.0069	0.0067	0.0063	0.0063	0.0061	0.11	SEQG
Lead-210	Bq/L	0.0062	0.0057	0.0084	0.0083	0.0067	0.0067	0.0064	0.2	HC
Polonium-210	Bq/L	0.0063	0.0058	0.0067	0.0072	0.0062	0.0062	0.0062	0.1	HC
Mercury	mg/L	No background information or effluent concentration to model								
Aluminum		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
TSS		Will be mitigated through design and treatment and monitored as per CCME and MDMER Sched 4 criterion								MDMER Sched 4
Iron		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Thallium		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Manganese		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5
Phosphorus		Monitoring required under MDMER Schedule 5 - no criteria stipulated under this regulation								MDMER Sched 5

Notes

(1) Bolded values are those that exceed the screening concentrations

* Hardness induced guideline, assuming hardness >250 mg/L

** Hardness induced guideline, assuming hardness >250 mg/L, pH=7.0, DOC = 5.26 mg/L

Un-ionized ammonia represented by calculated values

IR-114 Table 1: Total and Dissolved Mercury Concentrations in the LSA and RSA

Parameter	Total Mercury, Dissolved	Total Mercury
Units	mg/L	mg/L
Total Count	40	59
Count (<RDL)	39	46
Minimum	<1.00E-05	<1.00E-07
5th Percentile	<1.00E-05	<8.20E-07
50th Percentile	<1.00E-05	<1.00E-05
95th Percentile	<1.00E-05	<1.00E-05
Maximum	<1.00E-05	<1.00E-05
Arithmetic Mean	<1.00E-05	<7.63E-06
StdDev	2.76E-12	3.70E-06
Std Error	0	4.81E-07
Geometric Mean	<1.00E-05	<5.38E-06
Geometric StdDev	1.	3.281

Notes:

1. The summary time is between 01-Jan-2010 and 31-Dec-2021.

2. The reporting locations are: "LA-1", "LA-1-Bottom", "LA-5", "LA-6", "LAB-1", "LAB-2", "SA-1", "SA-2", "SA-3", "SA-6".

Attachment IR-114 (included in Round 2 submission)

The requested tables have been updated to include water quality thresholds derived from receiving environment parameters (background) as well as effluent induced concentrations for completeness. Please see the tables below and updated in Section 8 of the EIS.

Table 8.2-9: Predicted Effluent Water Quality

Constituent	Unit	Predicted Discharge Concentrations (Max Expected)
General Chemistry, Nutrients and Anions		
Alkalinity	mg/L	12.4
Ammonia (as N)	mg/L	3.9
Un-Ionized Ammonia	mg/L	4.74
Hardness	mg/L (as CaCO3)	250
Conductivity	µS/cm	21.7
Nitrate	mg/L	0.249
pH	pH Unit	7
Phosphorus	mg/L	N/A
Sulphate	mg/L	2600
TDS	mg/L	6420
Temperature	deg C	16.5
TSS	mg/L	6
Chloride	mg/L	600
Metals		
Aluminum	mg/L	0.051
Arsenic	mg/L	0.006
Cadmium	mg/L	0.0018
Chromium	mg/L	0.025
Cobalt	mg/L	0.0027
Copper	mg/L	0.02
Cyanide	mg/L	NA
Iron	mg/L	0.0039
Lead	mg/L	0.0003
Manganese	mg/L	0.03
Mercury	mg/L	0.00001
Molybdenum	mg/L	2.5
Nickel	mg/L	0.0138
Selenium	mg/L	0.042
Strontium	mg/L	1.68
Thallium	mg/L	0.0006
Uranium	mg/L	0.057
Vanadium	mg/L	0.059
Zinc	mg/L	0.042
Radiological		
Lead-210	Bq/L	0.42
Polonium-210	Bq/L	0.15
Radium-226	Bq/L	0.15
Thorium-230	Bq/L	0.9
Uranium-238	Bq/L	0.7
Uranium-234	Bq/L	0.7

Table 8.2-10: Near-field Receiving Water Quality Results

Parameter	Units	Short-term Screening Criteria (background hardness)	Short-term Screening Criteria (Hardness induced [>250 mg/L])	Source	Note	Long-term Screening Criteria (background hardness)	Long-term Screening Criteria (Hardness induced [>250 mg/L])	Source	Note	Discharge Concentration (max predicted)	LA-5 Well Mixed (7Q10)	LA-5 Well Mixed (Monthly Low)	LA-5 Well Mixed (Average)
General Chemistry, Nutrients and Anions													
Alkalinity	mg/L	--	--	--	--	--	--	--		12.4	12.4	12.4	12.4
Ammonia (as N)	mg/L	--	--	--	--	5.74	5.74	SEQG/CCME	(4)	3.9	0.13	0.11	0.1
Un-Ionized Ammonia	mg/L	--	--	--	--	6.98	6.98	SEQG/CCME	(4)	4.74	0.08	0.05	0.03
Hardness	mg/L	--	--	--	--	--	--	--	--	250	9	8	7
Conductivity	µS/cm	--	--	--	--	--	--	--	--	21.7	21.7	21.7	21.7
Nitrate	mg/L	550	550	CCME		3	3	SEQG	--	0.249	0.249	0.249	0.249
pH	pH units	--	--	--	--	6.5-9.0	6.5-9.0	SEQG/CCME	--	7	7	7	7
Phosphorus	mg/L	--	--	--	--	0.02 - 0.035	0.02 - 0.035	CCME	(17)	0.03	0.0103	0.0102	0.0101
Sulphate	mg/L	--	--	--	--	128	429	BC MOE	(12)	2600	43	26	19
TDS	mg/L	--	--	--	--	500	500	SEQG	--	6420	131	90	74
Temperature	°C	--	--	--	--	ambient temp	ambient temp	--	--	16.5	15	15	15
TSS	mg/L	15	15	MDMER Schedule 4	(22)	background + 5 mg/L	background + 5 mg/L	CCME	--	6	4	4	4
Chloride	mg/L	640	640	SEQG/CCME	(6)	120	120	SEQG/CCME	(6)	600	10	6	5
Metals													
Aluminum	mg/L	--	--	--	--	0.1	0.1	SEQG/CCME	(5)	0.051	0.0	0.0	0.0
Arsenic	mg/L	0.1	0.1	[	--	0.005	0.005	SEQG/CCME	--	0.006	0.000	0.000	0.000
Cadmium	mg/L	0.00011	0.0053	SEQG/CCME	(18)	0.00004	0.00034	SEQG/CCME	--	0.0018	0.00005	0.00004	0.00003
Chromium	mg/L	--	--	--	--	0.001	0.001	SEQG/CCME		0.025	0.001	0.001	0.001
Cobalt	mg/L	--	--	--	--	0.000295	0.00149	FEQG	(10)	0.0027	0.000142	0.000125	0.000119
Copper	mg/L	0.0009	0.00004	SEQG	(19)	0.002	0.004	CCME	--	0.02	0.001	0.000	0.000
Cyanide	mg/L	--	--	--	--	--	--	--	--	N/A	0.0	0.0	0.0
Iron	mg/L	--	--	--	--	0.3	0.3	SEQG/CCME	--	0.0039	0.178	0.179	0.180
Lead	mg/L	--	--	--	--	0.001	0.007	SEQG/CCME	(8)	0.0003	0.000	0.000	0.000
Manganese	mg/L	0.501	15	CCME	(3)	0.26	0.64	SEQG/CCME	(3)	0.03	0.020	0.020	0.020
Mercury	mg/L	--	--	--	--	0.000026	0.000026	CCME	--	0.00001	0.000010	0.000010	0.000010
Molybdenum	mg/L	--	--	--	--	0.07	0.07	WHO	(16)	2.5	0.04	0.02	0.02
Nickel	mg/L	--	--	--	--	0.07	0.07	WHO	(16)	0.0138	0.00	0.00	0.00
Selenium	mg/L	--	--	--	--	0.001	0.001	CCME	--	0.042	0.001	0.001	0.000
Strontium	mg/L	--	--	--	--	205	2.5	FEQG	(11)	1.68	0.04	0.03	0.03
Thallium	mg/L	--	--	--	--	0.0008	0.0008	SEQG/CCME	--	0.0006	0.0002	0.0002	0.0002
Uranium	mg/L	0.033	0.033	CCME		0.015	0.015	SEQG/CCME	--	0.057	0.001	0.001	0.001
Vanadium	mg/L	--	--	--	--	0.12	0.12	FEQG	(13)	0.059	0.0011	0.0007	0.00
Zinc	mg/L	0.008	0.204	CCME	(9)(20)	0.007	0.058	CCME	(9)(23)	0.042	0.002	0.001	0.001
Radiological													
Lead-210	Bq/L	--	--	--	--	0.2	0.2	HC	--	0.42	0.026	0.024	0.023
Polonium-210	Bq/L	--	--	--	--	0.1	0.1	HC	--	0.15	0.007	0.006	0.006
Radium-226	Bq/L	--	--	--	--	0.11	0.11	SEQG	--	0.15	0.008	0.007	0.007
Thorium-230	Bq/L	--	--	--	--	0.6	0.6	HC	--	0.9	0.024	0.019	0.016
Uranium-238	Bq/L	--	--	--	--	3	3	HC	--	0.7	0.013	0.008	0.006
Uranium-234	Bq/L	--	--	--	--	3	3	HC	--	0.7	0.013	0.008	0.006

Notes:

(1) Saskatchewan Water Quality Objectives, SEQG on-line (https://envrbrportal.crmp.saskatchewan.ca/seqg-search/), SEQG for the protection of aquatic life were selected, based on total concentrations, a temperature of 15°C and a pH of 7.0.

(2) Hardness dependent WQOs are for very soft water (hardness <25 mg $CaCO_3$/L). Site-specific hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(3) Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Manganese, Appendix B - Canadian Water Quality Guidelines Calculator (pH = 7.5, hardness = 15 mg/L). Guideline is based on dissolved manganese. Benchmark = exp(0.878[ln(hardness)] + 4.76) where the benchmark is expressed in dissolved manganese concentration (µg/L), and hardness is measured as CaCO3 equivalents in mg/L.

(4) Total ammonia-N calculated from the total ammonia guideline for a temperature of 15°C and a pH of 7.0, Un-ionized Ammonia from Table 1 of temperature and pH Canadian Water Quality Guidelines for the Protection of Aquatic Life - Ammonia (https://ccme.ca/en/res/ammonia-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf)

(5) Based on a pH of >6.5.

(6) Based on water hardness >0 to <17 mg/L.

(7) Based on water hardness >0 to <82 mg/L.

(8) Based on water hardness >0 to ≤60 mg/L equation used at hardness of 5.26. At hardness >180 mg/L, the CWQG is 7 µg/L

(9) Guideline is based on dissolved zinc.

(10) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and site-specific baseline hardness of 15 mg/L.

(11) ECCC 2020. Federal Environmental Quality Guidelines Strontium. July.

(12) BC MECCS 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf

(13) Environment Canada 2016. Federal Environmental Quality Guidelines, Vanadium. May.

(14) Health Canada 2020. Guidelines for Canadian Drinking Water Quality Summary Table. September. https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/summary-table-EN-2020-02-11.pdf

(15) BC MECCS 2020. Source Drinking Water Quality Guidelines, Guideline Summary Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch .

(16) WHO 2017. Guidelines for Drinking Water Quality. Fourth Edition Incorporating The First Addendum.

(17) Framework - guideline for meso-eutrophic waterbody 20-35 µg/L

(18) Based on water hardness of >0 to <5.3 mg/L

(19) Based on hardness of 5 mg/L (Short-term equation is ($e^{\{0.979123[\ln(hardness)]-8.64497\}}$)*1000 (SEGQ via AEP 1996b)

(20) Based on benchmark = exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). Site-specific background hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6). Site-specific DOC is 2.2 (arithmetic mean for LA-5 and LA-6), induced hardness of 250.5 used as upper limit of extrapolation available.

(21) based on water hardness of > 250 mg/L ($CaCO_3$) (251 mg/L)

(22) MDMER Schedule 4 - maximum authorized monthly mean concentration

(23) Bold numbers indicate exceedance of long-term criteria

SEQG – Saskatchewan Environmental Quality Guidelines – Water Quality Guidelines for Freshwater Aquatic Life.

CWQG – Canadian Council of Ministers of the Environment – Canadian Water Quality Guidelines for the Protection of Aquatic Life.

SSWQO – Saskatchewan Surface Water Quality Objectives.

DOC – Dissolved organic carbon.

TDS – Total dissolved solids.

TKN – Total Kjeldahl Nitrogen.

TOC – Total organic carbon.

TSS – Total suspended solids.

Table 8.2-13: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Screening Criteria	Source of Screening Concentration	Notes
Alkalinity(1)	mg/L	NE	NE	12.4	12.4	NE	NE	NE	--	--	
Aluminum	mg/L	0.01766	0.01616	0.01835	0.02226	0.01500	0.01499	0.01614		MDMER Sched 5	(5)
Ammonia (as N)	mg/L	0.01463	0.01463	0.05232	0.05215	0.03978	0.0395	0.03368	5.74	SEQG/CCME	(4)
Un-ionized Ammonia	mg/L	0.01770	0.01770	0.06331	0.06310	0.04813	0.04780	0.04075	6.98	SEQG/CCME	(4)
Arsenic	mg/L	0.00012	0.00011	0.00015	0.00015	0.00013	0.00013	0.00012	0.005	SEQG/CCME	
Cadmium	mg/L	0.000024	0.000023	0.00004	0.000039	0.000033	0.000033	0.00003	0.0003	SEQG/CCME*	
Chloride	mg/L	0.32	0.32	6.14	6.11	4.2	4.16	3.26	120	SEQG/CCME	(6)
Chromium	mg/L	0.00053	0.0005	0.0007	0.0007	0.0007	0.0007	0.0006	0.001	SEQG/CCME	
Cobalt	mg/L	0.000101	0.000101	0.000129	0.000128	0.000119	0.000119	0.000114	0.0003	FEQG	(10)
Copper	mg/L	0.00062	0.00062	0.00082	0.00082	0.00075	0.00075	0.00072	0.004	SEQG/CCME*	
Iron	mg/L	0.0467	0.0424	0.0470	0.0567	0.0400	0.0400	0.0425		MDMER Sched 5	
Lead	mg/L	0.000124	0.000114	0.000118	0.00013	0.000114	0.000114	0.000116	0.005	CCME	(8)
Lead-210	Bq/L	0.0062	0.0057	0.0084	0.0083	0.0067	0.0067	0.0064	0.2	HC	
Manganese	mg/L	0.001674	0.001524	0.001722	0.001867	0.001593	0.001590	0.001593	0.64	SEQG/CCME	(3)
Mercury	mg/L	0.0000053	0.0000053	0.0000053	0.0000053	0.0000053	0.0000053	0.0000053	0.000026	CCME	
Molybdenum	mg/L	0.0001	0.0001	0.0243	0.024	0.0158	0.0156	0.0118	0.07	WHO	(16)
Nickel	mg/L	0.00039	0.00038	0.00051	0.0005	0.00046	0.00046	0.00044	0.07	WHO	(16)
Nitrate(1)	mg/L	NE	NE	0.249	0.249	NE	NE	NE	3	SEQG	
Phosphorus(1)	mg/L	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	0.02 - 0.035	CCME	(17)
Polonium-210	Bq/L	0.0063	0.0058	0.0067	0.0072	0.0062	0.0062	0.0062	0.1	HC	
Radium-226	Bq/L	0.0057	0.0056	0.0069	0.0067	0.0063	0.0063	0.0061	0.11	SEQG	
Selenium	mg/L	0.000034	0.00003	0.00043	0.00041	0.00026	0.00026	0.0002	0.001	SEQG/CCME	
Sulphate	mg/L	0.69	0.69	38.66	38.49	26.03	25.75	19.88	128	BC MOE	(12)
Thallium	mg/L	9.97E-05	9.96E-05	1.04E-04	1.04E-04	1.03E-04	1.03E-04	1.02E-04	0.0008	SEQG/CCME	
Thorium-230	Bq/L	0.01014	0.01012	0.01868	0.01854	0.01569	0.01563	0.0143	0.6	HC	
TSS	mg/L	1.60	1.60	1.65	1.65	1.63	1.63	1.63	background + 5 mg/L	CCME	
Un-ionized Ammonia	mg/L	0.0000086	0.0000086	0.0000309	0.0000308	0.0000235	0.0000233	0.0000199	1	MDMER Sched 4	
Uranium	mg/L	0.00003	0.00003	0.00057	0.00055	0.00034	0.00033	0.00025	0.02	SEQG/CCME	
Vanadium	mg/L	0.00017	0.00015	0.00067	0.00056	0.00033	0.00033	0.00027	0.12	FEQG	(13)
Zinc	mg/L	0.0007	0.00069	0.00106	0.00103	0.0009	0.0009	0.00084	0.007	FEQG	(9)

Notes

Notes

Estimates of mercury concentration are based on 50% of the detection limit in both background and effluent.

(1) Estimated from near-field model

NE = No estimate for this lake for this parameter

Saskatchewan Water Quality Objectives, SEQG on-line (https://envrbrportal.crmp.saskatchewan.ca/seqg-search/), SEQG for the protection of aquatic life were selected, based on total concentrations, a temperature of 15°C and a pH of 7.0.

Hardness dependent WQOs are for very soft water (hardness <25 mg $CaCO_3$/L). Site-specific hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(4) Total ammonia-N calculated from the total ammonia guideline for a temperature of 15°C and a pH of 7.0, Un-ionized Ammonia from Table 1 of temperature and pH Canadian Water Quality Guidelines for the Protection of Aquatic Life - Ammonia (https://ccme.ca/en/res/ammonia-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf)

(5) Based on a pH of >6.5.

(6) Based on water hardness >0 to <17 mg/L.

(7) Based on water hardness >0 to <82 mg/L.

(8) Based on water hardness >0 to ≤60 mg/L equation used at hardness of 5.26. At hardness >180 mg/L, the CWQG is 7 µg/L

(9) Guideline is based on dissolved zinc.

(10) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and site-specific baseline hardness of 15 mg/L.

(11) ECCC 2020. Federal Environmental Quality Guidelines Strontium. July.

(12) BC MECCS 2021. British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/wqg_summary_aquaticlife_wildlife_agri.pdf

(13) Environment Canada 2016. Federal Environmental Quality Guidelines, Vanadium. May.

(14) Health Canada 2020. Guidelines for Canadian Drinking Water Quality Summary Table. September. https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/summary-table-EN-2020-02-11.pdf

(15) BC MECCS 2020. Source Drinking Water Quality Guidelines, Guideline Summary Ministry of Environment & Climate Change Strategy Water Protection & Sustainability Branch .

(16) WHO 2017. Guidelines for Drinking Water Quality. Fourth Edition Incorporating The First Addendum.

(17) Framework - guideline for meso-eutrophic waterbody 20-35 µg/L

Attachment IR-114 (Round 3 submission)

Updated tables as requested by ECCC for the following:

- Table 8.2-8;
- Table 8.2-10;
- Table 8.2-13; and,
- Table 8.2-14.

Table** Error! No text of specified style in document.**-1: Summary of Background Water Quality Screening Criteria

Parameter	Units	Short-term Screening Criteria (background hardness)	Short-term Screening Criteria (Hardness induced [>250 mg/L])	Source	Note	Long-term Screening Criteria (background hardness)	Long-term Screening Criteria (Hardness induced [>250 mg/L])	Source	Note
General Chemistry, Nutrients and Anions									
Alkalinity	mg/L	--	--	--	--	--	--	--	
Ammonia (as N)	mg/L	--	--	--	--	5.74	5.74	SEQG/CCME	(2)
Un-Ionized Ammonia	mg/L	--	--	--	--	0.019	0.019	SEQG/CCME	
Hardness	mg/L	--	--	--	--	--	--	--	--
Conductivity	µS/cm	--	--	--	--	--	--	--	--
Nitrate	mg/L	550	550	CCME		3	3	SEQG	--
pH	pH units	--	--	--	--	6.5-9.0	6.5-9.0	SEQG/CCME	--
Phosphorus	mg/L	--	--	--	--	0.004-0.01	0.004-0.01	CCME	(10)
Sulphate	mg/L	--	--	--	--	128	429	BC MOE	
TDS	mg/L	--	--	--	--	500	500	SEQG	--
Temperature	°C	--	--	--	--	ambient temp	ambient temp	--	--
TSS	mg/L	15	15	MDMER Schedule 4	(11)	background + 5 mg/L	background + 5 mg/L	CCME	--
Chloride	mg/L	640	640	SEQG/CCME	(4)	120	120	SEQG/CCME	
Metals									
Aluminum	mg/L	--	--	--	--	0.1	0.1	SEQG/CCME	(1)
Arsenic	mg/L	0.1	0.1	MDMER Schedule 4		0.005	0.005	SEQG/CCME	--
Cadmium	mg/L	0.00011	0.0053	SEQG/CCME	(3)	0.00004	0.00034	SEQG/CCME	--
Chromium	mg/L	--	--	--	--	0.001	0.001	SEQG/CCME	(5)
Cobalt	mg/L	--	--	--	--	0.00078	0.00149	FEQG	(15)(16)
Copper	mg/L	0.0009	0.00004	SEQG	(6)	0.002	0.004	CCME	(7)
Cyanide	mg/L	--	--	--	--	--	--	--	--
Iron	mg/L	--	--	--	--	0.3	0.3	SEQG/CCME	--
Lead	mg/L	--	--	--	--	0.001	0.007	SEQG/CCME	
Manganese	mg/L	0.501	15	CCME	(8)	0.21	0.64	SEQG/CCME	(9)
Mercury	mg/L	--	--	--	--	0.000026	0.000026	CCME	--
Molybdenum	mg/L	--	--	--	--	0.073	0.073	CCME	
Nickel	mg/L	--	--	--	--	0.025	0.025	CCME	
Selenium	mg/L	--	--	--	--	0.001	0.001	CCME	--
Strontium	mg/L	--	--	--	--	2.5	2.5	FEQG	
Thallium	mg/L	--	--	--	--	0.0008	0.0008	SEQG/CCME	--
Uranium	mg/L	0.033	0.033	CCME		0.015	0.015	SEQG/CCME	--
Vanadium	mg/L	--	--	--	--	0.12	0.12	FEQG	
Zinc	mg/L	0.008	0.204	CCME	(12)(13)	0.013	0.058	CCME	(14)
Radiological									
Lead-210	Bq/L	--	--	--	--	0.2	0.2	HC	--
Polonium-210	Bq/L	--	--	--	--	0.1	0.1	HC	--
Radium-226	Bq/L	--	--	--	--	0.11	0.11	SEQG	--
Thorium-230	Bq/L	--	--	--	--	0.6	0.6	HC	--
Uranium-238	Bq/L	--	--	--	--	3	3	HC	--
Uranium-234	Bq/L	--	--	--	--	3	3	HC	--

Notes:

All parameters listed as total concentrations unless otherwise specified

Saskatchewan Water Quality Objectives, SEQG on-line (https://envrbrportal.crmp.saskatchewan.ca/seqg-search/), SEQG for the protection of aquatic life were selected, based on total concentrations

Bold numbers indicate exceedance of long-term criteria

Bold and italicized indicate exceedance of short-term criteria and long-term criteria.

SEQG – Saskatchewan Environmental Quality Guidelines – Water Quality Guidelines for Freshwater Aquatic Life.

CWQG – Canadian Council of Ministers of the Environment – Canadian Water Quality Guidelines for the Protection of Aquatic Life.

SSWQO – Saskatchewan Surface Water Quality Objectives.

DOC – Dissolved organic carbon.

TDS – Total dissolved solids.

TKN – Total Kjeldahl Nitrogen.

TOC – Total organic carbon.

TSS – Total suspended solids.

Narrative – Temperature - Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded. Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

* A pH of 7 and a temperature of 15°C were assumed to convert total ammonia to un-ionized ammonia in accordance with CCME (2002).

(1) Long-term criterion for aluminum based on CCME/SEQG of 0.1 mg/L for dissolved aluminum when pH is greater than 6.5.

(2) Total ammonia-N calculated from the total ammonia guideline for an average annual temperature of 15°C and a pH of 7.0, Un-ionized Ammonia from Table 1 of temperature and pH, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Ammonia (https://ccme.ca/en/res/ammonia-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf).

(3) Based on water hardness of >0 to <5.3 mg/L (Site-specific background hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(4) Based on water hardness >0 to <17 mg/L.

(5) Guideline specific to Chromium VI for conservative comparison to baseline water quality

(6) Based on hardness of 5.26 mg/L (Short-term equation is ($e^{(0.979123[\ln(\text{hardness})]-8.64497)}$)*1000 (SEGQ via AEP 1996b)

(7) Federal Water Quality Guideline for Copper Biotic Ligand Model (BLM) Tool and User Manual, (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6)

(8) Short Term Guideline is based on dissolved manganese. Benchmark = exp(0.878[ln(hardness)] + 4.76) where the benchmark is expressed in dissolved manganese concentration (µg/L), and hardness is measured as CaCO3 equivalents in mg/L. (Site-specific hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(9) Long-term guideline for manganese based on Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Manganese, Appendix B - Canadian Water Quality Guidelines Calculator (pH = 6.61, hardness = 5.26 mg/L.

(10) Framework provides Trigger Ranges for Total Phosphorus (µg/L) - guideline for oligotrophic waterbody 4 - 10 µg/L

(11) MDMER Schedule 4 - maximum authorized monthly mean concentration

(12) Guideline is based on dissolved zinc.

(13) Short term guideline is based on Benchmark = exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(14) Long term guideline is based on CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(15) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and lowest hardness for equation of 52 mg/L

(16) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt. Based on equation and hardness of 250 mg/L for equation of FWQG = exp{(0.414[ln(hardness)] – 1.887}.

Table 8.2-10: Near-field Receiving Water Quality Results

Parameter	Units	Short-term Screening Criteria (background hardness)	Short-term Screening Criteria (Hardness induced [>250 mg/L])	Source	Note	Long-term Screening Criteria (background hardness)	Long-term Screening Criteria (Hardness induced [>250 mg/L])	Source	Note	Discharge Concentration (max predicted)	LA-5 Well Mixed (7Q10)	LA-5 Well Mixed (Monthly Low)	LA-5 Well Mixed (Average)
General Chemistry, Nutrients and Anions													
Alkalinity	mg/L	--	--	--	--	--	--	--		12.4	12.4	12.4	12.4
Ammonia (as N)	mg/L	--	--	--	--	5.74	5.74	SEQG/CCME	(2)	3.9	0.13	0.11	0.1
Un-Ionized Ammonia	mg/L	--	--	--	--	0.019	0.019	SEQG/CCME		0.0129	0.0004	0.0003	0.0003
Hardness	mg/L	--	--	--	--	--	--	--	--	250	9	8	7
Conductivity	µS/cm	--	--	--	--	--	--	--	--	21.7	21.7	21.7	21.7
Nitrate	mg/L	550	550	CCME		3	3	SEQG	--	0.249	0.249	0.249	0.249
pH	pH units	--	--	--	--	6.5-9.0	6.5-9.0	SEQG/CCME	--	7	7	7	7
Phosphorus	mg/L	--	--	--	--	0.004-0.01	0.004-0.01	CCME	(10)	0.01	0.005	0.005	0.005
Sulphate	mg/L	--	--	--	--	128	429	BC MOE		2600	43	26	19
TDS	mg/L	--	--	--	--	500	500	SEQG	--	6420	131	90	74
Temperature	°C	--	--	--	--	ambient temp	ambient temp	--	--	16.5	15	15	15
TSS	mg/L	15	15	MDMER Schedule 4	(11)	background + 5 mg/L	background + 5 mg/L	CCME	--	6	4	4	4
Chloride	mg/L	640	640	SEQG/CCME	(4)	120	120	SEQG/CCME		600	10	6	5
Metals													
Aluminum	mg/L	--	--	--	--	0.1	0.1	SEQG/CCME	(1)	0.051	0.01	0.01	0.01
Arsenic	mg/L	0.1	0.1	MDMER Schedule 4		0.005	0.005	SEQG/CCME	--	0.006	0.0002	0.0002	0.0001
Cadmium	mg/L	0.00011	0.0053	SEQG/CCME	(3)	0.00004	0.00034	SEQG/CCME	--	0.0018	0.00005	0.00004	0.00003
Chromium	mg/L	--	--	--	--	0.001	0.001	SEQG/CCME	(5)	0.025	0.001	0.001	0.001
Cobalt	mg/L	--	--	--	--	0.00078	0.00149	FEQG	(15)(16)	0.0027	0.000142	0.000125	0.000119
Copper	mg/L	0.0009	0.00004	SEQG	(6)	0.002	0.004	CCME	(7)	0.02	0.001	0.0004	0.0004
Cyanide	mg/L	--	--	--	--	--	--	--	--	N/A	--	--	--
Iron	mg/L	--	--	--	--	0.3	0.3	SEQG/CCME	--	0.0039	0.178	0.179	0.180
Lead	mg/L	--	--	--	--	0.001	0.007	SEQG/CCME		0.0003	0.000	0.000	0.000
Manganese	mg/L	0.501	15	CCME	(8)	0.21	0.64	SEQG/CCME	(9)	0.03	0.020	0.020	0.020
Mercury	mg/L	--	--	--	--	0.000026	0.000026	CCME	--	0.00001	0.000010	0.000010	0.000010
Molybdenum	mg/L	--	--	--	--	0.073	0.073	CCME		2.5	0.04	0.02	0.02
Nickel	mg/L	--	--	--	--	0.025	0.025	CCME		0.0138	0.0003	0.0002	0.0002
Selenium	mg/L	--	--	--	--	0.001	0.001	CCME	--	0.042	0.001	0.001	0.000
Strontium	mg/L	--	--	--	--	2.5	2.5	FEQG		1.68	0.04	0.03	0.03
Thallium	mg/L	--	--	--	--	0.0008	0.0008	SEQG/CCME	--	0.0006	0.0002	0.0002	0.0002
Uranium	mg/L	0.033	0.033	CCME		0.015	0.015	SEQG/CCME	--	0.057	0.001	0.001	0.001
Vanadium	mg/L	--	--	--	--	0.12	0.12	FEQG		0.059	0.0011	0.0007	0.00
Zinc	mg/L	0.008	0.204	CCME	(12)(13)	0.013	0.058	CCME	(14)	0.042	0.002	0.001	0.001
Radiological													
Lead-210	Bq/L	--	--	--	--	0.2	0.2	HC	--	0.42	0.026	0.024	0.023
Polonium-210	Bq/L	--	--	--	--	0.1	0.1	HC	--	0.15	0.007	0.006	0.006
Radium-226	Bq/L	--	--	--	--	0.11	0.11	SEQG	--	0.15	0.008	0.007	0.007
Thorium-230	Bq/L	--	--	--	--	0.6	0.6	HC	--	0.9	0.024	0.019	0.016
Uranium-238	Bq/L	--	--	--	--	3	3	HC	--	0.7	0.013	0.008	0.006
Uranium-234	Bq/L	--	--	--	--	3	3	HC	--	0.7	0.013	0.008	0.006

Notes:

All parameters listed as total concentrations unless otherwise specified

Saskatchewan Water Quality Objectives, SEQG on-line (https://envrbrportal.crmp.saskatchewan.ca/seqg-search/), SEQG for the protection of aquatic life were selected, based on total concentrations

Bold numbers indicate exceedance of long-term criteria

Bold and italicized indicate exceedance of short-term criteria and long-term criteria.

SEQG – Saskatchewan Environmental Quality Guidelines – Water Quality Guidelines for Freshwater Aquatic Life.

CWQG – Canadian Council of Ministers of the Environment – Canadian Water Quality Guidelines for the Protection of Aquatic Life.

SSWQO – Saskatchewan Surface Water Quality Objectives.

DOC – Dissolved organic carbon.

TDS – Total dissolved solids.

TKN – Total Kjeldahl Nitrogen.

TOC – Total organic carbon.

TSS – Total suspended solids.

Narrative – Temperature - Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded. Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

* A pH of 7 and a temperature of 15°C were assumed to convert total ammonia to un-ionized ammonia in accordance with CCME (2002).

(1) Long-term criterion for aluminum based on CCME/SEQG of 0.1 mg/L for dissolved aluminum when pH is greater than 6.5.

(2) Total ammonia-N calculated from the total ammonia guideline for an average annual temperature of 15°C and a pH of 7.0, Un-ionized Ammonia from Table 1 of temperature and pH, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Ammonia (https://ccme.ca/en/res/ammonia-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf).

(3) Based on water hardness of >0 to <5.3 mg/L (Site-specific background hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(4) Based on water hardness >0 to <17 mg/L.

(5) Guideline specific to Chromium VI for conservative comparison to baseline water quality

(6) Based on hardness of 5.26 mg/L (Short-term equation is ($e^{(0.979123[\ln(hardness)]-8.64497)}$)*1000 (SEQG via AEP 1996b)

(7) Federal Water Quality Guideline for Copper Biotic Ligand Model (BLM) Tool and User Manual, (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6)

(8) Short Term Guideline is based on dissolved manganese. Benchmark = exp(0.878[ln(hardness)] + 4.76) where the benchmark is expressed in dissolved manganese concentration (µg/L), and hardness is measured as CaCO3 equivalents in mg/L. (Site-specific hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(9) Long-term guideline for manganese based on Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Manganese, Appendix B - Canadian Water Quality Guidelines Calculator (pH = 6.61, hardness = 5.26 mg/L.

(10) Framework provides Trigger Ranges for Total Phosphorus (µg/L) - guideline for oligotrophic waterbody 4 - 10 µg/L

(11) MDMER Schedule 4 - maximum authorized monthly mean concentration

(12) Guideline is based on dissolved zinc.

(13) Short term guideline is based on Benchmark = exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(14) Long term guideline is based on CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(15) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and lowest hardness for equation of 52 mg/L

(16) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt. Based on equation and hardness of 250 mg/L for equation of FWQG = exp{(0.414[ln(hardness)] – 1.887}.

Table** Error! No text of specified style in document.**-2: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Short-term Benchmark			Long-term Benchmark		
									Value	Reference	Notes	Value	Reference	Notes
Alkalinity	mg/L	NE	NE	12.4	12.4	NE	NE	NE						
Aluminum	mg/L	0.01766	0.01616	0.01835	0.02226	0.01500	0.01499	0.01614				0.1	SEQG/CCME	(1)
Ammonia (as N)	mg/L	0.01463	0.01463	0.05232	0.05215	0.03978	0.0395	0.03368				5.74	SEQG/CCME	(2)
Un-ionized Ammonia	mg/L	0.0000086	0.0000086	0.0000309	0.0000308	0.0000235	0.0000233	0.0000199				0.019	SEQG/CCME	
Arsenic	mg/L	0.00012	0.00011	0.00015	0.00015	0.00013	0.00013	0.00012	0.1	MDMER Schedule 4	(11)	0.005	SEQG/CCME	
Cadmium	mg/L	0.000024	0.000023	0.00004	0.000039	0.000033	0.000033	0.00003	29	CCME		1.5	SEQG/CCME	
Chloride	mg/L	0.32	0.32	6.14	6.11	4.2	4.16	3.26	640	SEQG/CCME	(3)	0.00004	SEQG/CCME	
Chromium	mg/L	0.00053	0.0005	0.0007	0.0007	0.0007	0.0007	0.0006				0.001	SEQG/CCME	(5)
Cobalt	mg/L	0.000101	0.000101	0.000129	0.000128	0.000119	0.000119	0.000114				0.00078	FEQG	(15)
Copper	mg/L	0.00062	0.00062	0.00082	0.00082	0.00075	0.00075	0.00072	0.0009	SEQG	(6)	0.002	CCME	
Iron	mg/L	0.0467	0.0424	0.0470	0.0567	0.0400	0.0400	0.0425						
Lead	mg/L	0.000124	0.000114	0.000118	0.00013	0.000114	0.000114	0.000116				0.001	SEQG/CCME	
Lead-210	Bq/L	0.0062	0.0057	0.0084	0.0083	0.0067	0.0067	0.0064						
Manganese	mg/L	0.001674	0.001524	0.001722	0.001867	0.001593	0.001590	0.001593	0.501	CCME	(8)	0.21	SEQG/CCME	(9)
Mercury	mg/L	0.0000053	0.0000053	0.0000053	0.0000053	0.0000053	0.0000053	0.0000053				0.000026	CCME	
Molybdenum	mg/L	0.0001	0.0001	0.0243	0.024	0.0158	0.0156	0.0118				0.07	CCME	
Nickel	mg/L	0.00039	0.00038	0.00051	0.0005	0.00046	0.00046	0.00044				0.025	CCME	
Nitrate	mg/L	NE	NE	0.249	0.249	NE	NE	NE	550	CCME		3	SEQG	
Phosphorus	mg/L	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01				0.004 - 0.01	CCME	(10)
Polonium-210	Bq/L	0.0063	0.0058	0.0067	0.0072	0.0062	0.0062	0.0062				0.1	HC	
Radium-226	Bq/L	0.0057	0.0056	0.0069	0.0067	0.0063	0.0063	0.0061				0.11	SEQG	
Selenium	mg/L	0.000034	0.00003	0.00043	0.00041	0.00026	0.00026	0.0002				0.001	CCME	
Sulphate	mg/L	0.69	0.69	38.66	38.49	26.03	25.75	19.88				128	BC MOE	
Thallium	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001				0.0008	SEQG/CCME	
Thorium-230	Bq/L	0.01014	0.01012	0.01868	0.01854	0.01569	0.01563	0.0143				0.6	HC	
TSS	mg/L	1.60	1.60	1.65	1.65	1.63	1.63	1.63	15	MDMER Schedule 4	(11)	background +5 mg/L	CCME	
Uranium	mg/L	0.00003	0.00003	0.00057	0.00055	0.00034	0.00033	0.00025	0.033	CCME		0.015	SEQG/CCME	
Uranium-234	Bq/L	0.000385	0.000377	0.00705	0.00672	0.00415	4.11E-03	3.09E-03						
Uranium-238	Bq/L	0.000385	0.000377	0.00705	0.00672	0.00415	4.11E-03	3.09E-03						
Vanadium	mg/L	0.00017	0.00015	0.00067	0.00056	0.00033	0.00033	0.00027				0.12	FEQG	
Zinc	mg/L	0.0007	0.00069	0.00106	0.00103	0.0009	0.0009	0.00084	0.008	CCME	(12)(13)	0.013	CCME	(14)

Notes:

All parameters listed as total concentrations unless otherwise specified

Saskatchewan Water Quality Objectives, SEQG on-line (https://envrbrportal.crmp.saskatchewan.ca/seqg-search/), SEQG for the protection of aquatic life were selected, based on total concentrations

Bold numbers indicate exceedance of long-term criteria

Bold and italicized indicate exceedance of short-term criteria and long-term criteria.

SEQG – Saskatchewan Environmental Quality Guidelines – Water Quality Guidelines for Freshwater Aquatic Life.

CWQG – Canadian Council of Ministers of the Environment – Canadian Water Quality Guidelines for the Protection of Aquatic Life.

SSWQO – Saskatchewan Surface Water Quality Objectives.

DOC – Dissolved organic carbon.

TDS – Total dissolved solids.

TKN – Total Kjeldahl Nitrogen.

TOC – Total organic carbon.

TSS – Total suspended solids.

Narrative – Temperature - Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded. Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

* A pH of 7 and a temperature of 15°C were assumed to convert total ammonia to un-ionized ammonia in accordance with CCME (2002).

(1) Long-term criterion for aluminum based on CCME/SEQG of 0.1 mg/L for dissolved aluminum when pH is greater than 6.5.

(2) Total ammonia-N calculated from the total ammonia guideline for an average annual temperature of 15°C and a pH of 7.0, Un-ionized Ammonia from Table 1 of temperature and pH, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Ammonia (https://ccme.ca/en/res/ammonia-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf).

(3) Based on water hardness of >0 to <5.3 mg/L (Site-specific background hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(4) Based on water hardness >0 to <17 mg/L.

(5) Guideline specific to Chromium VI for conservative comparison to baseline water quality

(6) Based on hardness of 5.26 mg/L (Short-term equation is ($e^{\{0.979123[\ln(\text{hardness})]-8.64497\}}$)*1000 (SEGQ via AEP 1996b)

(7) Federal Water Quality Guideline for Copper Biotic Ligand Model (BLM) Tool and User Manual, (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6)

(8) Short Term Guideline is based on dissolved manganese. Benchmark = exp(0.878[ln(hardness)] + 4.76) where the benchmark is expressed in dissolved manganese concentration (µg/L), and hardness is measured as CaCO3 equivalents in mg/L. (Site-specific hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(9) Long-term guideline for manganese based on Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Manganese, Appendix B - Canadian Water Quality Guidelines Calculator (pH = 6.61, hardness = 5.26 mg/L.

(10) Framework provides Trigger Ranges for Total Phosphorus (µg/L) - guideline for oligotrophic waterbody 4 - 10 µg/L

(11) MDMER Schedule 4 - maximum authorized monthly mean concentration

(12) Guideline is based on dissolved zinc.

(13) Short term guideline is based on Benchmark = exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(14) Long term guideline is based on CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(15) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and lowest hardness for equation of 52 mg/L.

Table** Error! No text of specified style in document.**-3: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water During Future Centuries

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Long-term Screening Concentration	Source of Screening Concentration	Notes
Aluminum	mg/L	0.01358	0.01358	0.01388	0.01373	0.0136	0.0136	0.01359	0.1	SEQG/CCME	(1)
Ammonia (as N)	mg/L	0.01463	0.01463	0.01463	0.01463	0.01463	0.01463	0.01463	5.74	SEQG/CCME	(2)
Un-ionized Ammonia	mg/L	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035	0.000035	0.019	CCME	
Arsenic	mg/L	0.000103	0.000103	0.000107	0.000107	0.000105	0.000105	0.000104	0.005	SEQG/CCME	
Cadmium	mg/L	0.0000232	0.0000232	0.0000233	0.0000233	0.0000233	0.0000233	0.0000232	0.00004	SEQG/CCME*	
Chloride	mg/L	0.32	0.32	0.41	0.41	0.39	0.39	0.38	120	SEQG/CCME	
Chromium	mg/L	0.00052	0.00052	0.00053	0.00053	0.00052	0.00052	0.00052	0.001	SEQG/CCME	
Cobalt	mg/L	0.0001	0.0001	0.00011	0.00011	0.00011	0.0001	0.0001	0.00078	FEQG	(15)
Copper	mg/L	0.00062	0.00062	0.00063	0.00063	0.00062	0.00062	0.00062	0.002	CCME	
Iron	mg/L	0.12126	0.12126	0.12756	0.12672	0.12408	0.12405	0.12308	0.3	SEQG/CCME	
Lead	mg/L	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011	0.001	SEQG/CCME	
Lead-210	Bq/L	0.00527	0.00527	0.00605	0.00592	0.00557	0.00556	0.00545	0.2	HC	
Manganese	mg/L	0.01206	0.01206	0.01419	0.01413	0.01355	0.01353	0.01317	0.21	SEQG/CCME	(9)
Mercury	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.000026	CCME	
Molybdenum	mg/L	0.00011	0.00011	0.00012	0.00012	0.00011	0.00011	0.00011	0.07	CCME	
Nickel	mg/L	0.00038	0.00038	0.00041	0.00041	0.0004	0.0004	0.00039	0.025	CCME	
Phosphorus	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.004 - 0.01	CCME	
Polonium-210	Bq/L	0.00536	0.00536	0.00615	0.00602	0.00566	0.00564	0.00553	0.1	HC	
Radium-226	Bq/L	0.00557	0.00557	0.00639	0.00637	0.00615	0.00614	0.006	0.11	SEQG	
Selenium	mg/L	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.001	SEQG/CCME	
Sulphate	mg/L	0.69	0.69	0.72	0.72	0.71	0.71	0.71	128	BC MOE	
Thallium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0008	SEQG/CCME	
Thorium-230	Bq/L	0.0101	0.0101	0.01036	0.01036	0.0103	0.0103	0.01025	0.6	HC	
TSS	mg/L	3.0	2.0	2.6	2.6	2.5	2.2	4.0	background +5 mg/L	CCME	
Uranium	mg/L	0.00003	0.00003	0.00004	0.00004	0.00003	0.00003	0.00003	0.02	SEQG/CCME	
Vanadium	mg/L	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.12	FEQG	
Zinc	mg/L	0.00068	0.00068	0.00074	0.00074	0.00072	0.00072	0.00071	0.013	CCME	(14)

Notes:

All parameters listed as total concentrations unless otherwise specified

Saskatchewan Water Quality Objectives, SEQG on-line (https://envrbrportal.crmp.saskatchewan.ca/seqg-search/), SEQG for the protection of aquatic life were selected, based on total concentrations

Bold numbers indicate exceedance of long-term criteria

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Narrative – Temperature - Maximum Weekly Average Temperature: Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded. Short-term Exposure to Extreme Temperature: Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species.

* A pH of 7 and a temperature of 15°C were assumed to convert total ammonia to un-ionized ammonia in accordance with CCME (2002).

(1) Long-term criterion for aluminum based on CCME/SEQG of 0.1 mg/L for dissolved aluminum when pH is greater than 6.5.

(2) Total ammonia-N calculated from the total ammonia guideline for an average annual temperature of 15°C and a pH of 7.0, Un-ionized Ammonia from Table 1 of temperature and pH, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Ammonia (https://ccme.ca/en/res/ammonia-en-canadian-water-quality-guidelines-for-the-protection-of-aquatic-life.pdf).

(3) Based on water hardness of >0 to <5.3 mg/L (Site-specific background hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(4) Based on water hardness >0 to <17 mg/L.

(5) Guideline specific to Chromium VI for conservative comparison to baseline water quality

(6) Based on hardness of 5.26 mg/L (Short-term equation is $(e^{(0.979123[\ln(\text{hardness})]-8.64497)})$*1000 (SEGQ via AEP 1996b)

(7) Federal Water Quality Guideline for Copper Biotic Ligand Model (BLM) Tool and User Manual, (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6)

(8) Short Term Guideline is based on dissolved manganese. Benchmark = exp(0.878[ln(hardness)] + 4.76) where the benchmark is expressed in dissolved manganese concentration (μg/L), and hardness is measured as CaCO3 equivalents in mg/L. (Site-specific hardness is 5.26 mg/L (95th percentile of LA-5 and LA-6).

(9) Long-term guideline for manganese based on Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Manganese, Appendix B - Canadian Water Quality Guidelines Calculator (pH = 6.61, hardness = 5.26 mg/L.

(10) Framework provides Trigger Ranges for Total Phosphorus (μg/L) - guideline for oligotrophic waterbody 4 - 10 μg/L

(11) MDMER Schedule 4 - maximum authorized monthly mean concentration

(12) Guideline is based on dissolved zinc.

(13) Short term guideline is based on Benchmark = exp(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC mg·L-1)] + 0.526). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(14) Long term guideline is based on CWQG = exp(0.947[ln(hardness mg·L-1)] - 0.815[pH] + 0.398[ln(DOC mg·L-1)] + 4.625). (Site-specific background hardness is 5.26 mg/L, DOC is 2.24 mg/L, pH is 6.61 (95th percentile of LA-5 and LA-6). Note – extrapolated for value outside the hardness range.

(15) Environment Canada 2017. Federal Environmental Quality Guidelines, Cobalt, May. Based on equation and lowest hardness for equation of 52 mg/L.

Attachment IR-114 (Round 4)

Part 2 of IR-114 (Round 4) requested that Denison use the copper Federal Environmental Quality Guideline (FEQG). The copper FEQG guideline is the most restrictive guideline and based on current science and incorporates the use of site-specific environmental modifying factors.

A)
Baseline conditions for the Wheeler River include a background hardness of 5.26 mg/L, DOC of 2.24 mg/L, and pH of 6.61 (95th percentile of LA-5 and LA-6). Using ECCC's Biotic Ligand Model for copper, the calculated HC_5 is below 0.0002 mg/L, however, 0.0002 mg/L is considered by the FEQG to be the lowest concentration routinely measured and therefore replaces the calculated HC_5 value for this water chemistry. Therefore, at baseline conditions the FEQG is 0.0002 mg/L.

Table 3-1, Table 3-3, and Table 3-5 of the ERA (Appendix 10-A) were updated to include the copper FEQG of 0.0002 mg/L as the screening criterion. Likewise, Tables 8.2-2, 8.2-3, 8.2-10, 8.2-13 and 8.2-14 in Section 8 of the EIS were updated to include the copper FEQG of 0.0002 mg/L as the screening criteria.

B)
As identified in Section 5.3.1.1 of the ERA (Appendix 10-A), toxicity reference values (TRVs) for copper were obtained from the USEPA Ecotoxicology Database (ECOTOX) for aquatic organisms. The selected TRVs were 20% Effect Concentrations (i.e., EC_{20} values), which are concentrations at which only 20% of the test organisms respond. The TRVs are shown in Table IR-114-1 below. Where the TRVs derived from ECOTOX were lower than the CCME guideline the CCME guideline was selected.

Table IR-114-1: Copper Toxicity Reference Values Used for Aquatic Organisms in the ERA

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Copper	Forage fish	0.002	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=237)	ECOTOX
	Predator fish	0.003	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=89)	ECOTOX
	Zooplankton	*0.002*	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=117)	ECOTOX; CCME
	Benthic invertebrates	*0.002*	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=264)	ECOTOX; CCME
	Phytoplankton	0.0092	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=101)	ECOTOX
	Aquatic plants	0.038	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=28)	ECOTOX

As requested in IR-114, the TRVs have been re-evaluated using the FEQG and the BLM. The BLM was run based on baseline site-specific conditions. The test species and concentrations identified as used to generate the BLM were evaluated to develop TRVs for the applicable biotic groups. The most restrictive effect concentration for each biotic group was identified. The test endpoint was either an EC_{10} or an IC_{10}. Based on the protocol identified in Table 5-11 of the ERA, the EC_{10} (or IC_{10}) was multiplied by 2 to obtain an EC_{20}, which was then utilized as the TRV. A summary of the TRVs for baseline conditions is identified in Table IR-114-2.

Considering that while the facility is in operation it is expected that hardness will increase to approximately 250 mg/L and pH will increase to approximately 7, the BLM was re-run under updated site conditions and the TRVs were re-evaluated based on the test species and concentrations used to generate the BLM. The copper TRVs under site conditions are presented in Table IR-114-3.

Table IR-114-2: Copper Toxicity Reference Values from Baseline Conditions BLM

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Copper	Forage fish	0.0052	mg/L	Fathead minnow, growth (IC_{10} = 0.0026 mg/L)	FEQG BLM
	Predator fish	0.0008	mg/L	White sturgeon, growth (EC_{10} = 0.0004 mg/L)	FEQG BLM
	Zooplankton	0.0009	mg/L	Daphnia magna, reproduction (EC_{10} = 0.0004 mg/L)	FEQG BLM
	Benthic invertebrates	0.0004	mg/L	Pond snail, growth (EC_{10} = 0.0002 mg/L)	FEQG BLM
	Phytoplankton	0.0091	mg/L	Rotifer, intrinsic (EC_{10} = 0.0046 mg/L)	FEQG BLM

	Aquatic plants	0.0212	mg/L	Duckweed, root length (EC_{10} = 0.01 mg/L)	FEQG BLM

Notes:
BLM based on hardness of 5.26 mg/L, DOC of 2.24 mg/L, pH of 6.61, temperature of 13°C.
TRV is an EC_{20}, adjusted from an EC_{10} or IC_{10}.

Table IR-114-3: Copper Toxicity Reference Values from Site Conditions BLM

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Copper	Forage fish	0.025	mg/L	Fathead minnow, growth (IC_{10} = 0.012 mg/L)	FEQG BLM
	Predator fish	0.005	mg/L	White sturgeon, growth (EC_{10} = 0.002 mg/L)	FEQG BLM
	Zooplankton	0.005	mg/L	Daphnia magna, reproduction (EC_{10} = 0.003 mg/L)	FEQG BLM
	Benthic invertebrates	0.003	mg/L	Pond snail, growth (EC_{10} = 0.001 mg/L)	FEQG BLM
	Phytoplankton	0.040	mg/L	Rotifer, intrinsic (EC_{10} = 0.02 mg/L)	FEQG BLM
	Aquatic plants	0.014	mg/L	Duckweed, root length (EC_{10} = 0.007 mg/L)	FEQG BLM

Notes:
BLM based on hardness of 250 mg/L, DOC of 2.24 mg/L, pH of 7, temperature of 13°C.
TRV is an EC_{20}, adjusted from an EC_{10} or IC_{10}.

The hazard quotients (HQs) for aquatic organisms were re-evaluated using both sets of TRVs, baseline conditions and site conditions during operation where hardness and pH are increased (Table IR-114-4). Consistent with Section 5.4.1 of the ERA (Appendix 10-A) an HQ less than or equal to 1 suggests low risk to the ecological receptor, and an HQ above 1 needs further investigation to determine if adverse effects are possible. Conservatively using baseline conditions, HQs for all aquatic organisms are less than 1 with the exception of predator fish in Whitefish Lake, and benthic invertebrates at all locations where HQs are slightly above 1. As such, further consideration was given to changes in site conditions when the facility is in operation. Using more realistic site conditions for hardness and pH, HQs for all aquatic organisms are less than 1 at all locations, indicating no adverse effects to aquatic organisms from facility related copper. It is relevant to consider all aspects of the receiving environment and this includes induced hardness since the scenario being evaluated only occurs during periods of effluent discharge. This approach is used in other jurisdictions (e.g., water licences in northern Canada issued through local water boards) and therefore the concept of induced hardness is not unique.

The copper predictions in the ERA are considered conservative based on the following assumptions:

- Baseline concentrations of copper are predominantly below the detection limit, indicating that baseline concentrations of copper are likely overestimated in the ERA.
- The effluent predictions in the ERA are based on available information from test studies at the time the ERA was prepared. Denison will be refining the effluent quality through the BATEA assessment and licensing process.
- Based on the effluent quality and quantity released to Whitefish Lake, the maximum copper concentration in Whitefish Lake and downstream waterbodies was evaluated as part of the HQ. This is a conservative assumption.
- Once the facility is operational, site conditions will change which includes increased hardness and pH; therefore, the predicated HQs under baseline conditions are considered conservative and overestimate risk.

Denison is in the process of collecting additional baseline water quality data which will be used in future ERA iterations to reconsider the baseline copper concentration in the Wheeler River. The ERA is a living document that will continue to be updated at defined intervals and will integrate new data when it is available. Denison has also committed to an ongoing environmental monitoring program which will be used to determine if there are any adverse effects to aquatic organisms from copper and other constituents of potential concern.

Table IR-114-4: Re-Evaluated Hazard Quotients for Copper in Aquatic Organisms

Location	Maximum Copper Concentration in Water (mg/L)	Hazard Quotients (unitless) – Baseline Conditions						Hazard Quotients (unitless) – Site Operation Conditions					
		Forage Fish	Predator Fish	Zooplankton	Benthic Invertebrate	Phyto-plankton	Aquatic Plants	Forage Fish	Predator Fish	Zooplankton	Benthic Invertebrate	Phytoplankton	Aquatic Plants
Kratchkowsky Lake (reference) [1]	6.22E-04	0.12	0.80	0.70	**1.49**	0.07	0.03	0.12	0.80	0.70	**1.49**	0.07	0.03
Whitefish Lake North	6.20E-04	0.12	0.80	0.70	**1.49**	0.07	0.03	0.03	0.14	0.12	0.25	0.02	0.05
Whitefish Lake Middle	8.22E-04	0.16	**1.06**	0.93	**1.97**	0.09	0.04	0.03	0.18	0.16	0.33	0.02	0.06
Whitefish Lake South	8.17E-04	0.16	**1.05**	0.92	**1.96**	0.09	0.04	0.03	0.18	0.16	0.32	0.02	0.06
McGowan Lake	7.50E-04	0.14	0.97	0.85	**1.80**	0.08	0.04	0.03	0.16	0.14	0.30	0.02	0.05
Icelander River	7.49E-04	0.14	0.97	0.84	**1.80**	0.08	0.04	0.03	0.16	0.14	0.30	0.02	0.05
Russell Lake Inlet	7.17E-04	0.14	0.92	0.81	**1.72**	0.08	0.03	0.03	0.16	0.14	0.28	0.02	0.05

Note:
Bold and shaded value indicates hazard quotient greater than 1.
[1] Kratchkowsky Lake is a reference lake located upstream of the effluent discharge point, and as such, the site operation conditions were the same as baseline conditions.

IR-126

- Department: ECCC
- Project Effects Link: Aquatic species
- Reference to EIS, appendices, or supporting documentation: Section 8.5.3, Appendix 10-A (ERA), Section 5.3.1.1.8

<table>
<tr><th>Original IR#</th><th>Follow-Up IR #</th><th>Context and Rationale</th><th>IR (ROUND 1, March 2023)</th><th>Denison Response (ROUND 1, August 2023)</th><th>IR (ROUND 2, December 2023)</th><th>Denison Response (ROUND 2, Feb. 2024)</th><th>IR (ROUND 3, May 31, 2024)</th><th>Denison Response (ROUND 3, June 28, 2024)</th><th>IR (ROUND 4, Sept. 6 2024)</th><th>Denison Response (ROUND 4 October 15, 2024)</th></tr>
<tr>
<td>IR- 126</td>
<td>-</td>
<td>Context: The Proponent has used the US Environmental Protection Agency (US EPA) guidelines for the assessment of selenium fish tissue concentrations in Section 8.5.3 of the draft EIS and in the Environmental Risk Assessment (ERA) in Appendix 10-A (ERA) of Section 10.

Rationale: ECCC's Federal Environmental Quality Guidelines of 6.7 ug/g dry weight fish whole body tissue for selenium should be used, as it is more protective than the US EPA guidelines.</td>
<td>Update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA (Appendix 10-A (ERA) in Section 10) as needed using ECCC's FEQG.</td>
<td>Denison is aware of the ECCC Federal Environmental Quality Guideline for selenium in fish. The ECCC FEQG is for fish tissue egg-ovary and whole-body. Denison selected the US EPA guideline over the ECCC guideline since US EPA provides guidelines for fish tissue muscle as well. The fish assessed in the ERA were large-bodied fish including northern pike and white sucker. A fish tissue muscle TRV is appropriate for assessment of large-bodied fish; therefore, the US EPA selenium fish tissue muscle benchmark was preferred over the whole body value from ECCC.</td>
<td>ECCC acknowledges that the Proponent prefers the use of the US EPA guidelines due to the ability to perform fish tissue muscle TRV, however, Environmental Effects Monitoring (EEM) would require a study on fish tissue selenium whole-body or egg-ovary concentrations. The current baseline data will not be comparable to future EEM studies using fish tissue muscle concentrations of selenium and US EPA guideline methodology. There is currently EEM guidance under development for conducting selenium fish tissue sampling in fish populations that will utilize the FEQG which applies to fish tissue egg-ovary and whole-body concentrations of selenium. Additionally, the Proponent has made a commitment to utilize the most stringent guidelines available.

Based on the Project's proposed effluent concentrations of selenium, fish tissue sampling will be required as part of the EEM monitoring for the Project. The ECCC FEQG is the guideline applied to these studies, and the current use of this guideline will facilitate the comparison to future monitoring studies.

Furthermore, the Proponent has not provided sufficient explanation in their response for the use of the less stringent US EPA guideline compared to the more conservative FEQG.

The Proponent should explain their use of the US EPA guidelines over the ECCC FEQG or update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA as needed using ECCC's FEQG.

As noted in IR-126, please update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA (Appendix 10- A (ERA) in Section 10) as needed using ECCC's FEQG. If the FEQG will not be used, provide further rationalization for the use of the US EPA guidelines when creating the study on fish tissue selenium concentration in the EEM.</td>
<td>The EIS assessed selenium in fish in terms of muscle tissue because the available baseline data were for muscle tissue. Since the review comment highlights the EEM program and the fish tissue selenium study component more specifically we note that the MDMER (2023) allows use of muscle tissue in the EEM study of selenium in fish (see Schedule 5, 12(1)(e)(iv). It is further noted that Denison has committed to a pre-operational EEM study and will conduct that study in accordance with the regulation and available federal guidance. The pre-operational EEM study will include a study respecting selenium in fish tissue.

Regarding the EIS, Denison and its SME stand by the current assessment approach, using muscle tissue. Nevertheless, to address the reviewer's concern, we have calculated whole-body concentrations from the predicted selenium in muscle (Table B.5 of the revised draft EIS Appendix 10-A), using EPA (2021) conversion factors. The resulting whole-body concentrations do not exceed either EPA (2021) or ECCC (2022) guidelines for whole-body tissue, which are 8.5 μg/g dw and 6.7 μg/g dw, respectively, and therefore the conclusions of the risk assessment are unchanged. No change to the EIS is warranted.

<table>
<tr><th>Fish Species</th><th>Lake</th><th>Musde ug/g fw</th><th>Muscle ug/g dw</th><th>Whole ug/g dw</th></tr>
<tr><td>N. Pike</td><td>Ref</td><td>1.89E-01</td><td>7.56E-01</td><td>5.95E-01</td></tr>
<tr><td></td><td>WL North</td><td>1.86E-01</td><td>7.44E-01</td><td>5.86E-01</td></tr>
<tr><td></td><td>WL Mid</td><td>1.57E+00</td><td>6.28E+00</td><td>4.94E+00</td></tr>
<tr><td></td><td>WL South</td><td>1.51E+00</td><td>6.04E+00</td><td>4.76E+00</td></tr>
<tr><td></td><td>McGowan</td><td>1.02E+00</td><td>4.08E+00</td><td>3.21E+00</td></tr>
<tr><td></td><td>Russell</td><td>8.12E-01</td><td>3.25E+00</td><td>2.56E+00</td></tr>
<tr><td>W. Sucker</td><td>Ref</td><td>1.46E-01</td><td>5.84E-01</td><td>4.60E-01</td></tr>
<tr><td></td><td>WL North</td><td>1.43E-01</td><td>5.72E-01</td><td>4.50E-01</td></tr>
<tr><td></td><td>WL Mid</td><td>1.74E+00</td><td>6.96E+00</td><td>5.48E+00</td></tr>
<tr><td></td><td>WL South</td><td>1.66E+00</td><td>6.64E+00</td><td>5.23E+00</td></tr>
<tr><td></td><td>McGowan</td><td>1.06E+00</td><td>4.24E+00</td><td>3.34E+00</td></tr>
<tr><td></td><td>Russell</td><td>8.06E-01</td><td>3.22E+00</td><td>2.54E+00</td></tr>
</table>
Notes:
dry wt = fresh wt / (1-0.75) [EPA (2021)]
whole = muscle / 1.27 [EPA (2021)]

References:

MDMER. 2023. Metal and Diamond Mining Effluent Regulations. SOR/2002-222. Last amended June 9, 2023. Minister of Justice.
EPA. 2021. 2021 Revision to: Aquatic Life Ambient Water Quality Criterion for Selenium 2016. EPA 822-R-21-006. U.S. Environmental Protection Agency.
ECCC. 2022. Federal Environmental Quality Guidelines. Selenium. Environment and Climate Change Canada.</td>
<td>The Proponent did not compare their predictions for fish tissue selenium to the FEQGs in the ERA as requested. Furthermore, in their response the Proponent does not use available species-specific moisture content and conversion factors available for northern pike and lake whitefish when converting muscle selenium concentrations to whole-body selenium concentrations. This means that the Proponent's prediction likely underestimates the selenium tissue concentrations in the fish. Consequently, the hazard quotients reported are lower than expected.

Additionally, the method used by the Proponent to predict selenium concentrations in northern pike and lake whitefish does not appear to include dietary uptake and bioaccumulation of selenium, only direct contact with pore water and overlying water is considered (Table 5-5 in Appendix 10A; Section 2.2.2 of Appendix A to Appendix 10-A). Selenium uptake through the aquatic food web has been shown to result in bioaccumulation of selenium in aquatic-dependent wildlife and resulting in reproductive impairments and malformations (ECCC 2022). Dietary sources of selenium would typically be expected to be the main contribution to total concentrations of selenium compared to selenium uptake from water. In most situations, the conversion of inorganic selenium to organic selenium through uptake from water into periphyton/algae is the rate limiting step of selenium bioaccumulation into higher level organisms including benthic invertebrates and fish. This step is affected by many environmental parameters (e.g. temperature, substrate, lentic/lotic environment). Considering that the effluent discharge contains 42 ug/L selenium, consideration of dietary selenium is warranted.

The Proponent should update the final EIS with the following information:

1. Update the ERA with the assessment of selenium concentrations in fish tissue to include a comparison of selenium fish tissue concentrations to ECCC FEQG guidelines for either fish whole body tissue (6.7 ug/g dry weight) or fish egg/ovary tissue (14.7 ug/g dry weight) using species-specific moisture content and muscle : whole body and/or egg-ovary : muscle conversion factors (see Tables B-1b, Table B-3, Table B-4, and Table B-5 in US EPA (2021)).

2. Update the ERA for the assessment of selenium concentrations in fish tissue using a method that considers dietary uptake and bioaccumulation in order to determine predicted fish tissue</td>
<td>1. The Round 2 IR response provided a comparison against the ECCC FEQG by converting the muscle tissue concentrations to whole-body tissue concentrations using generic conversion values. The dry weight to fresh weight conversion factor used was 0.25. Based on Denison's measured dry weight content in fish (northern pike and white sucker) the dry weight content ranged from 0.24 to 0.26 which is consistent with literature values; therefore, there is minimal difference in the moisture content. The species specific conversion factors for whole body and egg ovary for northern pike and white sucker from US EPA (2021) have been used to calculate the whole body and egg ovary tissue concentrations. (see Table in Attachment IR-126 Round 3 below for results). All predicted tissue concentrations for northern pike and white sucker in all lakes are below the FEQG.
2. The ERA utilizes a bioaccumulation factor (BAF) model from water to tissue to conservatively reflect all the multi-media contributions to uptake. The BAFs are provided in Appendix A to the ERA in Section 3.6.1. The selenium BAF for northern pike is a non-linear BAF where BAF = $949x^{0.827}$ (x is in units of μg/L). The selenium BAF for white sucker is 4425 L/kg (the rounded value shown in Figure IR-126-1 is 4400 L/kg). Both BAFs are based on publicly available regional data from other uranium mine sites in northern Saskatchewan (see Appendix A to Appendix 10-A, Section 3.6.1). Additional information on the derivation of the BAFs is provided below in Attachment IR-126 Round 3.
3. The fish tissue selenium concentrations represent the maximum concentration over the Project phases. This is the most conservative result.

References:

US EPA. 2021. 2021 Revision to: Aquatic Life Ambient Water Quality Criterion for Selenium 2016. EPA 822-R-21-006. U.S. Environmental Protection Agency.

ECCC. 2022. Federal Environmental Quality Guidelines. Selenium. Environment and Climate Change Canada.</td>
<td>Following a supplementary submission by Denison on July 2nd, it has been determined that item one and two of this IR have been resolved, but item three remains outstanding.

Denison has not provided the information requested to address Item 3 of the Round 3 IR. Including the estimates of error for the predicted selenium concentrations in fish is necessary as the maximum predictions for Northern Pike in Whitefish Lake North and Middle are within 1-2 ug/g dw of the Egg/Ovary FEQG guideline of 14.7 ug/g dw.

In order to resolve this IR, Denison are expected to:

1) Provide an estimate of error associated with the Northern Pike BAF.

2) Include this estimate of error for the results in Table -IR-126-2 and consider this in the effects assessment.</td>
<td>1. An estimate of the error associated with the Northern Pike BAF is included in Attachment IR-126 Round 4.

2. An estimate of the whole body and egg-ovary concentrations using the range of uncertainty (low to high) is included in Attachment IR-126 Round 4.

Denison will include the information on selenium BAF sensitivity analysis from this IR response in a new section in the final EIS of Appendix 10-A, Section 6.2.3.</td>
</tr>
</table>

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, June 28, 2024)	IR (ROUND 4, Sept. 6 2024)	Denison Response (ROUND 4 October 15, 2024)
							concentrations of selenium in northern pike and lake whitefish. This is recommended to be done over all Project phases for both the Expected Case and sensitivity scenarios. Provide predicted fish tissue selenium concentrations that include the range of variability of data used to develop the tissue selenium predictions. Only one output value without a confidence interval is provided for each location and species (see Table B.5 in Appendix B of Appendix 10-A).			

Attachment IR-126 Round 3

The whole-body concentrations were recalculated from the predicted selenium in muscle tissue concentrations (Table B.5 of the revised draft EIS Appendix 10-A), using site-specific moisture content and the species-specific US EPA (2021) conversion factors. The values used for moisture content and conversion factors for muscle to whole body and egg-ovary to whole body are shown in Table IR-126-1 below. The resulting whole-body concentrations (Table IR-126-2) do not exceed either EPA (2021) or ECCC (2022) guidelines for whole-body tissue, which are 8.5 µg/g dw and 6.7 µg/g dw, respectively, and therefore the conclusions of the risk assessment are unchanged. Note that selenium was identified as a COPC in the risk assessment and a full quantitative risk assessment was completed including calculation of hazard quotients. No change to the EIS is warranted based on the results shown in the Table below. The calculations do not change the conclusions of the EIS of no significant adverse effect. Selenium is included as part of the environmental monitoring program throughout all phases of the Project.

Table IR-126-1: Moisture Content and Conversion Factors used for Selenium Calculations

Fish Species	Moisture Content (Aquatic Baseline Studies, Table A-17)	Muscle:Whole Body (Table B-4, B-5, US EPA 2021)	Egg-Ovary:Muscle (Table B-3, US EPA 2021)
Northern Pike	77.98	1.27	1.88
White Sucker	76.55	1.34	1

Table IR-126-2: Calculated Whole Body and Egg-Ovary

FEQG (µg/g dw)				6.7	14.7
Fish Species	Lake	Muscle µg/g fw	Muscle µg/g dw	Whole Body µg/g dw	Egg-Ovary µg/g dw
Northern Pike	Ref	1.89E-01	8.58E-01	0.68	1.61
	Whitefish Lake North	1.86E-01	8.45E-01	0.67	1.59
	Whitefish Lake Middle	1.57E+00	7.13E+00	5.61	13.40
	Whitefish Lake South	1.51E+00	6.86E+00	5.40	12.89
	McGowan Lake	1.02E+00	4.63E+00	3.65	8.71
	Russell Lake	8.12E-01	3.69E+00	2.90	6.93
White Sucker	Ref	1.46E-01	6.23E-01	0.46	0.62
	Whitefish Lake North	1.43E-01	6.10E-01	0.46	0.61
	Whitefish Lake Middle	1.74E+00	7.42E+00	5.54	7.42
	Whitefish Lake South	1.66E+00	7.08E+00	5.28	7.08
	McGowan Lake	1.06E+00	4.52E+00	3.37	4.52
	Russell Lake	8.06E-01	3.44E+00	2.57	3.44

2.

Selenium bioaccumulation factors (BAFs) were derived using regional data. Using measured fish tissue data and measured water concentrations to develop the BAF incorporates the selenium bioaccumulation through the food chain and would represent the transfer (enrichment function and trophic transfer) as shown in the figure below.

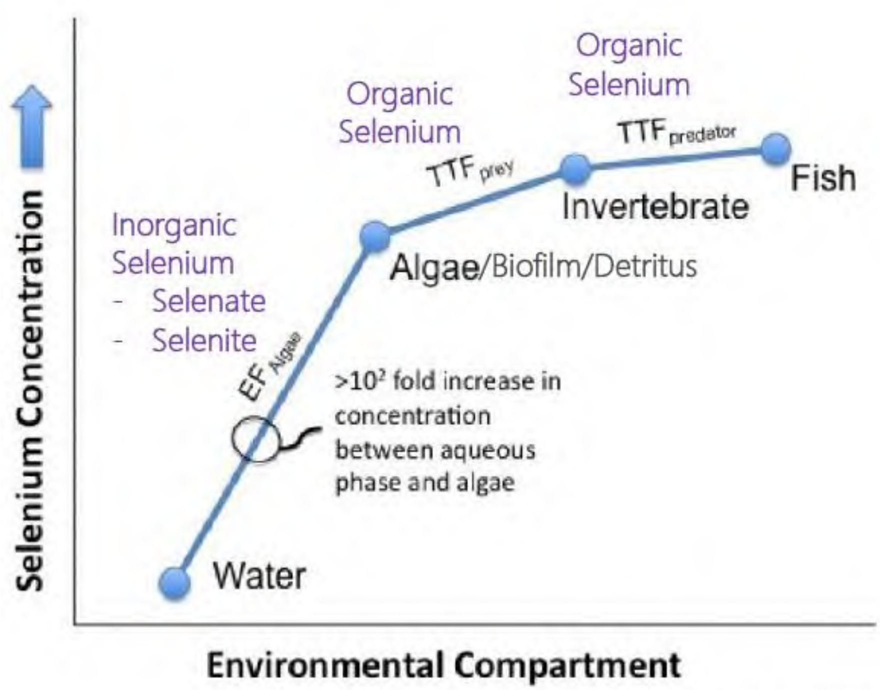


Image adapted from Chapman *et al.* (2009)

Large- and small-bodied fish were considered separately because selenium concentrations are based on different tissue analyses for these two groups: wet weight muscle and wet weight whole body, respectively. Tissue data were available for northern pike, cisco, lake trout, longnose sucker, lake whitefish, white sucker, lake chub and spottail shiner. The data comparisons resulted in the following conclusions:

- The same BAF can be applied to a fish species at different lakes;
- The BAF values for longnose sucker, cisco and lake trout were not significantly different from those for northern pike, therefore data from these species were combined to derive a BAF for northern pike;
- The BAF values for lake whitefish and white sucker were significantly different ($p<0.05$) from that for northern pike; and
- The BAF values for lake chub and spottail shiner were not significantly different ($p>0.05$) from each other, therefore data for these two species were combined to derive a BAF for small-bodied fish.

Most of the data from fish species evaluated demonstrated a linear relationship between fish tissue and water concentrations. The linear regression line was shown to underestimate selenium in northern pike tissue at low water concentrations. Therefore, a non-linear relationship was adopted for northern pike, where the BAF = $949x^{0.827}$ (x is in units of µg/L). As shown in the figure, the linear (dotted line) and power function (solid red curve) are quite similar except where the water concentrations were less than 0.001 mg/L. The R^2 values for the linear and power function are similar but the better fit at the lower water concentration values provided a basis for selecting the power function as the preferred model for the northern pike. Correlation analyses of the tissue and water concentration data for selenium indicated that a significant relationship ($p<0.05$) existed between the water and tissue concentrations in northern pike, white suckers, lake whitefish and small-bodied fish.

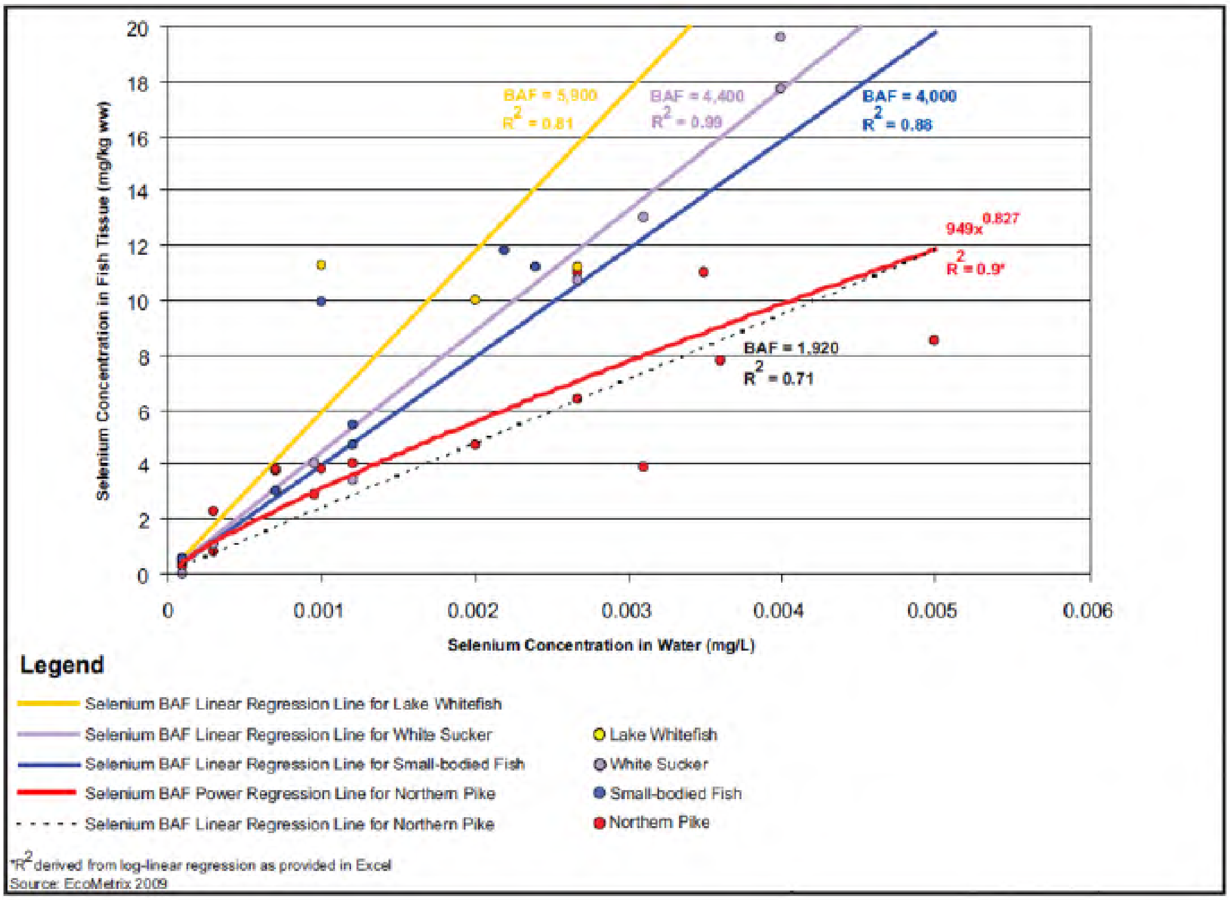


Figure IR-126-1: Development of Regional Fish BAFs for Selenium in Saskatchewan

References:

Chapman PM, Adams WJ, Brooks ML Delos CG, LuomaSN, Maher WA, OhlendorfHM, Presser TS and Shaw DP. 2009. Ecological Assessment of Selenium in the Aquatic Environment. SETAC Pellston Workshop, February 22-28, 2009, Pensacola, FL, USA.

EPA. 2021. 2021 Revision to: Aquatic Life Ambient Water Quality Criterion for Selenium 2016. EPA 822-R-21-006. U.S. Environmental Protection Agency.

Attachment IR-126 Round 4

As identified in Attachment IR-126 Round 3, selenium bioaccumulation factors (BAFs) were derived using regional data. Using measured fish tissue data and measured water concentrations to develop the BAF incorporates the selenium bioaccumulation through the food chain. For northern pike, a non-linear relationship was adopted where the BAF = $949x^{0.827}$ (x is the water concentration in units of µg/L).

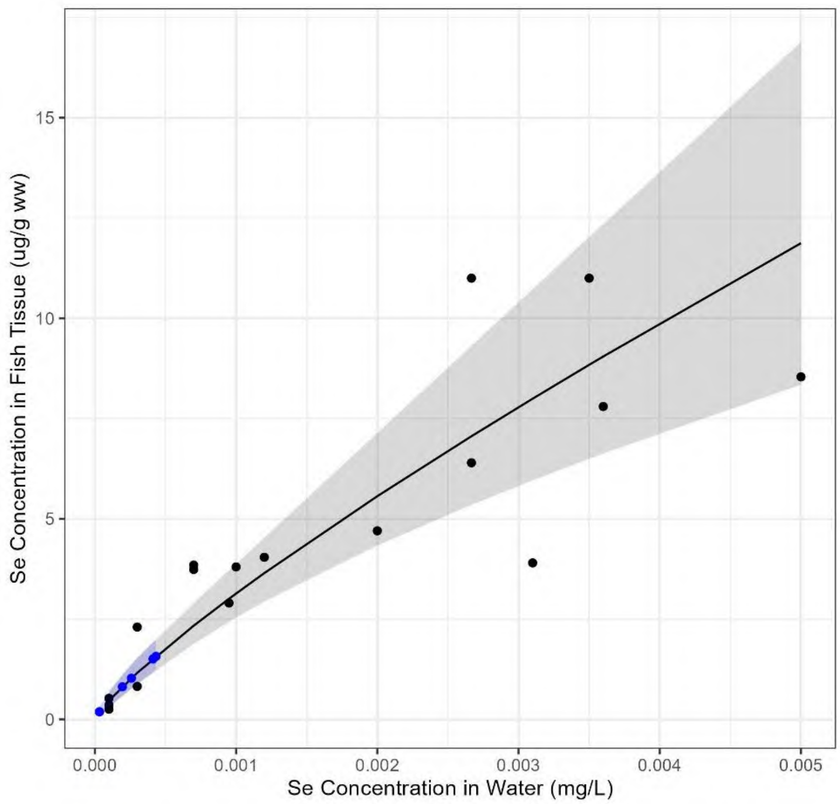
The whole-body concentrations were calculated from the predicted range of selenium in muscle tissue concentrations, using site-specific moisture content and the species-specific US EPA (2021) conversion factors. The resulting whole-body concentrations do not exceed either EPA (2021) or ECCC (2022) guidelines for whole-body tissue, which are 8.5 µg/g dw and 6.7 µg/g dw, respectively, and therefore the conclusions of the risk assessment are unchanged. Note that selenium was identified as a COPC in the risk assessment and a full quantitative risk assessment was completed including calculation of hazard quotients.

To evaluate the range of uncertainty in the northern pike BAF, a power-regression (log-log) of the water and fish tissue selenium data was used to generate the expected relationship between selenium in water and selenium in tissue. The model was a good fit to the data (R^2 = 0.88). The regression equation ($y = ax^b$) was:

$$Se_{[\text{tissue; µg/g ww}]} = a \times Se_{[\text{water; mg/L}]}{}^{b},$$

where the 95% confidence interval for ‘*a*’ was 295–3060 and for ‘*b’* was 0.66–0.99.

The predicted mean response and confidence ribbon for those values are shown in Figure IR-126-1 and Table IR-126-1. Analysis was completed in *R v.* 4.4.4 using base functions (e.g., *lm()* and associated *predict()*). Plots were generated using *ggplot v.* 3.5.5.



Note: Blue dots are Wheeler River predictions, black dots are regional data

Figure IR-126-1: Predicted Mean Response and Confidence Ribbon – Selenium in Fish

Table IR-126-1: Predicted Mean Lower and Upper Fish Tissue Selenium Concentrations

Fish Species	Lake	Water Concentration LA-5 mg/L	Fish Muscle Tissue (Mean Value) µg/g fw	Fish Muscle Tissue (Low Value) µg/g fw	Fish Muscle Tissue (Upper Value) µg/g fw
Northern Pike	Reference	3.35E-05	1.89E-01	1.06E-01	3.36E-01
	Whitefish Lake North	3.28E-05	1.86E-01	1.04E-01	3.31E-01
	Whitefish Lake Middle	4.33E-04	1.57E+00	1.23E+00	2.00E+00
	Whitefish Lake South	4.12E-04	1.51E+00	1.18E+00	1.93E+00
	McGowan Lake	2.59E-04	1.02E+00	7.65E-01	1.37E+00
	Russell Lake	1.95E-04	8.12E-01	5.85E-01	1.12E+00

Using the range of the uncertainty in the northern pike BAF (from Table IR-126-1), fish muscle tissue selenium concentrations were calculated for the various lakes, using site-specific moisture content and the species-specific US EPA (2021) conversion factors (see Table IR-126-2).

For reference, as indicated previously the whole body tissue and egg-ovary concentrations do not exceed the ECCC (2022) guidelines for the mean BAF. The resulting whole-body tissue and egg-ovary concentrations do not exceed the ECCC (2022) guidelines for the BAF lower range of uncertainty. At the upper range of the BAF, the egg-ovary concentration in Whitefish Lake exceeds the whole body guideline of 6.7 µg/g dw and the egg-ovary guideline of 14.7 µg/g dw from ECCC (2022). At all other lakes the predicted whole body and egg-ovary concentrations are below the selenium guidelines (see Table IR-126-3).

The results of the EIS are interpreted based on the expected mean BAF. Based on the expected selenium BAF, no significant adverse effects are predicted to northern pike from exposure to selenium. The uncertainty results requested by the CNSC provide a range (lower and upper) around the risk; however, there are numerous conservative assumptions in the overall assessment that would indicate the expected BAF is sufficiently conservative. The effluent quality in the EIS provides a bounding assessment and a conservative representation of risk; however, Denison plans to continue to refine effluent quality predictions as part of the BATEA assessment and licensing process. Additionally, selenium is included as part of the environmental monitoring program throughout all phases of the Project. Continued monitoring will provide the ability for adaptive management throughout the life of the mine, which is commensurate with the level of risk associated with the upper bound BAF.

Table IR-126-2: Calculated Whole Body and Egg-Ovary Selenium Concentrations – Expected Mean BAF

			FEQG (µg/g dw)	6.7	14.7
Fish Species	**Lake**	**Muscle µg/g fw**	**Muscle µg/g dw[(a)]**	**Whole Body µg/g dw[(b)]**	**Egg-Ovary µg/g dw[(c)]**
Northern Pike	Ref	1.89E-01	8.58E-01	0.68	1.61
	Whitefish Lake North	1.86E-01	8.45E-01	0.67	1.59
	Whitefish Lake Middle	1.57E+00	7.13E+00	5.61	13.40
	Whitefish Lake South	1.51E+00	6.86E+00	5.40	12.89
	McGowan Lake	1.02E+00	4.63E+00	3.65	8.71
	Russell Lake	8.12E-01	3.69E+00	2.90	6.93

Notes:

(a) The site-specific moisture content for northern pike of 77.98% was used to convert from fresh weight to dry weight.

(b) A Muscle:Whole Body ratio of 1.27 was used for northern pike from Table B-4, B-5, US EPA 2021

(c) An Egg-Ovary:Muscle ratio of 1.88 was used for northern pike from Table B-3, US EPA 2021

Table IR-126-3: Calculated Whole Body and Egg-Ovary Selenium Concentrations – Range of Uncertainty

						FEQG (µg/g dw)	6.7	6.7	14.7	14.7
Fish Species	**Lake**	**Water Concent-ration LA-5 mg/L**	**Fish Muscle Tissue (Lower Value) µg/g fw**	**Fish Muscle Tissue (Upper Value) µg/g fw**	**Fish Muscle Tissue (Lower Value) µg/g dw**	**Fish Muscle Tissue (Upper Value) µg/g dw**	**Whole Body (Lower Value) [(b)] µg/g dw**	**Whole Body (Upper Value) [(b)] µg/g dw**	**Egg-Ovary (Lower Value) [(c)] µg/g dw**	**Egg-Ovary (Upper Value) [(c)] µg/g dw**
Northern Pike	Reference	3.35E-05	1.06E-01	3.36E-01	4.82E-01	1.53E+00	0.38	1.20	0.91	2.87
	Whitefish Lake North	3.28E-05	1.04E-01	3.31E-01	4.72E-01	1.50E+00	0.37	1.18	0.89	2.83
	Whitefish Lake Middle	4.33E-04	1.23E+00	2.00E+00	5.59E+00	9.07E+00	4.40	**7.14**	10.51	**17.06**
	Whitefish Lake South	4.12E-04	1.18E+00	1.93E+00	5.35E+00	8.74E+00	4.21	**6.88**	10.05	**16.44**
	McGowan Lake	2.59E-04	7.65E-01	1.37E+00	3.48E+00	6.24E+00	2.74	4.91	6.54	11.73
	Russell Lake	1.95E-04	5.85E-01	1.12E+00	2.66E+00	5.10E+00	2.09	4.02	5.00	9.59

Notes:
(a) The site-specific moisture content for northern pike of 77.98% was used to convert from fresh weight to dry weight.
(b) A Muscle:Whole Body ratio of 1.27 was used for northern pike from Table B-4, B-5, US EPA 2021
(c) An Egg-Ovary:Muscle ratio of 1.88 was used for northern pike from Table B-3, US EPA 2021
Bold indicates exceedance of the selenium guideline.

References:

Environment and Climate Change Canada (ECCC). 2022. Federal Environmental Quality Guidelines Selenium. August.

US EPA. 2021. 2021 Revision to: Aquatic Life Ambient Water Quality Criterion for Selenium 2016. EPA 822-R-21-006. U.S. Environmental Protection Agency.

IR-142, IR-159, IR-167 -R1

- Department: ECCC
- Project Effects Link: Migratory birds
- Reference to EIS, appendices, or supporting documentation: Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 8, 2024)	IR (ROUND 4, Sept. 16, 2024)	Denison Response (ROUND 4, Sept. 27 2024)
IR-142		**Context:** The Proponent did not conduct any field work to identify potential wolverine dens in the Project area and therefore did not present any mitigations for the potential impacts to wolverine dens. In Section 9.3.3.2.1, the Proponent states: "Denning females are sensitive to disturbance during denning season in February to April and may abandon their dens and, in some cases, their litter, which may decrease their reproductive success. " In Section 9.3.6, the Proponent states: "In the Project Area, 145.0 ha or 100% of available wolverine habitat is assumed to be removed and will not be available to wolverine for the duration of the Project (Table 9.3-13). Similarly, 145.0 ha (3.4%) of available wolverine habitat within the Wildlife LSA is anticipated to be removed, all from the Project Area, during site clearing in Construction. In the Terrestrial RSA, up to 0.5% (145.0 ha; from the Project Area) of available wolverine habitat is anticipated to be removed during site clearing in Construction." The residual effect assessment estimates that 8.2% of available wolverine habitat within the Terrestrial RSA may be altered or lost (Table 9.3-20). **Rationale**: As Wolverine is a Species at Risk Act Schedule 1 listed species, effects need to be identified, avoided, lessened and monitored. Mitigations, such as setback distances, should be used to protect important habitat features, such as dens. Wolverine occupy large home ranges and, therefore, need vast tracts of undisturbed land to maintain viable populations. The species avoids most human footprint types and linear features	1. Please provide additional information on whether the lost and/or altered wolverine habitat overlaps with wolverine home ranges. 2. Describe any important wolverine habitat feature (i.e., dens) that may be lost as a result of the Project. 3. Assess the need for pre-construction/pre-clearing surveys to identify any wolverine denning sites. 4. Please provide additional information on whether the remaining, available, undisturbed wolverine habitat size is suitable to maintain populations.	1. While wolverine were not observed during baseline studies for the Project, it is assumed that the Project (Project Area, LSA) may overlap with wolverine home ranges. As described in the EIS, wolverine occur in low densities across all forest stand and vegetation types but are generally absent from areas of human development and activities. 2. No wolverine dens were identified during any of the baseline studies. It is not anticipated that wolverine denning sites will be lost and/or altered because there are no specific landscape features typically used by wolverine as potential denning sites located in the Project footprint. Further, much of the proposed Project footprint will be developed within previously disturbed areas, including roads and cutlines. 3. Pre-construction surveys will be completed to identify all sensitive wildlife habitat features, including wolverine denning sites. 4. Most of the Project footprint is already disturbed through previous exploration activities. The total expected direct habitat loss of 169.6 ha includes the already disturbed areas. In the Terrestrial RSA, 8.2% of available wolverine habitat may be altered or lost; this includes 0.5% that will be cleared within the Project Area during Construction, and an additional 7.7% that may be altered through indirect effects (sensory disturbance). The magnitude of this effect was characterized as being "moderate" and the residual effect is not expected to result in a change that will alter wolverine habitat integrity to the point where it would not be able to sustain the regional populations of wolverine. This considers that no wolverine were observed during the baseline investigations, the small Project footprint, and the typically large size of a wolverine home range.	The information provided by the Proponent is complete, however, a follow up IR regarding survey methods for all pre-construction and pre-clearing surveys is required. See follow-up IR-142-159-167.	n/a	n/a	n/a	n/a	n/a
IR-159		Context and Rationale: Information presented in the draft EIS is insufficient to accurately predict Project impacts to breeding birds. The Proponent collected a single year of breeding songbird point counts and aerial waterfowl surveys (including avian species at risk). A single year of surveys in which birds may be unusually scarce or abundant could severely compromise interpretation of post-construction monitoring data. Additionally, data presented in the draft EIS is from 2017 and ECCC advises that more recent data is needed for a comprehensive baseline to verify Project impacts. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal Avian Modelling project contain information on avian densities and avian species at risk that could supplement field data. The national standard for major projects recommends a minimum of two years of field surveys to be provided, so that temporal variability can be considered when comparing post-construction against baseline records and other available data.	Supplement breeding bird point count data and aerial waterfowl data collected during 2017 with additional pre-construction field data or existing post-2017 data/modelling to provide a comprehensive baseline that can be used to verify Project impacts during construction and operational phases.	The baseline data presented in the draft EIS are sufficient for the intended purpose – that is the data are sufficient, in conjunction with regionally available data, to identify potential project effects. The data collected as part of the baseline studies for birds was focused on the habitat types and areas most likely to be disturbed as a result of the Project. Conducting additional baseline surveys for waterfowl, raptors, and breeding birds is not anticipated to result in changes to the assessment outcomes and predictions made as part of the effects assessment, which was habitat-based, for avian species. The assessment methods used a conservative approach with the assumption that following the implementation of site-specific mitigation measures, the proposed Project activities would have a residual effect on these species guilds regardless of species presence on site. As described in the EIS, pre-construction surveys will be conducted prior to the commencement of any vegetation clearing or soil disturbance. Avian species will also be routinely monitored throughout the life of the Project. Results from the surveys and monitoring activities are expected to inform the adaptive management process to update Project design and identify the need for additional mitigation measures, if required. Note: Section 9.4.3.3 of the draft EIS includes all available information from the HABISask database at the time of the assessment. While recent surveys from Environment and Climate Change Canada and the Saskatchewan Breeding Bird Atlas have expanded surveys into the northern boreal forest, these data are not yet publicly available or published to make inferences on population trends for	This response has not been accepted. The Proponent's response indicated that their opinion is that the data presented in the draft EIS is sufficient and that no updates to the draft EIS are needed. However, a single year of baseline data from 2017 is insufficient to assess Project impacts during the follow-up and monitoring program. Although pre-construction surveys prior to clearing can give a very localized picture of the avian community, it does not provide a baseline within the Regional Study Area (RSA) of the bird community and will be of limited use for comparing construction and operational monitoring data to baseline conditions. Use of more recent data or supplemental data	Denison and its SME continue to be of the opinion that the data on which the effects assessment is based are sufficient and fit for purpose as it concerns the EA process. The effects assessment was not based on the 2017 field survey data alone. The EA used an accepted, proven habitat-based EA approach to address the variability of population surveys. Further, the EA used all available, recent/relevant survey data collected in appropriately timed and executed methodologies, including IK. The supplemental avian data received from records from the Saskatchewan Breeding Bird Atlas downloaded through the NatureCounts web portal (Saskatchewan Breeding Bird Atlas 2017), which also includes data received as part of the Saskatchewan Boreal Monitoring Strategy program. These data represent bird observations from 24-point counts conducted on June 7 and June 9, 2019. Nine point-counts are located approximately 6.5 km east of the Project footprint, the majority of which are located in the BS3 ecosite type; 15 point-counts are located approximately 7.7 km south of the Project footprint, the majority of which are located in the BS3/BS7 ecosite type. During this survey effort, 24 migratory songbird species were documented. A summary of the total number of individuals observed for each species across all plots is provided in Appendix 9-F of the revised Draft EIS. While the supplemental data do provide further context for the RSA, they would not be expected to alter the findings or the mitigation measures proposed, nor the conclusions reached in the EA. The above does not preclude the implementation of further breeding bird surveys prior to site development and operations. Denison accepts the comment that additional, more recent information, as well as supplemental data as available, and will provide	n/a (accepted)	n/a	n/a	n/a

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				migratory songbirds that could use the available habitat in the Terrestrial RSA.	can account for interannual variation and any regional effects and will allow for a more accurate review of mitigation and follow-up measures. See follow-up IR-142-159-167-R1	the basis for a more effective review of mitigation and follow-up measures as the Project moves forward. The details of such follow-up monitoring will be defined as part of the further consideration of planning related to follow up programs. For clarification the pre-clearance wildlife sweeps are intended to identify sensitive wildlife features (e.g., hibernacula, roosting habitat, dens, nests, mineral licks) that would require site-specific mitigation measures to limit or avoid adverse effects. The spatial scale of where these pre-construction sweeps would be completed could be expanded to include other areas beyond the Project Area but within the RSA.				
IR-167	-	**Context and Rationale:** The Proponent has stated that when it is not practicable to clear outside of the breeding bird window, they will conduct pre-clearing surveys. Section 9.4.5.2.1 states: "Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting season, pre-clearing nest surveys will be conducted at that location within the Project Area." ECCC does not recommend the use of nest searches or pre-clearing surveys for active bird nests during the breeding season as a mitigation, given the difficulty associated with finding nests reliably and the high likelihood of disturbing nesting birds when searching. Instead, ECCC recommends that clearing and grubbing activities not be conducted during the breeding bird season. The Migratory Birds Regulations 2022 (MBR 2022) brings new scenarios that need to be considered: 1. Most migratory birds: - Nests are protected only when they are in use or when live eggs or chicks are present. 2. Migratory birds listed in MBR 2022 Schedule 1: - For the 18 species of migratory birds identified on Schedule 1, the MBR 2022 provide year-round nest protection until they can be deemed abandoned. 3. Migratory birds listed under SARA: - For some SARA listed migratory birds, the residence prohibition (s.33) will protect nests that are not active, but are re-used in subsequent years, and the critical habitat prohibition (s.58) will protect nests that are part of the critical habitat identification. Those prohibitions apply everywhere in Canada and at all times of the year. In these cases, a SARA permit will be required.	Provide the following information: • details on how vegetation clearing related to site development will be conducted to minimize risk to migratory birds and species at risk (SAR). • the timing window that will be used for vegetation removal to reduce risk to migratory birds and SAR	Site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for migratory birds and SAR (i.e., winter), where practical, to avoid disturbance during sensitive time periods. It is noted that additional information related to timing windows and species as it concerns Project activities has been provided in response to IR-134. Pre-clearing surveys will be conducted and set-back buffers implemented, as needed. The pre-clearance surveys will be completed prior to all clearing events, regardless of the time of year / season when clearing is set to occur. If nests or tree cavities should be encountered during pre-construction surveys or ongoing monitoring activities, any subsequent Project activities will be in accordance with the 2022 Migratory Birds Regulations.	Response is accepted, but also see AD-57 in the Advice to Proponent table and follow-up IR-142-159-167-R1.	n/a	Response is accepted, but also see AD-57 in the Advice to Proponent table and follow-up IR-142-159-167-R1.	See response to IR-142-159-167-R1 below.	n/a	n/a
n/a	IR-142, IR-159, IR-167 - R1		n/a	n/a	Provide survey methodology and timing for all preconstruction and pre-clearing surveys, including avian and species at risk surveys (caribou, wolverine).	As noted in the August 2023 IR responses, site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for migratory birds and SAR (i.e., winter), where practical, to avoid disturbance during sensitive time periods. However, in the event that site clearing activities or other works are anticipated to occur during a sensitive timing window for migratory birds and SAR, the pre-disturbance wildlife sweeps would be conducted by qualified biologists at least 7 days prior to any scheduled vegetation/land disturbance. The biologist would search the proposed area to be cleared, plus a 100 m buffer, for sensitive wildlife features that may be used by avian SAR (e.g., nests and/or nesting cavities), woodland caribou, and bats (e.g., roosting sites/cavities). The wildlife sweeps will not be species-specific surveys focused on species at risk per se, but will be based on timing of Project related activities (i.e., will be completed in advance of site clearing activities). These surveys are intended to identify sensitive wildlife features such as hibernacula, dens, nests, cavities, mineral licks, that would require specific mitigation measures to avoid or minimize adverse effects on identified features and are not species-specific. Nevertheless, the methods associated with these pre-construction and pre-clearing sweeps will be	The Proponent notes that: • Site clearing and other works that involve disturbance of vegetation and/or soil will be completed in winter. • Pre-disturbance wildlife sweeps would be conducted by qualified biologists at least seven days prior to any scheduled vegetation/land disturbance. • Mitigation measures to avoid or minimize adverse effects on identified features are not species specific. • The methods associated with these pre-construction and pre-clearing sweeps will be	The requested information on species at risk pre-clearance sweeps are summarized below in Attachment IR-142, IR-159, IR-167-R1 (Round 3). Denison and its SMEs believe we have provided sufficient information and analysis in the EIS, associated supporting documents and IR responses for the federal government to make a determination as to the effect of the Project on SAR, within the approved scope of the Project and *CEAA 2012*. Commensurate with the stage of the Project and EA process conceptual level detail for monitoring and follow-up programs (see EIS Appendix 16F) and a description of the programs fit into the overall environmental management system (EIS Section 2.9) have been provided. Further details regarding these programs	The Proponent notes that they will use visual searches for several bird SAR. This includes Bank Swallow, Barn Swallow, Common Nighthawk, and Horned Grebe. While visual observations are an appropriate method for detecting Barn and Bank Swallow nests, it is not suitable for detecting Common Nighthawk. The province of Saskatchewan provides appropriate protocols for detection of Common Nighthawk. The Proponent also notes that they will conduct call-playback or visual searches for Olive-sided Flycatcher and Short-eared Owl. While the call-playback surveys would be more likely to detect individuals in areas to be cleared, the visual searches are unlikely to be effective for these species. The Proponent should consider following the provincial detection survey protocols for Short-eared Owl and Olive-Sided Flycatcher.	1. To address this part of the Round 4 IR, the wildlife species at risk pre-clearance sweep methods and timing table (now included in the final EIS Appendix 9-D as Table 4-1) has been updated. In this table, the column "survey techniques" has been updated as follows: - common nighthawk – "visual search" changed to "call-playback" - short-eared owl – "call-playback or visual searches" changed to "call-playback." - olive-sided flycatcher – "call-playback or visual searches" changed to "call-playback." A reference to the Saskatchewan SDSPs have been added to the last column of Table 4-1. Finally, a footnote has been added to the table: "Surveys will be completed by qualified professional biologists; in their capacity as professional biologists, they will refer to available guidance such as the Saskatchewan species detection survey protocols to develop details of the surveys (e.g.,

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						tailored to species at risk that may potentially be using habitats at certain times of the year. For example, methods will include searching prominent topographic features such as rock outcropping or downed forest trees and debris where wolverine may establish denning sites. In the event the sweeps are conducted during the winter period, methods related to snow tracking would identify wolverine presence based on tracks and potential denning sites in the snow pack within ravines or drainages within the forested areas within the study areas (as per Resources Inventory Committee 1999). Additionally, methods will include searching for potential roost trees for bat species, as per protocols included in the Wildlife Habitat Features Field Guide (BC Ministry of Environment and Climate Change Strategy, Ecosystems Branch 2019). Depending on the results of these sweeps, appropriate mitigation measures will be developed and implemented. If sensitive wildlife features are found, they will be documented (e.g., photographs, GPS location recorded). The data collected would inform the development and implementation of appropriate mitigation measures (e.g., appropriate set-back distances for Project activities and/or consideration of timing windows as per SK MOE (2017), in consideration of applicable laws and regulations (e.g., Migratory Birds Conservation Act, Wildlife Act), as appropriate. **References:** B.C. Ministry of Environment and Climate Change Strategy Ecosystems Branch. 2019. Wildlife Habitat Features Field Guide (Kootenay Boundary Region). October 2019. Pp. 119 Resources Inventory Committee. 1999. Inventory Methods for Medium-Sized Territorial Carnivores: Coyote, Red Fox, Lynx, Bobcat, Wolverine, Fisher and Badger. Standards for Components of BC's Biodiversity No. 25. Ministry of Environment, Lands and Parks. Saskatchewan Ministry of Environment (SK MOE). 2017. Saskatchewan Activity Restriction Guidelines for Sensitive Species. https://publications.saskatchewan.ca/api/v1/products/79242/formats/89555/download (accessed July 2021).	tailored to species at risk that may potentially be using habitats at certain times of the year. • Methods will include searching for potential roost trees for bat species, as per protocols included in the Wildlife Habitat Features Field Guide (BC Ministry of Environment and Climate Change Strategy, Ecosystems Branch 2019). If sensitive features are found, then they will be documented, and data collected would inform the development and implementation of appropriate mitigation measures. It is unclear what is meant by "surveys are not species-specific" but sweeps will be "tailored to the species at risk". It is also unclear how mitigation measures will be developed and implemented in a seven-day period. In order for ECCC and CNSC to provide advice on potential effects to SAR based on the habitat potential mapping, the development of species-specific mitigation measures needs to be produced for review during this assessment process. The Proponent also needs to provide details on follow up and monitoring programs that are in place to confirm that the mitigation measures implemented are effective. In addition, ongoing monitoring is required for SAR. Denison is expected to describe the planned monitoring and follow-up programs for SAR. Denison must justify how the proposed methods are adequate to provide a baseline for each SAR, to verify that mitigation measures are effective, and to allow for statistically robust comparison to assess potential impacts on SAR over the lifecycle of the project.	have been provided in response to various IRs. Denison continues to refine the program level detail, and in parallel develop its plan level documentation to support CNSC licensing and provincial permitting. Any ongoing monitoring for SAR will be detailed in the Wheeler River Project's Environmental Management Program documentation, including for example the Biodiversity Management Plan. We also note that ongoing SAR management is under Provincial jurisdiction. For reference, within the EIS, the EMS framework is described in Section 2.9, wildlife monitoring plans are provided in Section 9.3.8, avian monitoring plans are provided in 9.4.8, and a summary of general and species-specific mitigation measures is provided in Appendix 9-D. Briefly, wildlife and avian species will be routinely monitored throughout the life of the Project in accordance with the wildlife monitoring plans. An adaptive management process will be employed, after applicable consultations and approvals, where implemented mitigation measures are found to be unsuccessful.	In order to resolve this IR, Denison are expected to: 1. Modify the Table in "Attachment IR-142, IR-159, IR-167-R1 (Round 3)" to incorporate appropriate protocols for detection of Common Nighthawk, Short-eared Owl, and Olive-Sided Flycatcher, as suggested by ECCC. 2. Incorporate the Table into the EIS documentation, e.g., Appendix 9-D. 3. Update any related commitments for pre-clearance / pre-disturbance surveys in their commitments register.	selecting the appropriate time of day for the survey)." 2. The table is now available in the final EIS (Appendix 9-D Table 4-1). 3. Existing commitment 9-3 has been updated and now reads (additions in **bold**): "To adequately address potential effects, regardless of the wildlife, seasonal or species-specific sensitivities, pre-disturbance wildlife clearance surveys (i.e., not species-specific surveys) will be completed prior to any work commencing. Results of the wildlife clearance surveys will be used to inform the design and delineation/establishment of suitable setback distances (i.e., specific to species, habitat, life-cycle sensitivities), work delays and/or other species-specific mitigation measures at that location, with discussions with ENV as appropriate. **The details on the methodology of species-specific pre-clearance sweep protocols and timing are provided in the Appendix 9-D of the final EIS.**"

Attachment IR-142, IR-159, IR-167-R1 (Round 3)

Table 1: Species at Risk Survey Methods

Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique	Timing	Action if Species Detected	Information Source
Northern Leopard Frog	Not observed.	Appendix 9-D	From winter sites, adult frogs travel up to 1.6 km to breed.	Wetlands/ water/ riparian / wet/ moist/ scrublands/ bogs/ fens.	Visual searches for egg masses or frogs.	Snow/ice-free early spring and spring season.	Pond setback; 10m (low); 200m (Mod) and 500m (High);	MOE (2017)
			They breed in the shallow, warm waters of a variety of wetlands including marshes, springs, flooded ditches, dugouts, borrow pits, beaver ponds, margins of lakes, and slow-moving waters of streams and rivers.		Auditory call surveys.	April 20 to June 10.		
			After breeding, adults and sub-adults may disperse up to 8 km from breeding ponds.					
			Northern Leopard Frogs usually do not utilize areas that are heavily wooded		Visual searches for egg masses or frogs.	Snow/ice-free early spring and spring season.		
			They forage in the summer in riparian or upland habitats. These areas are moist habitats including meadows, pastures, scrublands, riparian corridors, and drainage or irrigation ditches.		Visual searches for egg masses or frogs.	Snow/ice-free early spring and spring season.		
Little Brown Myotis and Northern Bat	34 ultrasonic detections of little brown/northern myotis.	Appendix 9-D	The presence of large snags, tree cavities, is an important attribute in old growth forest stands that provides maternity roosts and day roosts for northern myotis and little brown bats. Building are also used.	Treed areas with the largest diameter and/or older trees. Focus on older forest, or areas with large snags in younger forest within the project footprint (majority is regenerating forest 1-5m).	Daytime visual search of trees and potential roost sites. Systematic meandering search of areas to be cleared during active bat season. Focus on searching for roost features (snags, cracks, stumps, cavities, bark peeling) and bat sign (e.g., guano).	May to Sept	Should a roosting bat be discovered the area will be afforded protection from clearing for 24 hours and re-surveyed. The area will only be cleared if no bats are discovered. A 100 m buffer will be given to nursery roots and 50 m to daily roosting bats. If many roosting bats are recorded compensation will be considered (e.g., bat houses).	COSEWIC (2013a); Resources Information Standards Committee (RISC) (2022)

Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique	Timing	Action if Species Detected	Information Source
			Foraging habitat in proximity to roosting sites is also an important factor in roost selection.	Treed areas in proximity to clearings, wetlands and open water.		Year Round	Roost/Foraging site; 100m(low); 500m (Mod) and 500m (High);	MOE (2017)
Wolverine	Not observed.	Section 9.3	A wide variety of forested and vegetation associations are used by wolverine. Habitats must have an adequate year-round supply of food, mainly consisting of smaller prey such as rodents and Snowshoe Hares, and the carcasses of large ungulates, like Moose, Caribou, and Muskox.	All areas of project activity.	Winter den searches.	Snow cover months.	Setback of 250m when occupied and 100m when unoccupied.	COSEWIC (2014); Environmental Protection and Management Guideline (2024)
			Females den under snow-covered rocks, logs or within snow tunnels. Wolverines reproduce in areas where snow cover persists at least into April.					
Woodland Caribou	Observed.	Section 9.3	Woodland caribou may occupy all potential project areas but prefer forests greater than 40 year of age.	All areas of project activity.	Visual search to ensure no caribou are in the area. Ongoing vigilance.	Year Round	If caribou are in the area cease operations until they are clear of the area.	SME (2021)
Rusty Blackbird	Not observed.	Section 9.4	Rusty blackbird primarily nests in small conifers, predominantly spruce. In Canada, nests have also been found in Balsam Fir, Eastern White Cedar, Paper Birch, Balsam Poplar, Red Maple, Pin Cherry, emergent sedges, cattails, and on the ground on a beaver dam	All habitat with spruce, white birch and balsam poplar. Very limited suitable (spruce) habitat within project footprint.	Visual search for nests.	MBCA window	A 75 m buffer around coniferous bogs, fens and other wetlands suitable for Rusty blackbirds (Odsen and Pyper 2019).	Environment Canada. (2015); Odsen and Pyper (2019); Wildlife Division (2020)
			We only have spruce, birch and poplar at Wheeler.			May 1 to July 31	Nest setback of 0-50m (low activity); 150m (Mod activity) and 300m (High activity);	Manitoba Conservation (2021)
Yellow Rail	Not observed.	Section 9.4	Yellow rails inhabit shallow wetlands and other wet areas with grass-like vegetation.	Using available mapping conduct daytime Ecosite verification and stratify surveys in appropriate habitat only. Based on available mapping, no suitable habitat within project footprint.	Mid May to mid to late June. Triplicate nocturnal (23:00-03:00) call-playback surveys spaced at least 4 days apart. Or use Autonomous Recording Units throughout the breeding season.			Environment Canada (2012); SME (2014)
			They breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes					
			These wetlands are generally dominated by short, fine-stemmed herbaceous vegetation, especially sedges (Carex spp.), as well as other graminoid vegetation of the families Cyperaceae, Poaceae, and Juncaceae. Vegetation structure (e.g. short, grass-like, and dense) is likely more important than its taxon					

Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique	Timing	Action if Species Detected	Information Source
			Breeding habitats may have up to 50 cm of standing water, but typically nesting sites are less than 15 cm deep			May 1 to July 15	Nest site setback; 100m(low); 150m (Mod) and 350m (High);	MOE (2017)
Bank Swallow	Not observed.	Appendix 9-D	The Bank Swallow readily breeds in a wide variety of low-elevation (< 900 m), natural and anthropogenic habitats, including: lake and ocean bluffs; stream and river banks; sand and gravel pits; roadcuts; and piles of sand, topsoil, sawdust, coal ash, and other materials.	Survey key habitat features identified as important.	Visual survey during timing window.	May 15 to July 31	Nesting Colony Setback; 50m (low); 150m (Mod) and 300m (High);	Manitoba Conservation (2021)
			Nest burrows are nearly always in a vertical or near-vertical bank (range: 76-105° slope;					COSEWIC (2013b)
			In some cases, Bank Swallows have nested in drain pipes and in structures designed and built specifically for nesting Bank Swallows					
Barn Swallow	Four visual/auditory detections.	Appendix 9-D	Nest on horizontal and vertical structures that include natural sites, such as cliffs and caves, as well as human-made structures, such as barns, bridges, and culverts . The nesting substrate must be rough, or have a ledge or projecting objects, such as bolts or light fixtures, to provide additional structural support to the nest.	Open areas in proximity to water. All buildings and man made structures.	Visual.	May 15 to Sept 30	Nest site setback; 50m (low); 100m (Mod) and 100m (High);	Manitoba Conservation (2021)
			Nesting sites must provide access to open areas with an abundant supply of aerial insects to feed on; features such as wetlands, waterbodies, watercourses, meadows, grazed grassland, and farmland are preferred . Proximity to a waterbody or moist area with a supply of wet mud is needed to facilitate nest construction.					COSEWIC (2021a)
Common Nighthawk	Two nests, five visuals and 76 auditory/visual detections.	Section 9.4	Nests are typically in open sites with dry, well-drained substrates that will not overheat and that have shade nearby for young to shelter from the sun and predators. Nest sites include forest clearings, bare patches in grassland, gravel pits, outcrops, road or rail sides, and, rarely, fenceposts.	All upland habitat.	Visual searches.	May 1 to Aug 31	Nest site setback; 0-50m (low); 150m (Mod) and 300m (High);	MOE (2017)
Horned Grebe	One observation.	Appendix 9-D	More than 90% of the Horned Grebes in North America breed in ponds and lakes in western and northern Canada.	Water bodies within the project area.	Visual searches.	May 1 to Sept 15	Nest site setback; 100m (low); 200m (Mod) and 400m (High);	Manitoba Conservation (2021)
								COSEWIC (2009)

Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique	Timing	Action if Species Detected	Information Source
Olive-sided Flycatcher	Fourteen observations.	Section 9.4	Olive-sided Flycatcher has been widely observed in open coniferous or mixed coniferous forests, often located near water or wetlands with the presence of tall snags or trees	All conifer and/treed upland areas.	Call-playback or visual searches.	May 1 to Aug 31	Nest setback; 100m (low); 300m (Mod) and 500m (High);	MOE (2017)
			Data gathered from points across Canada indicate that mature conifer stands within patchy landscapes influenced by natural disturbance (e.g., recent burns) support the highest densities					Environment Canada (2016)
			Olive-sided Flycatcher prefers post-burn areas or wetlands that create open habitats for the species to forage					
Short-eared Owl	Not observed.	Section 9.4	Nesting generally occurs in large open areas	Open upland and lowland areas with no trees and some shrub cover.	Call-playback or visual searches.	March 25 to Aug 1	100m (low); 300m (Mod) and 500m (High);	MOE (2017)
			Requires a minimum area of about 50-100 ha, consistent with the mean territory size of 82 ha reported in Manitoba.					COSEWIC (2021b)
			In the north, nests are primarily in tundra (Sinclair et al. 2003), and sometimes beside a small shrub that provides cover					

References:

COSEWIC 2021a. COSEWIC Assessment and Status Report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the status of Endangered Wildlife in Canada (COSEWIC). Special concern 2021.

COSEWIC 2021. COSEWIC Assessment and Status Report on the Short-eared Owl *Asio flammeus* in Canada. Committee on the status of Endangered Wildlife in Canada (COSEWIC). Threatened 2021

Environment Canada. 2016. Recovery Strategy for the Olive-sided Flycatcher (*Contopus cooperi*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 52 pp.

COSEWIC. 2014. COSEWIC assessment and status report on the Wolverine *Gulo gulo* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 76 pp.

COSEWIC. 2013a. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis* and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiv + 93 pp.

COSEWIC. 2013b. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 48 pp

COSEWIC. 2009. COSEWIC assessment and status report on the Horned Grebe *Podiceps auritus*, Western population and Magdalen Islands population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 42 pp.

Environmental Protection and Management Guideline. 2024. VERSION 3.1: July 2024. British Columbia Energy Regulator. 104pp.

Saskatchewan Ministry Environment (SME). 2021. Saskatchewan Ministry of the Environment Crown Land Work Authorization (2021). Denison Wheeler Project Area.

Environment Canada. 2015. Management Plan for the Rusty Blackbird (*Euphagus carolinus*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. iv + 26 pp.

Environment Canada. 2012. Management Plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. iv + 23 pp.

Odsen, S. and M. Pyper. 2019. Rusty blackbird forestry fact sheet. Foothills Research Institute. Summaries and Communications Fact Sheets.

Manitoba Conservation. 2021. Recommended Development Setback Distances and Restricted Activity Periods for Birds by Wildlife Feature Type Manitoba Conservation Data Centre 2021 November

Ministry of Environment (MOE 2017), Fish, Wildlife and Lands Branch. April 2017. Activity Restriction Guidelines for Sensitive Species. Regina, Saskatchewan. 4pp.

Resources Information Standards Committee (RISC). 2022. Inventory Methods for Bats, Standards for Components of British Columbia's Biodiversity No. 20. Version 3.0. B.C. Ministry of Land, Water and Resource Stewardship, Ecosystems Branch, Victoria, B.C.

Saskatchewan Ministry of the Environment (SME) 2014. Yellow Rail Survey Protocol. Fish and Wildlife Branch Report No. 2014-14.0. 3211 Alberta Street, Regina, Saskatchewan. 8pp.

Wildlife Division. 2020. Management Plan for the Rusty Blackbird (*Euphagus carolinus*) in Newfoundland and Labrador. Department of Fisheries, Forestry and Agriculture, Government of Newfoundland and Labrador, Corner Brook, Canada. v + 23 pp.

IR-170

- Department: ECCC
- Project Effects Link: Migratory birds
- Reference to EIS, appendices, or supporting documentation: Section 9.4.6.4, Residual Effects Evaluation for Bird SAR, Table 9.4-19

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 8, 2024)	IR (ROUND 4, Sept. 16, 2024)	Denison Response (ROUND 4, Sept. 27 2024)
IR-170	-	**Context and Rationale:** The table and map presented by the Proponent do not appear representative of all available habitat for common nighthawk (CONI). Although CONI do preferentially use open areas such as gravel (often an anthropogenic disturbance) and regenerating forest, as identified in the draft EIS, they also use rock outcrops that can be within forested areas. As this area lies within the pre- Cambrian shield, there are likely rock outcrops that are also available habitat. As aerial insectivores, CONI select nesting areas in close proximity to wetlands or lakes where there is abundant forage. Habitat requirements and preferences for all species at risk is required for developing effective mitigations and adaptive management.	1. Provide an updated table and map that considers all available habitat for common nighthawk. 2. Additionally, as part of environmental management plans the Proponent should include species-specific mitigations that are biologically relevant to all the species at risk for all Project phases and components.	1. The methodology for the habitat-based assessment appropriately evaluated potential adverse effects on avian species. The VCs and KIs were selected following extensive consultation with Indigenous nations and communities and other Interested Parties; the VCs and KIs appropriately focused the EA; no updated table or map is considered to be required. In addition, further mapping is not expected to affect or change the findings and conclusions of the draft EIS. 2. Common Nighthawk were observed in the Project study areas during the baseline studies and are considered to be present and breeding. Rocky outcrops were not reported during the baseline studies (see Section 9.2.3). Pre-clearing surveys will be conducted, set-back buffers implemented, and pre-clearing survey and monitoring results will be used for adaptive management purposes (see also response to IR-159). Species-specific mitigation appropriate for Common Nighthawk is largely related to loss and/or alteration of habitat (including both direct and indirect effects).	This response has not been accepted. Part 1 of the IR was addressed, however, part 2 has not been addressed. ECCC requires this information to properly assess potential the mitigations and adaptive management for Common Nighthawk.	Based on the baseline field survey observations (n=38) for common nighthawk, the majority of observations (n=20) were in association with anthropogenic (disturbed) ecosite types, while the remainder (n=10) were associated with the jack pine-blueberry/black spruce-blueberry/lich (BS3/BS7) ecosite. Updates to Figure 9.4-7, Figure 9.4-12 and Table 9.4-19 of the revised draft EIS have been completed to include all habitat (ecosite) types. See separate response to IR-170: Available Habitat for Common Nighthawk. Figure 9.4-12 in the revised draft EIS has been replaced in the EIS with a revised figure that includes all ecosite types. Mitigation measures that would pertain to common nighthawks are included in Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance, which state that site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, whenever practicable. The nesting season for the Raptors, Migratory Breeding Birds, and Bird Species at Risk VCs in Saskatchewan spans a period from March 15 to August 31. Further, in the event site clearing is necessary within this time frame, pre-clearance wildlife sweeps will be completed where common nighthawks are suspected of nesting; if an occupied nest is found, applicable activity restriction guidelines would be implemented (as per SK MOE 2017). **References:** Saskatchewan Ministry of Environment (SK MOE). 2017. Saskatchewan Activity Restriction Guidelines for Sensitive Species. https://publications.saskatchewan.ca/api/v1/products/79242/formats/89555/download (accessed July 2021).	Item one was accepted, but item two remains outstanding. In Section 9.4.5.2.1, the Proponent has not included species specific mitigations for all species at risk, including common nighthawk. The Proponent should include species specific mitigations for all species at risk, including common nighthawk, so that ECCC can provide advice on the extent of Project impacts to these species. Additionally, the Proponent indicates that prior to site clearing during the nesting season (period from March 15 to August 31), pre-clearing nest surveys will be conducted. ECCC does not typically recommend nest surveys as a pre-clearing activity (please refer to the Advice to the Proponent relating to IR-170). In some instances, surveying for breeding activity using non-invasive methods could be required to determine species presence, and for some migratory birds SAR it may be required to survey for nest trees (residences) prior to clearing as these have year-round protection through SARA and a permit may be required. Specifically, it is not adequate to group SAR together (e.g., all birds) due to the unique life history and habitat requirements of each individual SAR. Denison is expected to provide species-specific mitigation measures for each SAR separately.	See response to IR-142-159-167-R1.	Following the supplementary information provided by Denison on July 8th, CNSC staff determined that Denison has not provided the requested information on species-specific mitigation measures for each SAR. It is not adequate to group SAR together (e.g., all birds) due to the unique life history and habitat requirements of each individual SAR. Denison is expected to provide species-specific mitigation measures for each SAR separately. In order to resolve this IR, Denison are expected to: •Provide species-specific mitigation measures for each individual SAR. Denison may provide this information through revision of Section 3.3 and Table 4.1 in EIS Appendix 9-D.	The requested updates have been made in Appendix 9-D of the final EIS (October 2024).


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Appendix 9-D Wildlife Species At Risk

Appendix to final EIS, Section 9

Version 3~~2~~

~~January 2024~~October 2024

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Tables

Acronyms and Abbreviations

Term	Definition
BBS	Breeding Bird Survey
BC	British Columbia
CEA	Cumulative effects assessment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EMS	Environmental Management System
FIRT	Federal-Indigenous Review Team
IRs	Information requests
ISR	In situ recovery
KI	Key Indicator
LSA	Local Study Area
Project	Wheeler River Project
QP	Qualified Professional
RSA	Regional Study Area
SAR	Species at risk
SARA	*Species at Risk Act*
SARGSS	Saskatchewan Activity Restriction Guidelines for Sensitive Species
SKCDC	Saskatchewan Conservation Data Centre
VC	Valued Component

1 Introduction

1.1 Background

On October 21, 2022, Denison Mines Corp. (Denison) submitted a draft Environmental Impact Statement (EIS) for the proposed Wheeler River Project (the Project). Based on their initial review, the Canadian Nuclear Safety Commission indicated that the submission contained the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review of the draft EIS. On March 20, 2023, the FIRT provided Denison with a list of information requests (IRs) for Denison to respond to and eventually submit a final EIS document.

This Appendix provides additional information to address several IRs provided by Environment and Climate Change Canada (ECCC) as part of the initial round of Federal Indigenous Review Team (FIRT) comments. These IRs were related to 16 wildlife species at risk (SAR) listed under Schedule 1 of the federal *Species at Risk Act* (SARA). The draft EIS approach was conservative in that it considered appropriate representative species as Valued Components (VCs) and Key Indicators (KIs) in sections 9.3 Ungulates, Furbearers, and Woodland Caribou and 9.4 Raptors, Migratory Breeding Birds, and Bird SAR. Of the 16 wildlife SAR listed in Table 1-1, seven had been included as VCs or KIs in the EIS after a thorough scoping process (refer to Section 1.2 for additional information).

Nine of the sixteen were not included as individual VCs or KIs but are considered important from a regulatory perspective. The SARA-listed species identified by ECCC are listed in Table 1-1. Those noted in bold font indicate those for which further assessment is provided in this appendix.

Table 1-1~~1.1~~ Wildlife Species at Risk Listed by Environment and Climate Change Canada

Common Name	Scientific Name	Discussed in the ~~Draft~~ Section 9 of the draft EIS
Nine-spotted lady beetle	***Coccinella ovemnotata***	**No**
Transverse lady beetle	***Coccinella transversoguttata***	**No**
Yellow-banded bumble bee	***Bombus terricola***	**No**
Northern leopard frog	***Lithobates pipiens***	**No**
Little brown myotis	***Myotis lucifugus***	**No**
Northern myotis	***Myotis septentrionalis***	**No**
Wolverine	*Gulo gulo*	Yes
Woodland caribou	*Rangifer tarandus caribou*	Yes
Bank Swallow	***Riparia riparia***	**No**
Barn Swallow	***Hirundo rustica***	**No**
Common Nighthawk	*Chordeiles minor*	Yes
Horned Grebe	***Podiceps auritus***	**No**
Olive-sided Flycatcher	*Contopus cooperi*	Yes

Common Name	Scientific Name	Discussed in the ~~Draft~~ Section 9 of the draft EIS
Rusty Blackbird	*Euphagus carolinus*	Yes
Short-eared Owl	*Asio flammeus*	Yes
Yellow Rail	*Coturnicops noveboracensis*	Yes

Of the 16 species listed in Table 1-1, seven had been included as VCs or KIs in the EIS after a thorough scoping process, as summarized below.

1.2 Valued Component Selection

The VCs considered in the effects assessment for the Project are aspects of the biophysical and human environments that were considered to be likely to be affected (adversely or positively) by the Project. The VCs reflect identified scientific, local knowledge, and Indigenous Knowledge, and community interests regarding the Project and its potential effects. The potential effects are typically identified early in the environmental assessment process as a result of questions and concerns raised through engagement with Indigenous and community groups, government departments and agencies, and the general public.

Denison reviewed and considered all received input to develop a VC list that reflects the key environmental, socio-economic, heritage, and human health components and interests to appropriately focus the EA.

The initial VCs selected to represent bird SAR in the habitat-based assessment that were provided in the Terms of Reference (Denison 2019) were evaluated, consolidated, and organized to allow for the logical assessment of Project effects, and are presented in Table 1-2 and Table 1-3, which formed the basis for the subsequent VC-specific assessment.

Table 1-2~~1.2~~ Wildlife Species at Risk Valued Component and Rationale for their Inclusion in the Habitat-based Environmental Assessment for the Denison Wheeler River Project

Valued Component	Rationale
Biophysical Environment	
Terrestrial Environment	
Furbearers	Project activities and infrastructure may affect local furbearer populations, including species at risk (SAR), resulting in non-compliance with permit conditions (e.g., *Species at Risk Act* [SARA; Government of Canada 2022], *The Wildlife Act 1998* [Government of Saskatchewan 2020]).
Woodland Caribou	Project activities and infrastructure may affect woodland caribou populations, resulting in non-compliance with permit conditions (e.g., SARA [Government of Canada 2022], *The Wildlife Act, 1998* [Government of Saskatchewan 2020]).

Valued Component	Rationale
Bird Species at Risk	Project activities and infrastructure may affect bird SAR (specifically disturbance and/or destruction of eggs, young, and adults) resulting in non-compliance with regulatory requirements (e.g., SARA [Government of Canada 2022], *Migratory Birds Convention Act 1994* [Government of Canada 2017], *Saskatchewan Activity Restriction Guidelines for Sensitive Species* [Government of Saskatchewan 2017], *The Wildlife Act 1998* [Government of Saskatchewan 2020]).

Table 1-3~~1.3~~ Valued Components, Key Indicators, and Measurable Parameters for the Wildlife Component included in the Habitat-based Environmental Assessment for Denison Wheeler River Project

Valued Component	Key Indicator	Measurable Parameter
Furbearers	Wolverine	Amount of habitat (km^2) (not necessarily occupied) that may be altered or lost relative to its availability in the Regional Study Area (RSA). The number of wolverine mortalities directly or indirectly attributable to the Project.
Woodland Caribou	Woodland caribou	Amount of habitat (km^2) (not necessarily occupied) that may be altered or lost relative to its availability in the RSA. The number of woodland caribou mortalities directly or indirectly attributable to the Project.
Bird Species at Risk	Common Nighthawk	Percentage of habitat for Common Nighthawk altered/lost directly or indirectly as a result of Project activities. The number of Common Nighthawk mortalities directly or indirectly attributable to the Project.
	Rusty Blackbird	Percentage of habitat for Rusty Blackbird altered/lost directly or indirectly as a result of Project activities. The number of rusty blackbird mortalities directly or indirectly attributable to the Project
	Olive-sided Flycatcher	Percentage of habitat for Olive-sided Flycatcher altered/lost directly or indirectly as a result of Project activities. The number of Olive-sided Flycatcher mortalities directly or indirectly attributable to the Project
	Short-eared Owl	Percentage of habitat for Short-eared Owl altered/lost directly or indirectly as a result of Project activities. The number of Short-eared Owl mortalities directly or indirectly attributable to the Project.

Valued Component	Key Indicator	Measurable Parameter
	Yellow Rail	Percentage of habitat for Yellow Rail altered/lost directly or indirectly as a result of Project activities. The number of Yellow Rail mortalities directly or indirectly attributable to the Project.

The five bird species identified in Table 1-3 were selected as SAR VCs for the habitat-based EA in consideration of information/responses received during extensive Indigenous and community engagement completed by Denison, and they represent wildlife species of local importance. For these five species, additional information is not be provided in this Appendix. Rather, the reader is referred to the applicable sections in the EIS where appropriate information on existing conditions (Section 9.4.3.3), potential project-related effects (Section 9.4.4), mitigation measures (Section 9.4.5), residual effects and their significance (Section 9.4.6), and cumulative effects (Section 9.4.7) is provided.

2 Supplemental Information

As requested by ECCC, the following subsections provide supplemental information for the remaining nine species listed in Table 2-1 that were not included as VCs or KIs in the EIS. For these nine species, a brief overview of life history requirements (existing environment), a discussion on the effects assessment and mitigation measures, and a summary of residual and cumulative effects are included.

Table 2-12.1 Wildlife Species At Risk Considered in the Wheeler River Project Environmental Impact Statement

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Arthropods						
Nine-spotted lady beetle	*Coccinella novemnotata*	S4	Endangered	Habitat generalist – uses a diverse range of habitats and consumes a variety of prey. See Section 2.1.1 for further details.	Local Study Area (LSA) is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a Valued Component (VC) in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Transverse lady beetle	*Coccinella transversoguttata*	S4	Special Concern	Habitat generalist – uses a diverse range of habitats and consumes a variety of prey. See Section 2.1.2 for further details.	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Yellow-banded bumble bee	*Bombus terricola*	S4	Special Concern	Habitat generalist – uses a variety of habitats and consumes nectar and pollen from many different flowering plants. See Section 2.1.3 for further details.	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Amphibians						
Northern leopard frog	*Lithobates pipiens*	S3	Special Concern	Three district habitats: (1) overwintering waterbodies that are cold, well oxygenated, and do not freeze to bottom; (2) breeding and larval waterbodies with shallow, open habitats, neutral pH, and no fish; and (3) summering areas in shallow	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date. Amphibian nocturnal call	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				marshes, moist upland meadows where grass height is less than 1 m. See Section 2.2.1 for further details.	and visual search surveys were completed in the LSA and Regional Study Area (RSA) as part of the baseline program; however, only boreal chorus frogs (*Pseudacris maculata*) were detected (Appendix 9-C).	
Bats						
Little brown myotis	*Myotis lucifugus*	S4B, S4N	Endangered	Seasonal habitat requirements: (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies. See Section 2.3.1 for further details.	Documented during the acoustic bat surveys as part of the baseline field program as present in the LSA and RSA, and previously observed in the RSA (SKCDC 2023).	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Northern myotis	*Myotis septentrionalis*	S3	Endangered	Seasonal habitat requirements: (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies. See Section 2.3.2 for further details.	Documented during the acoustic bat surveys as part of the baseline field program as present in the LSA and RSA (Appendix 9-C).	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Terrestrial Wildlife Species						
Wolverine	*Gulo gulo*	S2	Special Concern	See Section 9.3.3.2 of the EIS for details.	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Included as a Key Indicator (KI) of the Furbearer VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Woodland caribou	*Rangifer tarandus caribou*	S3	Threatened	See Section 9.3.3.3 of the EIS for details.	Documented within the RSA during the baseline field program (Appendix 9-C)	Included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Avian Species						
Bank Swallow	*Riparia riparia*	S4B, S5M	Threatened	Nesting colonies are typically characterized by steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows. They are often adjacent to slow-moving or still waterbodies and may occur in natural habitats or in anthropogenic features. Bank Swallows are aerial insectivores that forage over a variety of open habitats. See Section 2.4.1 for further details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Not included as a KI of the Bird Species at Risk (SAR) VC in the EIS (Common Nighthawk was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).
Barn Swallow	*Hirundo rustica*	S4B	Threatened	Breeding habitat typically requires a suitable nesting site with a vertical or horizontal surface underneath a roof of	Documented during the breeding bird surveys as part of the baseline field	Not included as a KI of the Bird SAR VC in the EIS (Common Nighthawk was used as a surrogate species). A review of life history

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				some sort, open areas for foraging, and a waterbody with mud for nest building. Anthropogenic features such as barns, houses, bridges, and culverts are commonly used nesting sites. See Section 2.4.2 for further details.	program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).
Common Nighthawk	*Chordeiles minor*	S4B	Special Concern	See Section 9.4.3.3 of the EIS for details.	Documented during the baseline field program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Horned Grebe	*Podiceps auritus*	S5B	Special Concern	Breeding habitat consists of small to medium-sized freshwater lakes, ponds, and marshes that are shallow with open water (at least 40%), emergent vegetation, anchorage for nests, and concealment for nests and young. See Section 2.4.3 for further details.	Documented during the baseline field program as present in the LSA (Appendix 9-C).	Not included as a KI of the Bird SAR VC in the EIS (Yellow Rail was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).
Olive-sided Flycatcher	*Contopus cooperi*	S4B	Special Concern	See Section 9.4.3.3 of the EIS for details.	Documented during the baseline field program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Rusty Blackbird	*Euphagus carolinus*	S3B, SUN	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Short-eared Owl	*Asio flammeus*	S3B, S2N	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Yellow Rail	*Coturnicops noveboracensis*	S3B	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.

Note: shaded rows indicate SAR was included as a VC or KI in the draft EIS

1 Schedule 1 under the *Species at Risk Act*.

2 Potential for Occurrence – based on known species occurrence data from Saskatchewan Conservation Data Centre (2023), Omnia (Appendix 9-C), Birds of Saskatchewan (2019), and Atlas of Saskatchewan Birds (Smith 1996) and/or presence of suitable habitat.

2.1 Arthropods

2.1.1 Nine-Spotted Lady Beetle

Source: COSEWIC (2016a).

The nine-spotted lady beetle is a small beetle species found across southern Canada and the continental United States (COSEWIC 2016a). Its northern range limit in Saskatchewan is reported to occur near Lake Athabasca (COSEWIC 2016a). Based on records provided by the Saskatchewan Conservation Data Centre Hunting, Angling and Biodiversity of Saskatchewan (HABISask) database (SKCDC 2023), there are no historical observations of this species documented in the Regional Study Area (RSA).

The nine-spotted lady beetle is a habitat generalist that uses a diverse range of habitats (e.g., open to semi-open forests, grasslands, riparian areas) and consumes a variety of prey (e.g., many species of arthropods [particularly aphids], sap, nectar and pollen) (COSEWIC 2016a). Being a habitat generalist allows the nine-spotted lady beetle to exploit seasonally available prey sources, with prey availability influencing the species' distribution more than habitat availability (COSEWIC 2016a).

The nine-spotted lady beetle has four life stages (i.e., egg, larva, pupa, and adult) and may produce two generations per year (i.e., spring and fall) depending on regional climate conditions (COSEWIC 2016a). Lady beetles, in general, are highly mobile and may undertake short (few hundred metres) and long-distance (18 to 120 km) movements (COSEWIC 2016a). The nine-spotted lady beetle is not migratory nor does it display strong site fidelity (COSEWIC 2016a). The nine-spotted lady beetle overwinters in aggregations in well-ventilated habitats (e.g., in rock crevices, grass tussocks, or leaf litter, or under stones or tree bark), becoming active in the early spring when temperatures start to increase (COSEWIC 2016a).

The nine-spotted lady beetle is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). The species has undergone significant population declines in Canada since 1975, going from one of the more common lady beetles collected to being rarely collected relative to other lady beetles, despite comprehensive and targeted surveys (COSEWIC 2016a). Reasons for these population declines are currently unknown but are thought to be driven by competition, predation, and introduced diseases from non-native species (including non-native lady beetles), agricultural pesticide use to control aphids, habitat loss via urban expansion, and other human disturbances (COSEWIC 2016a).

2.1.2 Transverse Lady Beetle

Source: COSEWIC (2016b).

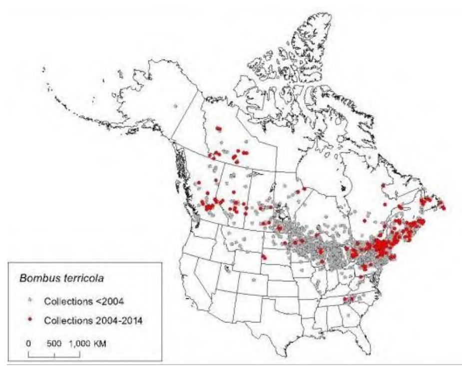
The transverse lady beetle is a small beetle species found across the United States and Canada, including all provinces and territories (COSEWIC 2016b). The species is a habitat generalist and uses similar habitat types and consumes similar prey as the nine-spotted lady beetle, which means it is also able to exploit seasonally available prey sources (COSEWIC 2016b). According to the information from the HABISask database, there are no historical observations of this species documented in the RSA.

The transverse lady beetle has four life stages (i.e., egg, larva, pupa, and adult) and may produce two generations per year (i.e., spring and fall) depending on regional climate conditions (COSEWIC 2016b). Lady beetles in general are highly mobile and may undertake short (few hundred metres) and long-distance (18 to 120 km) movements (COSEWIC 2016b). The transverse lady beetle is not migratory nor does it display strong site fidelity (COSEWIC 2016b). The transverse lady beetle overwinters in aggregations in well-ventilated habitats (e.g., in rock crevices, grass tussocks, or leaf litter, or under stones or tree bark), becoming active in the early spring when temperatures start to increase (COSEWIC 2016b).

The transverse lady beetle is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). The species was once abundant across its range in Canada and was one of the most common lady beetles collected; however, since 1986, the species is now absent, below detection limits, or present in low numbers in many parts of its range (COSEWIC 2016b). The transverse lady beetle has not been detected in Saskatchewan since 2001 (COSEWIC 2016b). Reasons for these population declines are currently unknown but are thought to be driven by the same factors listed for the nine-spotted lady beetle in Section 2.1.1.

2.1.3 Yellow-banded Bumble Bee

The yellow-banded bumble bee is a medium-sized bumble bee species found throughout eastern North America, from eastern British Columbia (BC) to Newfoundland and Labrador and from the northern United States up to the southern portion of the territories (COSEWIC 2015). The species is a habitat generalist (e.g., boreal habitats, mixed woodlands, montane meadows) and consumes nectar and pollen from many different flowering plants (COSEWIC 2015). According to the information from the HABISask database, there are no historical observations of this species documented in the RSA.



Source: COSEWIC (2015).

The yellow-banded bumble bee has four life stages (i.e., egg, larva, pupa, and adult) and produces one generation per year, with mated queens establishing new colonies each year (COSEWIC 2015). After overwintering underground in loose soil or decomposing organic material, the mated queens emerge in the spring and search for potential nest sites, which are typically located underground in existing cavities (e.g., abandoned rodent burrows, rotten logs, openings in dead wood, and grassy hummocks) (COSEWIC 2015). Once a queen has found a suitable nest site, she forages for nectar and pollen and then returns to her nest site to lay eggs, which will develop into her future workers (i.e., unmated daughters that do not typically reproduce) (COSEWIC 2015). After the initial eggs hatch and the larva and pupa develop into adult workers, the workers take over nest and brood care, foraging duties, and colony protection while the queen continues to lay eggs (COSEWIC 2015). Males and potential queens are produced by late summer once the colony reaches maximum worker production, at which point they leave the colony and mate (COSEWIC 2015). All males and workers die by fall while the mated queens hibernate through the winter in suitable overwintering sites (COSEWIC 2015).

The yellow-banded bumble bee is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure)

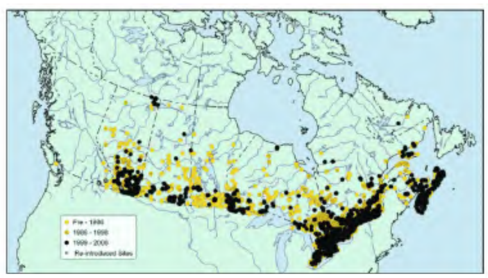
(Saskatchewan Conservation Data Centre 2023). Prior to the 1990s, the yellow-banded bumble bee was one of the more common bumble bees collected in eastern and boreal Canada (COSEWIC 2015, Environment and Climate Change Canada 2022a). Population declines started to occur in the early 1990s, with an average rate of decline of 66.5% in proportional abundance across central and southern Canada between 1992 and 2011 (COSEWIC 2015, Environment and Climate Change Canada 2022a). The species is no longer found at several historical collection sites (COSEWIC 2015).

The status of the yellow-banded bumble bee in boreal habitats and Arctic regions is unknown (COSEWIC 2015, Environment and Climate Change Canada 2022a). Reasons for these population declines are currently unknown but are thought to be driven by introduced diseases from managed bumble bee species, agricultural pesticide use, habitat loss via urban and agricultural expansion, and climate change (COSEWIC 2015).The species' unique type of sex determination, where colonies must reach maximum worker production to produce males and potential queens, has been identified as a limiting factor (COSEWIC 2015, Environment and Climate Change Canada 2022a).

2.2 Amphibians

2.2.1 Northern Leopard Frog

The northern leopard frog is found across most of west-central and northeastern North America (COSEWIC 2009a). The species is widespread in Canada, ranging from southeastern BC to Labrador, and from southcentral Northwest Territories (COSEWIC 2009a, NCC 2023).



Source: COSEWIC (2009a).

Three district habitats are used by the northern leopard frog on an annual basis: (1) overwintering waterbodies that are cold, well oxygenated, and do not freeze to bottom (e.g., rivers, streams, deep lake ponds and creeks, and spillways below dams); (2) breeding and larval waterbodies with shallow, open habitats (e.g., ponds, lakeshores, marshes, and slow-moving streams; may be permanent or semi-permanent), neutral pH, well vegetated, and no fish; and (3) summering areas in shallow marshes, moist upland meadows, forests and grasslands where grass height is less than 1 m (COSEWIC 2009a, NCC 2023). These habitats must be in proximity with suitable dispersal corridors interconnecting them (e.g., riparian areas and waterways) as the species is not capable of long-distance movements (COSEWIC 2009a, Environment Canada 2013).

Northern leopard frogs emerge from their overwintering waterbodies in early spring shortly after ice off (COSEWIC 2009a). The breeding season extends from mid-April to June, with exact timing dependent on location and latitude (COSEWIC 2009a). Females lay several thousand eggs, attaching them to submerged vegetation, which develop into tadpoles within two weeks depending on water temperatures (COSEWIC 2009a). The tadpoles in turn develop into small frogs over a two-to-three-month period, after which they migrate to their summering areas and forage on a variety of arthropods, worms, and snails, sometimes preying on small birds and smaller frogs (COSEWIC 2009a).

Three populations are recognized for the northern leopard frog in Canada: the Rocky Mountain, the Western Boreal/Prairie, and the Eastern (COSEWIC 2009a, NCC 2023). The Western Boreal/Prairie population is found in Alberta, Saskatchewan, Manitoba, and the Northwest Territories (COSEWIC 2009a, NCC 2023). The Western Boreal/Prairie population is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S3 species in Saskatchewan (i.e., Vulnerable) (Saskatchewan Conservation Data Centre 2023).

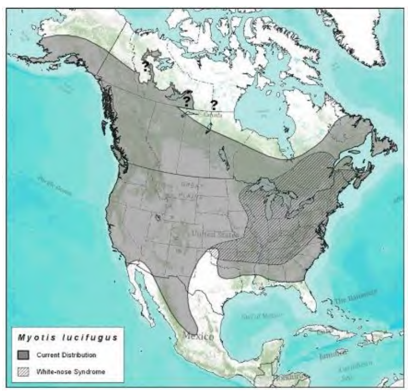
Population data are limited for the northern leopard frog in Canada (COSEWIC 2009a, Environment Canada 2013). Large-scale population declines occurred in the early 1970s, with populations in western Canada (i.e., BC and Alberta) most dramatically affected (COSEWIC 2009a). Information is lacking on the current status of northern leopard frog populations in Saskatchewan (COSEWIC 2009a, Environment Canada 2013).

Threats to the northern leopard frog include emerging diseases (e.g., *Chytridiomycosis*), introduced non-native species, habitat loss and fragmentation, environmental contamination, and increased frequency and severity of droughts (COSEWIC 2009a). The species' specific habitat requirements and vulnerability to diseases and prolonged periods of drought have been identified as limiting factors (Environment Canada 2013).

2.3 Bats

2.3.1 Little Brown Myotis

The little brown myotis is a small bat species found across North America, including across Canada south of the treeline (COSEWIC 2013a). The species is considered a short-distance regional migrant between its summer and winter ranges, with the distance travelled dependent on the location of suitable overwintering hibernacula (COSEWIC 2013a).



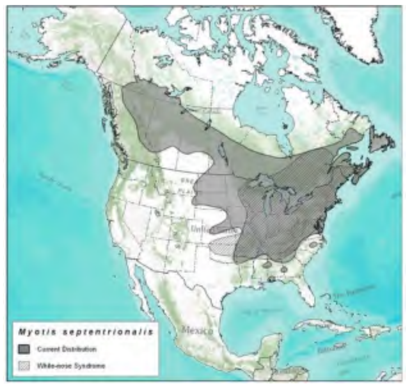
Source: COSEWIC (2013a).

Habitat for the little brown myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013a). Hibernacula and maternity sites are the main limiting habitat features for this species (COSEWIC 2013a). Hibernacula occur in parts of caves, mines, and buildings that have stable and specific temperature (-4 to 13°C) and humidity (>80%) conditions (COSEWIC 2013a). Maternity sites occur in large-diameter trees, rock crevices, buildings, and bat houses that offer warm and relatively stable microclimate conditions that allow females to avoid going into torpor so they can focus on caring for their young (COSEWIC 2013a, Slough and Jung 2020). Males are more versatile in their summer roosting requirements and use tree cavities, raised bark, foliage, rock crevices, buildings, and bridges with a broader range of microclimate conditions (COSEWIC 2013a, Johnson et al. 2019). Foraging areas for the little brown myotis include a variety of habitats situated close to roosting and maternity sites, including over water (e.g., wetlands, lakes, ponds, and rivers), along riparian areas and forest edges, and in forest gaps (COSEWIC 2013a).

The little brown myotis is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S4B, S4N species in Saskatchewan (i.e., Apparently Secure breeding population, Apparently Secure non-breeding population) (Saskatchewan Conservation Data Centre 2023).

The current size of the little brown myotis population in Canada is unknown. Prior to the arrival of White-nose Syndrome in 2010, the population in Canada was estimated to be over one million individuals (COSEWIC 2013a, Environment and Climate Change Canada 2018). White-nose Syndrome is a disease the causes high rates of mortality among hibernating bats, and it has been identified as the main threat for bat populations in Canada (COSEWIC 2013a). Other threats to the little brown myotis include habitat loss, colony eradication, chemical contamination, and wind turbines (COSEWIC 2013a).

2.3.2 Northern Myotis



Source: COSEWIC (2013a).

The northern myotis is a small bat species found across North America, including across Canada south of the treeline (COSEWIC 2013a). The species is considered a short-distance regional migrant between its summer and winter ranges, with the distance travelled dependent on the location of suitable overwintering hibernacula (COSEWIC 2013a).

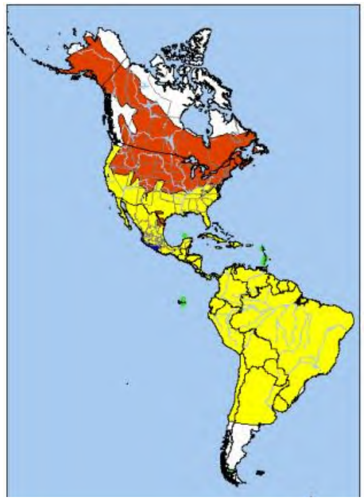
Habitat for the northern myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013a). Hibernacula and maternity sites are the main limiting habitat features for this species (COSEWIC 2013a). Hibernacula occur in parts of caves, mines, and buildings that have stable and specific temperature (0.6 to 14°C) and humidity (>80%) conditions (COSEWIC 2013a). Summer roosting trees are typically found in mature to old-growth forests, swamps, and riparian areas, although retained older trees and snags in younger forests may occasionally provide suitable roosting habitat (Environment and Climate Change Canada 2018). Females strongly prefer tall, large-diameter trees (both living and dead, typically deciduous) with early- to mid-decay for maternity sites (COSEWIC 2013a, Environment and Climate Change Canada 2018). Anthropogenic features (e.g., barns) may occasionally be used as maternity sites in fragmented landscapes with few potential roost trees (Environment and Climate Change Canada 2018). Maternity sites that maintain warm and relatively stable microclimate conditions are important to reproductive females and young as they allow more energy to be directed toward growth and development (Caceres and Barclay 2000, COSEWIC 2013a). Males are more versatile in their summer roosting requirements; they most frequently roost under exfoliating, raised bark but may also roost in the cavities and crevices of trees and snags with early- to mid-decay (Jung et al. 2004, COSEWIC 2013a).

The northern myotis is well adapted to flying in areas of dense or structurally complex vegetation where it catches flying insects on the wing or feeds by gleaning prey from foliage (Caceres and Barclay 2000, Henderson and Broders 2008). The species typically forages within the interior of mature to old-growth deciduous and mixedwood forests, but may also forage in forest gaps, along forest edges and riparian areas, and over rivers (Henderson and Broders 2008, COSEWIC 2013a).

The northern myotis is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S3 species in Saskatchewan (i.e., Vulnerable) (Saskatchewan Conservation Data Centre 2023). The current size of the northern myotis population in Canada is unknown. Prior to the arrival of White-nose Syndrome in 2010, the population in Canada was estimated to be over one million individuals (COSEWIC 2013a, Environment and Climate Change Canada 2018). White-nose Syndrome has been identified as the main threat for northern myotis populations in Canada (COSEWIC 2013a). . Other threats to the northern myotis include habitat loss, colony eradication, chemical contamination, and wind turbines (COSEWIC 2013a).

2.4 Avian Species

2.4.1 Bank Swallow



Source: COSEWIC (2013b).

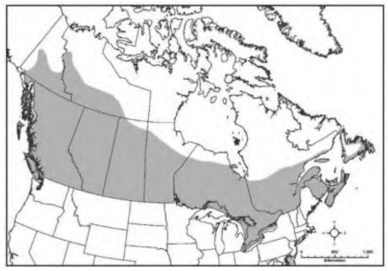
The Bank Swallow is a small songbird that occurs on every continent (except Antarctica and Australia), breeds throughout Canada, and winters primarily in South America (COSEWIC 2013b). Nesting colonies are typically characterized by steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows (COSEWIC 2013b, Government of Canada 2019a). These steep sand, silt, or clay embankments are frequently subject to erosion or slumping (COSEWIC 2013b, Garrison and Turner 2020).

Nesting colonies are often adjacent to slow-moving or still waterbodies (e.g., low gradient rivers or lakes) and may occur in natural habitats or in anthropogenic features (e.g., quarries or road cuts) (COSEWIC 2013b, Government of Canada 2019a, Garrison and Turner 2020). Colony size can range from less than half a dozen burrows to hundreds or thousands of burrows (COSEWIC 2013b, Government of Canada 2019a). Individual burrows within colonies may be recolonized in subsequent years if the integrity of the colony remains intact (i.e., does not erode and collapse) (Garrison and Turner 2020). Bank Swallows are aerial insectivores that forage over a variety of open habitats such as lakes, ponds, rivers, wetlands, grasslands, and agricultural areas (COSEWIC 2013b, Garrison and Turner 2020).

The Bank Swallow is federally listed under Schedule 1 of SARA as Threatened (Government of Canada 2023) and is designated as an S4B, S5M species in Saskatchewan (i.e., Apparently Secure breeding population, Secure aggregating transient population [migrants]) (Saskatchewan Conservation Data Centre 2023). The most recent breeding population estimate for Canada is 2.4 million individuals (Environment and Climate Change Canada 2022b). Based on Breeding Bird Survey (BBS) data collected between 1970 and 2019, the Bank Swallow population in Canada has declined at a rate of 5.3% per year, for an overall decline of 98.0% (Environment and Climate Change Canada 2022b). The long-term population decline appears to be driven by several threats acting cumulatively, including loss of nesting and foraging habitats, incidental take during anthropogenic activities (e.g., aggregate extraction and erosion control), large-scale declines in aerial insect populations, and climate change (COSEWIC 2013b). Bank Swallows are also particularly vulnerable to collisions with vehicles partly due to the attraction of individuals to intraspecific carcasses; one swallow hit by a vehicle could attract several individuals to a road, potentially resulting in subsequent collisions and large mortality events (COSEWIC 2013b, Garrison and Turner 2020).

Although colonial nesting may provide advantages (e.g., predation protection and assistance with thermoregulation), it has been identified as a limiting factor for the Bank Swallow, potentially making them more vulnerable to natural events or anthropogenic activities, which may result in mass mortality events (Environment and Climate Change Canada 2022b).

2.4.2 Barn Swallow



Source: COSEWIC (2021).

The Barn Swallow is a medium-sized songbird that occurs on every continent (except Antarctica), breeds throughout Canada, and winters in the southern United States, Mexico, and southwards (COSEWIC 2021a). Breeding habitat typically requires a suitable nesting site with a vertical or horizontal surface underneath a roof of some sort, open areas for foraging (e.g., grasslands, fields, wetlands, and shorelines), and a waterbody with mud for nest building (Government of Canada 2019b, Brown and Brown 2020, COSEWIC 2021a). Historically, suitable nesting sites were likely provided by caves, cliff faces, rock leges, tree branches, and hollow trees (Brown and Brown 2020, COSEWIC 2021a). Today, nesting sites are usually located within agricultural and rural areas, and along roads and highways (Brown and Brown 2020, COSEWIC 2021a). Anthropogenic features such as barns, houses, bridges, and culverts are commonly used for nesting sites (COSEWIC 2021a). Barn Swallows nest in colonies or independently and typically return to the same nesting sites each year and may reuse old nests (Government of Canada 2019b, Brown and Brown 2020, COSEWIC 2021a).

The Barn Swallow is federally listed under Schedule 1 of SARA as Threatened (Government of Canada 2023) and is designated as an S4B species in Saskatchewan (i.e., Apparently Secure breeding population) (Saskatchewan Conservation Data Centre 2023). An estimated 6.4 million individuals currently breed in Canada, with over 60% of the population breeding throughout the prairie provinces (COSEWIC 2021a). Based on BBS data collected between 1970 and 2019, the Barn Swallow population in Canada has declined at a rate of 2.34% per year, for an overall decline of 68.6% (COSEWIC 2021a). Intensification of agriculture, loss of nesting sites, large-scale declines in aerial insect populations, and climate change are cited as the most imminent threats for the Barn Swallow, and its dependence on aerial insects for prey and low post-fledging survival rates are cited as limiting factors for the species (COSEWIC 2021a). The repeated use of anthropogenic features for nesting makes Barn Swallows vulnerable to incidental take, especially if the anthropogenic features require routine maintenance. In addition, their frequent use of anthropogenic features for nesting makes Barn Swallows vulnerable to entrapment (e.g., buildings, pipes, vents, other enclosed spaces) as they search for potential locations to build a nest (COSEWIC 2021a).

2.4.3 Horned Grebe

Source: COSEWIC 2009b

The Horned Grebe is a small waterbird that occurs in North America and Eurasia (COSEWIC 2009b). Within North America, the species breeds across western Canada from BC and Yukon across to the Magdalen Islands in Quebec and winters along the Pacific and Atlantic coasts (COSEWIC 2009b).

Breeding habitat for the Horned Grebe consists of small to medium-sized freshwater lakes, ponds, and marshes that are shallow with open water (at least 40%), emergent vegetation, anchorage for nests, and concealment for nests and young (COSEWIC 2009b, Stedman 2020). Horned Grebes use a range of waterbody sizes for breeding, but typically prefer waterbodies between 0.3 and 2.0 ha in size (COSEWIC 2009b). Most pairs are solitary, but loose colonies of up to 20 pairs have been found on larger waterbodies with abundant food resources (COSEWIC 2009b, Stedman 2020). Nests are typically located in shallow water near shore on a floating or emerging mass of vegetation (COSEWIC 2009b). Horned Grebes are diving birds that feed on a variety of aquatic arthropods and fish (COSEWIC 2009b, Stedman 2020).

The Western population of the Horned Grebe is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S5B species in Saskatchewan (i.e., Secure breeding population) (Saskatchewan Conservation Data Centre 2023). An estimated 200,000 to 500,000 individuals occur in the Western population, with most breeding in southern Alberta and Saskatchewan (COSEWIC 2009b, Environment and Climate Change Canada 2022c). Based on BBS data collected between 1970 and 2019, the Western population of the Horned Grebe in Canada has declined at a rate of 1.7% per year, for an overall decline of 57.0% (Environment and Climate Change Canada 2022c). The reasons for this population decline are unknown. Probable threats include permanent habitat loss, temporary loss of habitat during droughts, eutrophication and degradation of habitat due to fertilizers, predator expansion on the prairies, Type E botulism in the Great Lakes, entanglement in commercial fishing gear, climate change and extreme weather, and oil spills on wintering grounds (COSEWIC 2009b).

3 Mitigation Measures

The Project will require the construction, operation, and decommissioning of several components (as described in Section 2 of the EIS). Expected interactions between these Project components and activities and the wildlife VCs and their associated KIs are summarized by Project phase and activity in Tables 9.3-6 and 9.4-5 of the EIS. Based on the timing and nature of interactions identified in Tables 9.3-6 and 9.4-5 of the EIS, the following adverse effects on the wildlife VCs, including SAR, are likely to occur during the lifetime of the Project:

- alteration and/or loss of habitat; and
- change in mortality.

These potential effects apply to Wildlife SAR as well. The potential effects are described in Sections 9.3.4.2 and 9.4.4.2 of the EIS for each Project phase as they may affect the wildlife VCs and associated KIs.

Mitigation in this EIS is defined as the elimination, reduction, or control of potential adverse effects of the Project on the environment throughout all Project phases. Project-specific mitigation measures include: Project design; implementation of best management practices; development of management plans; implementation of emergency response programs; and provision of training, education and awareness (Denison 2020). Mitigation measures for each potential effect are described in Sections 9.3.5 and 9.4.5 of the EIS. The following subsections summarize mitigation measures that will be implemented to avoid or minimize adverse effects on the Wildlife SAR.

3.1 Project Design Measures

Potential adverse effects on Raptors, Migratory Breeding Birds, and Bird SAR VCs will be avoided or minimized to the extent practical through Project design. All of the Project design measures listed here are consistent with those presented in Section 9 of the EIS (i.e., there are no new Project design measures proposed in this appendix):

- The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent practicable resulting in reduced habitat disturbance and noise propagation.
- Much of the proposed footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
- The powerline to the main substation at the site is relatively short (i.e., approximately 7 km) and will be constructed from the existing provincial power line adjacent to Highway 914.
- During Operation, progressive reclamation activities will be completed where possible, and the progress and success of these activities will be assessed annually.
- Cleared brush will be stockpiled when possible, to be used in progressive reclamation.
- Ongoing decommissioning of Project components will be completed when possible.
- Dust deposition on vegetation and waterbodies (including potential deposition of trace metals and radionuclides) will be reduced by:
  - directing processing plant exhaust from drying and packaging areas through a stack prior to release outside of the building;
  - designing the stack height based on results of air dispersion modelling to be an appropriate height for optimal dispersion;

  - controlling access to the property with both a north and south security gate (the north gate is on a decommissioned road and the south gate is manned);
  - making a wash bay available to clean items, equipment and vehicles that may have been in contact with potentially contaminated materials. Contaminated water from the wash bay will be collected in a sump tank and routed to the water treatment plant for treatment and discharge;
  - conducting radiological clearance scanning as required for any items, equipment, and vehicles leaving the Project Area; and
  - watering and traffic controls on roads.

- Battery-powered light vehicles and mobile equipment, and an AC powered dual rotary drill for ISR wellfield development instead of a traditional diesel-powered unit, will be employed, where practical, to reduce air emissions and noise levels and improve energy efficiency.
- The main sources of noise will be related to transport of people and goods, drilling of holes for the freeze wall and wellfield, operation of the batch plant, operation of the processing plant, and operation of the pumphouses. The use of high-quality, low sound emission equipment and regular maintenance will reduce noise associated with Project activities.
- Bulk storage tanks for processing chemicals such as sulphuric and/or hydrochloric acid, sodium hydroxide, and hydrogen peroxide will sit inside appropriately designed and sized secondary containment basins, physically separated from the containment basins for other chemical systems.
- Surface pipelines will be designed to have secondary containment or catchment and have leak detection systems in place at key locations.
- A freeze wall will be established around the uranium deposit to reduce groundwater disturbance.
- Mining solution and process water will be reused throughout the mining process, reducing water use requirements to the extent feasible and reducing the volume of treated effluent requiring discharge. Make-up water will be preferentially sourced from site runoff where possible.
- Double-walled, high-density polyethylene or equivalent piping will be used in the wellfields and will be freeze protected and secured to minimize pipe movement.
- Contaminated wastes (e.g., mineralized drill cuttings, solid impurities removed from mining solution, dewatered reject solids) will be properly contained on a double lined waste pad with leak detection capabilities and an associated monitoring program. An adjacent pond will be used to collect runoff from the pad and water in the waste pond will be piped to the water treatment plant. Such waste will be disposed of either on site or off site at an approved facility.
- The ISR wellfield and processing plant will be designed to re-use most of the solutions inside each circuit; any excess water will be released to a surface water body once acceptable water quality is achieved. All treated effluent released to surface water will meet federal and provincial regulatory discharge limits.
- All contaminated areas, such as waste ponds and pads, and the domestic landfill will be fenced to avoid contact with workers and wildlife. Fences will be monitored and maintained.

3.2 General Mitigation Measures for Wildlife Species at Risk

Mitigation measures specific to the Wildlife SAR, in accordance with the *Migratory Birds Convention Act* and tailored to Project features will be incorporated into various Project management and monitoring plans such as the erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring and Waste Management Plan.

The management plans within the Environmental Management System (EMS) will provide specific mitigation measures based on proven and accepted mitigation measures following standard industry guidelines and best management practices. The EMS will provide guidance to avoid or minimize potential adverse effects of the Project on avian species and their habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered. The Project management plans provide direction on monitoring and adaptive management so that responses are timely and effective.

The following subsections provides a description of the mitigation measures that will be applicable during all Project phases and expected to be effective immediately following implementation. ~~Additional mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text.~~

3.2.1 Work Timing Windows and Habitat Disturbance

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. The nesting season for many Wildlife SAR in Saskatchewan spans a period from March 15 to August 31; however, the dates differ for certain species. The Wildlife Management Plans within the EMS will provide details on nesting windows for avian species, as well as other sensitive time periods (e.g., caribou calving periods) occurring in the Terrestrial RSA based on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SARGSS), which were established to support the avoidance of sensitive species' habitats during sensitive periods (SK MOE 2017).
- Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting and breeding season, pre-disturbance wildlife clearance surveys will be conducted a by a Qualified Professional (QP) at that location within the Project Area to identify sensitive species and habitat features (e.g., nests as well as roosts and hibernacula used by bat species).
- Active and/or suspected breeding and roosting locations identified during the pre- disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). If guidelines cannot be met, due to safety or operational concerns, SK MOE will be contacted for advice on the appropriate response to the situation.
- In addition to the species listed under Schedule 1 of SARA, if any features (e.g., nests) of species included on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SK MOE 2017) are observed during the pre-clearing wildlife surveys, the applicable activity restrictions will be implemented, as appropriate, following discussion with SK MOE.

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3.2.2 Wildlife Education and Awareness

- Employees and contractors will be provided with wildlife education and awareness training, including education about potential Wildlife SAR issues on site and training on the mitigation measures to avoid or minimize potential adverse Project effects on Wildlife SAR and their habitats.
- Employees and contractors will be educated on waste management policies that limit human-avian interactions.
- Designated employees will be trained in appropriate avian deterrent techniques to minimize avian interactions with the Project.
- Employees and contractors will be requested to report avian observations on site, injured or dead birds (which will be reported to SK MOE). Avian encounters and outcomes will be monitored, and logbooks will be used to record observations. Logbooks and reports will be available to employees.

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3.2.3 Wildlife and Habitat Protection

- Personal firearms will be prohibited for employees and contractors within the Project Area to prevent hunting activities.
- If any individual were seeking access around the Project area to undertake Aboriginal and/or Treaty Rights, Denison staff would facilitate this, provided it were safe to do so given activities in the area.
- Policies will be implemented prohibiting employees and contractors from feeding, approaching, or harassing avian species within the Project Area.
- To support habitat regeneration, progressive reclamation and ecosystem-based revegetation will be conducted on disturbed areas as soon as practicable in accordance with the Reclamation and Closure Plan.

3.2.4 Wildlife Deterrence and Prevention of Wildlife Entrapment

- Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as possible. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.
- Physical, visual, and/or auditory deterrents will be used to discourage bird and bat use of buildings and other Project infrastructure (e.g., water or waste treatment ponds) for refuge, shelter, breeding, and roosting, and to deter birds and bats from potentially becoming entrapped.
- Noise emitting Project activities will be managed to minimize sensory disturbance of wildlife SAR species, especially during sensitive time periods (i.e., breeding and nesting).
- Low sound emission equipment, regular maintenance of equipment, and the use of silencers or mufflers (whenever practical) will be used to reduce noise associated with Project activities, to the extent practical.
- Directed lighting or light shielding, rather than broad lighting, will be implemented to minimize sensory disturbance on the wildlife SAR, and lighting will be focused on work sites and not surrounding areas.

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- Dust generation and subsequent deposition on vegetation and in waterbodies (including potential deposition of trace metals and radionuclides) will be limited through dust suppression techniques such as road watering and traffic management.

3.2.5 Road and Traffic Management

- Traffic and access control measures will be implemented will include reducing traffic volume by scheduling truck convoys, using high-volume haul trucks, and restricting public access to the Project site and roads (e.g., private vehicles, snowmobiles, all-terrain vehicles, and foot traffic). It is important to note that if any individual were seeking access around the Project area to undertake Aboriginal and / or Treaty Rights, Denison staff would facilitate this, provided it were safe to do so given activities in the area.
- Appropriate road signage will be installed (e.g., speed limits) along Project roads to raise awareness and minimize the potential for wildlife SAR-vehicle collisions.
- Wildlife will have the right-of-way on Project roads, unless it is unsafe to stop (i.e., if a collision is imminent). Vehicles will not be used to encourage wildlife to move off Project roads.
- Processes will be implemented for employees and contractors to slow down and/or stop vehicles/equipment to allow animals to move away or off the road before resuming normal road speeds for the area.
- Employees and contractors will report and communicate the location and circumstances of any roadkill observed on or alongside Project roads. Large-bodied wildlife carcasses found will be reported to SK MOE and disposed of as directed to discourage avian scavengers.
- Vegetation management, such as mowing and brush cutting, will be implemented along Project roads to reduce site attractiveness for wildlife SAR and maintain appropriate sightlines for drivers to minimize wildlife-vehicle collisions.
- Alternative measures on Project roads for de-icing and winter traction (e.g., sand, gravel) or dust suppression (e.g., water) will be implemented, whenever practicable.
- Appropriately sized gaps in the roadside snowbanks during winter will be maintained to facilitate wildlife crossing and escape thereby reducing the risk of wildlife-vehicle collisions.
- New Project site and access roads will be designed to minimize sightlines for predators, whenever practicable, while still maintaining general road safety.
- Ditches and culverts along Project roads will be designed and maintained to minimize pooling of water. Roadside pools that form may attract wildlife.

3.2.6 Waste and Hazardous Materials Management

- A "no littering policy" for employees and contractors will be implemented within the Project Area.
- Vegetation management will be incorporated in the vicinity of waste ponds to discourage wildlife SAR use of potentially affected vegetation.
- Waste will be collected and temporarily stored in wildlife-proof containers to avoid attracting scavengers and with that increase the risk for human-wildlife interaction.
- The wildlife-proof containers will be inspected regularly for evidence of avian presence (e.g., gull species) or access to waste disposal facilities. If evidence of avian presence or access to waste disposal facilities is detected, modified systems will be implemented and/or off-site waste disposal frequencies will be increased.
- The use of hazardous materials will be limited as much as possible.

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- Hazardous materials will be handled, stored, and disposed of appropriately and in accordance with a Waste Management Plan to avoid attracting avian scavengers (e.g., wildlife-proof containers, exclusion fencing).
- Physical deterrents (e.g., fencing) will be employed around contaminated areas (e.g., waste ponds and waste pads), the domestic landfill, or hazardous materials storage areas to discourage wildlife use.
- Appropriate hazardous materials management practices will be implemented in accordance with industry guidelines and a Waste Management Plan to minimize the risk of accidental spills or leakage.
- Appropriate spill response kits will be positioned adjacent to areas where hazardous materials are stored in accordance with the Spill Response Plan.
- A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing in accordance with the Spill Response Plan.
- Appropriate fuel, chemical, and materials management practices will be followed in accordance with the Spill Response Plan to minimize the risk of accidental spills or leakage of diesel fuel, other hydrocarbons, and other hazardous materials.
- Air emissions will be reduced to the extent practical through implementation of an air quality monitoring plan within the EMS.
- All vehicles and equipment will be equipped with industry-standard emission control systems; unnecessary idling of vehicles will be prohibited.
- Vehicles and equipment will be maintained in good working condition (e.g., no leaks) and furnished with industry-standard spill response kits.
- Mitigation measures to reduce the potential for dispersion of radiological contaminants of potential concern to vegetation will be implemented in accordance with the Radiation Protection Plan.
- Education on and enforcement of proper waste and hazardous materials management practices will be provided to employees and contractors.

3.3 Species-Specific Mitigation Measures for Wildlife Species at Risk

The following provides a summary of the species-specific mitigation measures that will be implemented during Project activities. Mitigation measures specific to the Wildlife SAR ~~that were not included or that were revised from what was described in the draft EIS are provided in bold text. These~~ have been ~~will be~~ added to ~~the~~ Section 9 of final EIS as applicable, with species-specific details provided here in the supporting appendix. For further information on methods and timing of SAR pre-clearance sweeps, refer to Section 4 of this appendix.

3.3.1 Arthropod Species

3.3.1.1 Nine-spotted lady beetle

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- Mitigation measures designed for the Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5) VCs are expected to mitigate adverse effects on nine-spotted lady beetle primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
  - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.

  - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
  - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.

- Herbicide use as part of vegetation management will be limited to the immediate Project Footprint and applied by licensed professional applicators, when necessary, to limit the potential for adverse effects on nine-spotted lady beetle.

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3.3.1.2 Transverse lady beetle

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- Mitigation measures designed for the Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5) VCs are expected to mitigate adverse effects on transverse lady beetle primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
  - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.
  - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
  - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.

- Herbicide use as part of vegetation management will be limited to the immediate Project Footprint and applied by licensed professional applicators, when necessary, to limit the potential for adverse effects on transverse lady beetle.

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~~3.3.1~~3.3.1.3 Yellow-banded bumble bee

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- Mitigation measures designed for the Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5) VCs are expected to mitigate adverse effects on ~~the arthropod species that are considered SAR (i.e., nine-spotted lady beetle, transverse lady beetle, and~~ yellow-banded bumble bee ~~)~~ primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
  - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.
  - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
  - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.

- Herbicide use as part of vegetation management will be limited to the immediate Project Footprint and applied by licensed professional applicators, when necessary, to limit the potential for adverse effects on ~~arthropod species~~yellow-banded bumble bee.

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3.3.2 Amphibian Species

~~3.3.2~~3.3.2.1 Northern leopard frog

- Mitigation measures designed for the Wetlands VC (Section 9.2.5) are expected to mitigate adverse effects on the northern leopard frog primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
  - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.
  - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
  - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.
- Pre- disturbance wildlife clearance surveys will be conducted to identify site-specific habitat features (e.g., ~~amphibian~~ northern leopard frog breeding ponds) and implement the setbacks and/or timing windows (that will be defined in the Wildlife Management Plan).
- In addition to the species listed under Schedule 1 of SARA, if any features (e.g., breeding and overwintering habitat) of species included on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SK MOE 2017) are observed during the pre-clearing wildlife surveys, the applicable activity restrictions will be implemented, as appropriate, following discussion with SK MOE.
- Locations of site-specific habitat features used by northern leopard frog ~~amphibians~~ will be communicated to Project personnel and the requirement to limit disturbance in these areas will be implemented.
- Appropriate setback and buffer distances from wetland features where northern leopard frog ~~amphibians~~ are known to occur will be implemented and maintained under the direction of a wildlife QP.
- Vehicle traffic and construction activities will be restricted to the approved access routes and work areas and will not cross or enter a watercourse or wetland.

3.3.3 Bat Species

3.3.3.1 Little brown myotis

- Vegetation clearing activities will occur outside of little brown myotis roosting periods, when practical.
- Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as little brown myotis maternal rooting sites and hibernacula used by little brown myotis. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented (refer to Table 4-1 in final EIS Appendix 9-D which will also be defined in the Wildlife Management Plan).
- In the event a little brown myotis maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for little brown myotis to leave but not the ability to re-enter the roosting site.

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- Locations of these site-specific habitat features used by little brown myotis will be communicated to the appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.
- Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.

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~~3.3.3~~3.3.3.2 Northern myotis

- Vegetation clearing activities will occur outside of northern myotis roosting periods, when practical.
- Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as northern myotis maternal rooting sites and hibernacula used by northern myotis~~bat species~~. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented (refer to Table 4-1 in final EIS Appendix 9-D which will also be defined in the Wildlife Management Plan).~~If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented in accordance with the SARGSS (SK MOE 2017 (that will also be defined in the Wildlife Management Plan).~~
- ~~In addition to the species listed under Schedule 1 of SARA, if any features (e.g., roost/foraging site) of species included on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SK MOE 2017) are observed during the pre-clearing wildlife surveys, the applicable activity restrictions will be implemented, as appropriate, following discussion with SK MOE.~~
- In the event a northern myotis maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for northern myotis ~~bats~~ to leave but not the ability to re-enter the roosting site.
- Locations of these site-specific habitat features used by northern myotis~~bats~~ will be communicated to the appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.
- Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.

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3.3.4 Avian Species

3.3.4.1 Bank Swallow

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the bank swallow nesting season, when practical. The breeding and nesting season for bank swallow in Saskatchewan typically spans a period from May 15 to July 31.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the bank swallow breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of bank swallow nests.
- Active and/or suspected bank swallow nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with adopted regulatory guidelines (e.g., Manitoba Conservation [2021] as there is currently no activity restriction guidelines for bank swallow in Saskatchewan) in accordance with the level of

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the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).

- Locations of nesting sites used by bank swallows will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.

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3.3.4.2 Barn Swallow

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the barn swallow nesting season, when practical. The breeding and nesting season for barn swallow in Saskatchewan typically spans a period from May 15 to September 30.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the barn swallow breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of barn swallow nests.
- Active and/or suspected barn swallow nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with adopted regulatory guidelines (e.g., Manitoba Conservation [2021] as there is currently no activity restriction guidelines for barn swallow in Saskatchewan) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).
- Locations of nesting sites used by barn swallows will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.

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3.3.4.3 Common Nighthawk

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the common nighthawk nesting season, when practical. The breeding and nesting season for common nighthawk in Saskatchewan typically spans a period from May 1 to August 31.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the common nighthawk breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of common nighthawk nests.
- Active and/or suspected common nighthawk breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).

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3.3.4.4 Horned Grebe

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the horned grebe nesting season, when practical. The breeding and

nesting season for horned grebe in Saskatchewan typically spans a period from May 1 to September 15.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the horned grebe breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of horned grebe nests.
- Active and/or suspected horned grebe nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in Saskatchewan) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).
- Locations of nesting sites used by horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.

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3.3.4.5 Olive-sided Flycatcher

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the olive-sided flycatcher nesting season, when practical. The breeding and nesting season for olive-sided flycatcher in Saskatchewan typically spans a period from May 1 to August 31.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the olive-sided flycatcher breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of olive-sided flycatcher nests.
- Active and/or suspected olive-sided flycatcher nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).

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3.3.4.6 Rusty Blackbird

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the rusty blackbird nesting season, when practical. The breeding and nesting season for rusty blackbird in Saskatchewan typically spans a period from May 1 to July 31.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the rusty blackbird breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of rusty blackbird nests.
- Active and/or suspected rusty blackbird nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active

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(e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).

3.3.4.7 Short-eared Owl

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the short-eared owl nesting season, when practical. The breeding and nesting season for short-eared owl in Saskatchewan typically spans a period from March 25 to August 1.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the short-eared owl breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of short-eared owl nests.
- Active and/or suspected short-eared owl nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).

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~~3.3.4~~3.3.4.8 Yellow Rail

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the yellow rail nesting season, when practical. The breeding and nesting season for yellow rail in Saskatchewan typically spans a period from May 1 to July 15.
- In the event Project activities such as vegetation clearing and/or soil disturbance are required during the yellow rail breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of yellow rail nests.
- Active and/or suspected yellow rail nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).
- ~~Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. The breeding and nesting season for most avian species in Saskatchewan typically spans a period from March 15 to August 31; however, the dates differ for certain species.~~
- ~~**In the event Project activities such as vegetation clearing and/or soil disturbance are required during the breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of avian SAR and/or their nests.**~~
- ~~**Active and/or suspected breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in**~~

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~~Saskatchewan) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).~~

- ~~In addition to the species listed under Schedule 1 of SARA, if any features (e.g., nests) of species included on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SK MOE 2017) are observed during the pre-clearing wildlife surveys, the applicable activity restrictions will be implemented, as appropriate, following discussion with SK MOE.~~
- ~~Locations of nesting sites used by bank swallows, barn swallows, and horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.~~
- ~~Deterrents designed to discourage or prevent barn swallows from using buildings and other Project infrastructure have been described in Section 3.2.4 of the EIS.~~
- ~~Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as practical. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.~~

4 Pre-clearance SAR Survey Methods

The methods and timing of proposed SAR pre-clearance sweep are provided in Table 4-1.

Table 4-1 Wildlife Species at Risk Pre-clearance Sweep Methods and Timing

Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique [1]	Timing	Action if Species Detected	Information Source
Northern Leopard Frog	Not observed.	Appendix 9-D	From winter sites, adult frogs travel up to 1.6 km to breed.	Wetlands/ water/ riparian / wet/ moist/ scrublands/ bogs/ fens.	Visual searches for egg masses or frogs.	Snow/ice-free early spring and spring season.	Pond setback; 10m (low); 200m (Mod) and 500m (High);	MOE (2017)
			They breed in the shallow, warm waters of a variety of wetlands including marshes, springs, flooded ditches, dugouts, borrow pits, beaver ponds, margins of lakes, and slow-moving waters of streams and rivers.		Auditory call surveys.	April 20 to June 10.		
			After breeding, adults and sub-adults may disperse up to 8 km from breeding ponds.					
			Northern Leopard Frogs usually do not utilize areas that are heavily wooded		Visual searches for egg masses or frogs.	Snow/ice-free early spring and spring season.		
			They forage in the summer in riparian or upland habitats. These areas are moist habitats including meadows, pastures, scrublands, riparian corridors, and drainage or irrigation ditches.		Visual searches for egg masses or frogs.	Snow/ice-free early spring and spring season.		
Little Brown Myotis and Northern Bat	34 ultrasonic detections of little brown/northern myotis.	Appendix 9-D	The presence of large snags, tree cavities, is an important attribute in old growth forest stands that provides maternity roosts and day roosts for northern myotis and little brown bats. Building are also used.	Treed areas with the largest diameter and/or older trees. Focus on older forest, or areas with large snags in younger forest within the project footprint (majority is regenerating forest 1-5m).	Daytime visual search of trees and potential roost sites. Systematic meandering search of areas to be cleared during active bat season. Focus on searching for roost features (snags, cracks, stumps, cavities, bark peeling) and bat sign (e.g., guano).	May to Sept	Should a roosting bat be discovered the area will be afforded protection from clearing for 24 hours and re-surveyed. The area will only be cleared if no bats are discovered. A 100 m buffer will be given to nursery roots and 50 m to daily roosting bats. If many roosting bats are recorded compensation will be considered (e.g., bat houses).	COSEWIC (2013a); Resources Information Standards Committee (RISC) (2022)

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Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique [1]	Timing	Action if Species Detected	Information Source
			Foraging habitat in proximity to roosting sites is also an important factor in roost selection.	Treed areas in proximity to clearings, wetlands and open water.		Year Round	Roost/Foraging site; 100m(low); 500m (Mod) and 500m (High);	MOE (2017)
Wolverine	Not observed.	Section 9.3	A wide variety of forested and vegetation associations are used by wolverine. Habitats must have an adequate year-round supply of food, mainly consisting of smaller prey such as rodents and Snowshoe Hares, and the carcasses of large ungulates, like Moose, Caribou, and Muskox. Females den under snow-covered rocks, logs or within snow tunnels. Wolverines reproduce in areas where snow cover persists at least into April.	All areas of project activity.	Winter den searches.	Snow cover months.	Setback of 250m when occupied and 100m when unoccupied.	COSEWIC (2014); Environmental Protection and Management Guideline (2024)
Woodland Caribou	Observed.	Section 9.3	Woodland caribou may occupy all potential project areas but prefer forests greater than 40 years of age.	All areas of project activity.	Visual search to ensure no caribou are in the area. Ongoing vigilance.	Year Round	If caribou are in the area cease operations until they are clear of the area.	SME (2021)
Rusty Blackbird	Not observed.	Section 9.4	Rusty blackbird primarily nests in small conifers, predominantly spruce. In Canada, nests have also been found in Balsam Fir, Eastern White Cedar, Paper Birch, Balsam Poplar, Red Maple, Pin Cherry, emergent sedges, cattails, and on the ground on a beaver dam	All habitat with spruce, white birch and balsam poplar. Very limited suitable (spruce) habitat within project footprint.	Visual search for nests.	MBCA window	A 75 m buffer around coniferous bogs, fens and other wetlands suitable for Rusty blackbirds (Odsen and Pyper 2019).	Environment Canada. (2015); Odsen and Pyper (2019); Wildlife Division (2020)
			We only have spruce, birch and poplar at Wheeler.			May 1 to July 31	Nest setback of 0-50m (low activity); 150m (Mod activity) and 300m (High activity);	Manitoba Conservation (2021)
Yellow Rail	Not observed.	Section 9.4	Yellow rails inhabit shallow wetlands and other wet areas with grass-like vegetation. They breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes	Using available mapping conduct daytime Ecosite verification and stratify surveys in appropriate habitat only.	Mid May to mid to late June. Triplicate nocturnal (23:00-03:00) call-playback surveys spaced at least 4	-	-	Environment Canada (2012); SME (2014) Detection surveys per Saskatchewan Species Detection Survey Protocol (SDSP) https://publications.saskatchewan.ca/#/products/79508

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Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique [1]	Timing	Action if Species Detected	Information Source
			These wetlands are generally dominated by short, fine-stemmed herbaceous vegetation, especially sedges (Carex spp.), as well as other graminoid vegetation of the families Cyperaceae, Poaceae, and Juncaceae. Vegetation structure (e.g. short, grass-like, and dense) is likely more important than its taxon	Based on available mapping, no suitable habitat within project footprint.	days apart. Or use Autonomous Recording Units throughout the breeding season.			
			Breeding habitats may have up to 50 cm of standing water, but typically nesting sites are less than 15 cm deep			May 1 to July 15	Nest site setback; 100m(low); 150m (Mod) and 350m (High);	MOE (2017)
Bank Swallow	Not observed.	Appendix 9-D	The Bank Swallow readily breeds in a wide variety of low-elevation (< 900 m), natural and anthropogenic habitats, including: lake and ocean bluffs; stream and river banks; sand and gravel pits; roadcuts; and piles of sand, topsoil, sawdust, coal ash, and other materials.	Survey key habitat features identified as important.	Visual survey during timing window.	May 15 to July 31	Nesting Colony Setback; 50m (low); 150m (Mod) and 300m (High);	Manitoba Conservation (2021)
			Nest burrows are nearly always in a vertical or near-vertical bank (range: 76-105° slope;			-	-	COSEWIC (2013b)
			In some cases, Bank Swallows have nested in drain pipes and in structures designed and built specifically for nesting Bank Swallows					
Barn Swallow	Four visual/auditory detections.	Appendix 9-D	Nest on horizontal and vertical structures that include natural sites, such as cliffs and caves, as well as human-made structures, such as barns, bridges, and culverts . The nesting substrate must be rough, or have a ledge or projecting objects, such as bolts or light fixtures, to provide additional structural support to the nest.	Open areas in proximity to water. All buildings and man-made structures.	Visual.	May 15 to Sept 30	Nest site setback; 50m (low); 100m (Mod) and 100m (High);	Manitoba Conservation (2021)
			Nesting sites must provide access to open areas with an abundant supply of aerial insects to feed on; features such as wetlands, waterbodies, watercourses, meadows, grazed grassland, and farmland are preferred . Proximity to a waterbody or moist area with a supply of wet mud is needed to facilitate nest construction.			-	-	COSEWIC (2021a)

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Species of Concern	Baseline Survey Results	Assessed in the EIS	Important Habitat and Needs	Survey Target Areas	Survey Technique [1]	Timing	Action if Species Detected	Information Source
Common Nighthawk	Two nests, five visuals and 76 auditory/visual detections.	Section 9.4	Nests are typically in open sites with dry, well-drained substrates that will not overheat and that have shade nearby for young to shelter from the sun and predators. Nest sites include forest clearings, bare patches in grassland, gravel pits, outcrops, road or rail sides, and, rarely, fenceposts.	All upland habitat.	Call-playback.	May 1 to Aug 31	Nest site setback; 0-50m (low); 150m (Mod) and 300m (High);	MOE (2017) Detection surveys per Saskatchewan Species Detection Survey Protocol (SDSP) https://publications.saskatchewan.ca/api/v1/products/79502/formats/117104/download
Horned Grebe	One observation.	Appendix 9-D	More than 90% of the Horned Grebes in North America breed in ponds and lakes in western and northern Canada.	Water bodies within the project area.	Visual searches.	May 1 to Sept 15	Nest site setback; 100m (low); 200m (Mod) and 400m (High);	Manitoba Conservation (2021)
						-	-	COSEWIC (2009b)
Olive-sided Flycatcher	Fourteen observations.	Section 9.4	Olive-sided Flycatcher has been widely observed in open coniferous or mixed coniferous forests, often located near water or wetlands with the presence of tall snags or trees	All conifer and/treed upland areas.	Call-playback.	May 1 to Aug 31	Nest setback; 100m (low); 300m (Mod) and 500m (High);	MOE (2017)
			Data gathered from points across Canada indicate that mature conifer stands within patchy landscapes influenced by natural disturbance (e.g., recent burns) support the highest densities			-	-	Environment Canada (2016)
			Olive-sided Flycatcher prefers post-burn areas or wetlands that create open habitats for the species to forage			-	-	Detection surveys per Saskatchewan Species Detection Survey Protocol (SDSP)
Short-eared Owl	Not observed.	Section 9.4	Nesting generally occurs in large open areas	Open upland and lowland areas with no trees and some shrub cover.	Call-playback.	March 25 to Aug 1	100m (low); 300m (Mod) and 500m (High);	MOE (2017)
			Requires a minimum area of about 50-100 ha, consistent with the mean territory size of 82 ha reported in Manitoba.			-	-	COSEWIC (2021b)
			In the north, nests are primarily in tundra (Sinclair et al. 2003), and sometimes beside a small shrub that provides cover			-	-	Detection surveys per Saskatchewan Species Detection Survey Protocol (SDSP) https://publications.saskatchewan.ca/api/v1/products/79506/formats/117101/download

[1] Surveys will be completed by qualified professional biologists; in their capacity as professional biologists, they will refer to available guidance such as the Saskatchewan species detection survey protocols to develop details of the surveys (e.g., selecting the appropriate time of day for the survey).

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~~4~~5 Residual and Cumulative Effects Summary

The approach to assessing residual Project effects on wildlife VCs followed the methodology outlined in Section 5.8 of the EIS, which included a habitat-based approach. For each VC and associated KI, each residual effect was assessed in the context of the Project activities that will occur within each Project phase. Each residual effect was then characterized based on the combined predicted residual effect for all phases. See Sections 9.3.6 and 9.4.6 of the EIS for specific details regarding the residual effects assessment for wildlife VCs (i.e., residual effect characterization and significance determination). A summary of the environmental assessment considerations and determination for predicted residual effects for Wildlife SAR is provided in Table 5-1. ~~Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text. These will be added to the final EIS~~.

The cumulative effects assessment (CEA) followed standard methodology as per provincial (e.g., Guidelines for an Environmental Assessment under the [Saskatchewan] *Environmental Assessment Act* 1980) and federal (e.g., Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act 2012*) guidance, and is discussed in detail in Section 5.9 of the EIS. Similar to the residual effects assessment, the CEA included a habitat-based approach. See Sections 9.3.7 and 9.4.7 of the EIS for specific details regarding the CEA for wildlife VCs. A summary of the significance determination of the cumulative effects on Wildlife SAR is provided in Table 5-2.

Table 5-14.1 Summary of the Environmental Assessment Considerations and Determination for Predicted Residual Effects for Wildlife Species At Risk

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Nine-spotted lady beetle ~~Transverse lady beetle~~ ~~Yellow-banded bumble bee~~	Amount of habitat that is altered or lost relative to its availability in the Terrestrial Regional Study Area (RSA).	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • Waste management (composting, domestic and industrial landfill operation, recycling). • Water management (including treatment). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• The proposed mitigation measures outlined in the EIS, particularly those designed for the Valued Components (VCs) Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5), adequately and appropriately address potential for adverse effects on ~~these species~~nine-spotted lady beetle, primarily related to limiting the loss and/or disruption of suitable habitat. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, and fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for ~~the~~ nine-spotted lady beetle ~~arthropod SAR~~ within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to groundwater and/or surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			

~~[1] Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text.~~

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Site water management, treatment, and release • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning	roads currently used for exploration activities, thereby minimizing additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.		
		Nine-spotted lady beetle ~~M~~mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Herbicide use as part of vegetation management will be limited to the immediate Project Footprint applied by licensed professional applicators when necessary to limit the potential for adverse effects on ~~arthropod species~~nine-spotted lady beetle.	Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of nine-spotted lady beetle~~the arthropod SAR~~ to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Transverse lady beetle	Amount of habitat that is altered or lost relative to its availability in the Terrestrial Regional Study Area (RSA).	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • Waste management (composting, domestic and industrial landfill operation, recycling). • Water management (including treatment). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• The proposed mitigation measures outlined in the EIS, particularly those designed for the Valued Components (VCs) Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5), adequately and appropriately address potential for adverse effects on transverse lady beetle, primarily related to limiting the loss and/or disruption of suitable habitat. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, and fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for transverse lady beetle within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to groundwater and/or surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release • Process water treatment and release.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.		additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually. • Herbicide use as part of vegetation management will be limited to the immediate Project Footprint applied by licensed professional applicators when necessary to limit the potential for adverse effects on transverse lady beetle.		
		Transverse lady beetle mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of transverse lady beetle to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Yellow-banded bumble bee	Amount of habitat that is altered or lost	• Development of access roads and air strip.	Construction	• The proposed mitigation measures outlined in the EIS,	Alteration and/or loss of habitat:	Not Significant: the predicted residual

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		relative to its availability in the Terrestrial Regional Study Area (RSA).	• Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • Waste management (composting, domestic and industrial landfill operation, recycling). • Water management (including treatment). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		particularly those designed for the Valued Components (VCs) Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5), adequately and appropriately address potential for adverse effects on yellow-banded bumble bee, primarily related to limiting the loss and/or disruption of suitable habitat. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing	predicted to be low magnitude, local geographical extent, long-term duration, frequent, and fully reversible.	effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for yellow-banded bumble bee within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to groundwater and/or surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release • Process water treatment and release.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.		additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually. • Herbicide use as part of vegetation management will be limited to the immediate Project Footprint applied by licensed professional applicators when necessary to limit the potential for adverse effects on yellow-banded bumble bee.		
		Yellow-banded bumble bee mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of yellow-banded bumble bee to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Northern leopard frog	Amount of habitat that is altered or lost	• Development of access roads and air strip.	Construction	• The proposed mitigation measures outlined in the EIS,	Alteration and/or loss of habitat:	Not Significant: the predicted residual

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		relative to its availability in the Terrestrial RSA.	• Site preparation and earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials.		particularly those designed for the Wetlands VC (Section 9.2.5), adequately and appropriately address potential adverse effects on northern leopard frogs, primarily related to limiting the loss and/or disruption of suitable habitat for this species. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress	predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for northern leopard frog within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Northern leopard frog ~~M~~mortalities	• Development of access roads and air strip.	Construction		Change in mortality: predicted to be low	The predicted residual effect of

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		directly or indirectly attributable to the Project.	• Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials.		and success of these activities will be assessed annually. • Pre- disturbance wildlife clearance surveys will be conducted to identify site-specific habitat features (e.g., amphibian breeding ponds) and implement the setbacks and/or timing windows (that will be defined in the Wildlife Management Plan). • Locations of site-specific habitat features used by amphibians will be communicated to Project personnel and the requirement to limit disturbance in these areas will be implemented. • Appropriate setback and buffer distances from wetland features where amphibians are known to occur will be implemented and maintained under the direction of a wildlife QP. • Vehicle traffic and construction activities will be restricted to the approved access routes and work areas and will not cross or enter a watercourse or wetland.	magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	change in mortality is not expected to alter the integrity of the regional populations of northern leopard frog to the point where they are not sustainable or available to contribute to ecological functions
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials	Operation			
			• Site water management, treatment, and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • Reclamation of disturbed areas). • On-site and off-site operation of vehicles and transport of materials.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures~~[1]~~	Predicted Residual Effect	Significance
Terrestrial Environment	Little brown myotis ~~Northern myotis~~	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Vegetation clearing activities will occur outside of roosting periods, when practical. • Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as maternal rooting sites and hibernacula used by ~~bat species~~little brown myotis. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented (refer to Table 4-1 in final EIS Appendix 9-D which ~~in accordance with the SARGSS (SK MOE 2017 (that~~ will also be defined in the Wildlife Management Plan). • In the event a little brown myotis maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for little brown	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for little brown myotis ~~bat species~~ within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Little brown myotis ~~M~~mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of little brown myotis~~the bat~~

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation	myotis ~~bats~~ to leave but not the ability to re-enter the roosting site. • Locations of these site-specific habitat features used by little brown myotis~~bats~~ will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented. • Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.		~~species~~ to the point where they are not sustainable or available to contribute to ecological functions
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Northern myotis	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Vegetation clearing activities will occur outside of northern myotis roosting periods, when practical. • Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as northern myotis maternal rooting sites and hibernacula used by northern myotis. If features are identified in the Project Footprint, appropriate setbacks	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for northern myotis within the Terrestrial RSA to the point where it is not sustainable or
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning	and/or timing windows will be implemented (refer to Table 4-1 in final EIS Appendix 9-D which will also be defined in the Wildlife Management Plan). • In the event a northern myotis maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for northern myotis to leave but not the ability to re-enter the roosting site. • Locations of these site-specific habitat features used by northern myotis will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented. • Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.		available to contribute to ecological functions.
		Northern myotis mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of northern myotis to the point where they are not sustainable or available to contribute to ecological functions
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Bank Swallow	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the bank swallow nesting season, when practical. The breeding and nesting season for most bank swallows in Saskatchewan typically spans a period from May 15 to July 31. • In the event Project activities such as vegetation clearing and/or soil disturbance are required during the bank swallow breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted a by a QP at that location within the Project Area before activities commence to identify the presence of bank swallow nests. • Active and/or suspected bank swallow nests identified during the pre- disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with adopted regulatory guidelines	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for bank swallow within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		Bank Swallow mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	(e.g., Manitoba Conservation [2021] as there is currently no activity restriction guidelines for bank swallow in Saskatchewan) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). • Locations of nesting sites used by bank swallows will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented. • Minimize height of salvaged soil stockpiles and avoid vertical slopes to deter bank swallows from creating nesting cavities.	Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of bank swallow to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Barn Swallow	Amount of habitat that is altered or lost relative to its	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the barn swallow	Alteration and/or loss of habitat: predicted to be low magnitude, local	Not Significant: the predicted residual effect of alteration and/or loss of

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		availability in the Terrestrial RSA.	• Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		nesting season, when practical. The breeding and nesting season for barn swallow in Saskatchewan typically spans a period from May 15 to September 30. • In the event Project activities such as vegetation clearing and/or soil disturbance are required during the barn swallow breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of barn swallow nests. • Active and/or suspected barn swallow nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with adopted regulatory guidelines (e.g., Manitoba Conservation [2021] as there is currently no activity restriction guidelines for barn swallow in Saskatchewan) **in**	geographical extent, long-term duration, frequent, fully reversible.	habitat is not expected to alter the integrity of the habitat for barn swallow within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Barn Swallow mortalities directly or indirectly	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area.	Construction		Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term	The predicted residual effect of change in mortality is not expected to alter the integrity of

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		attributable to the Project.	• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). • Locations of nesting sites used by barn swallows will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.	duration, infrequent, and fully reversible.	the regional populations of barn swallow to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Common Nighthawk	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the common nighthawk nesting season, when practical. The breeding and nesting season for common nighthawk in Saskatchewan typically spans a period from May 1 to August 31. • In the event Project activities such as vegetation clearing and/or soil disturbance are	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for common nighthawk within the Terrestrial RSA to the point where it is not sustainable or available to
			• Management of surface water (including seepage and site runoff).	Operation			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		required during the common nighthawk breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of common nighthawk nests. • Active and/or suspected common nighthawk nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).		contribute to ecological functions.
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Common Nighthawk mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of common nighthawk to the point where they are not sustainable or available to
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			contribute to ecological functions.
Terrestrial Environment	Horned Grebe	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the horned grebe nesting season, when practical. The breeding and nesting season for horned grebe in Saskatchewan typically spans a period from May 1 to September 15. • In the event Project activities such as vegetation clearing and/or soil disturbance are required during the horned grebe breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for horned grebe within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.		identify the presence of horned grebe nests. • Active and/or suspected horned grebe nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in Saskatchewan) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). • Locations of nesting sites used by horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.		
		Horned Grebe mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of horned grebe to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Olive-Sided Flycatcher	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the olive-sided flycatcher nesting season, when practical. The breeding and nesting season for olive-sided flycatcher in Saskatchewan typically spans a period from May 1 to August 31. • In the event Project activities such as vegetation clearing and/or soil disturbance are required during the olive-sided flycatcher breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of olive-sided flycatcher nests. • Active and/or suspected olive-sided flycatcher nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for olive-sided flycatcher within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		Olive-Sided Flycatcher mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).	Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of olive-sided flycatcher to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Rusty Blackbird	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the rusty blackbird nesting season, when practical. The breeding and nesting season for rusty blackbird in Saskatchewan typically spans a period from May 1 to July 31.	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for rusty blackbird within the Terrestrial RSA to the

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Air transportation for workers.		• In the event Project activities such as vegetation clearing and/or soil disturbance are required during the rusty blackbird breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of rusty blackbird nests. • Active and/or suspected rusty blackbird nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).		point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Rusty Blackbird mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of rusty blackbird to the point where they are not sustainable or available to
			• On-site and off-site operation of vehicles and transport of materials.	Operation			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Air transportation for workers.				contribute to ecological functions.
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Short-eared Owl	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the short-eared owl nesting season, when practical. The breeding and nesting season for short-eared owl in Saskatchewan typically spans a period from March 25 to August 1. • In the event Project activities such as vegetation clearing and/or soil disturbance are required during the short-eared owl breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for short-eared owl within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release.	Decommissioning			

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.		identify the presence of short-eared owl nests. • Active and/or suspected short-eared owl nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).		
		Short-eared Owl mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations short-eared owl to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Yellow Rail	Amount of habitat that is altered or lost	• Development of access roads and air strip.	Construction	• Site clearing and other works that involve disturbance of vegetation	Alteration and/or loss of habitat:	Not Significant: the predicted residual

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		relative to its availability in the Terrestrial RSA.	• Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		and/or soil will be conducted outside of the yellow rail nesting season, when practical. The breeding and nesting season for yellow rail in Saskatchewan typically spans a period from May 1 to July 15. • In the event Project activities such as vegetation clearing and/or soil disturbance are required during the yellow rail breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of yellow rail nests. • Active and/or suspected yellow rail nests identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the	predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for yellow rail within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Yellow Rail mortalities directly	• Development of access roads and air strip.	Construction		Change in mortality: predicted to be low	The predicted residual effect of

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Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		or indirectly attributable to the Project.	• Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		disturbance until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).	magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	change in mortality is not expected to alter the integrity of the regional populations of yellow rail to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

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Table 5-2~~4.2~~ Summary of Significance of the Cumulative Effects on Wildlife Species At Risk

Component	Valued Component	Key Indicator	Cumulative Effects	Summary of Significance of the Cumulative Effects
Terrestrial Environment	Wildlife Species at Risk	• Nine-spotted lady beetle • Transverse lady beetle • Yellow-banded bumble bee • Northern leopard frog • Little brown myotis • Northern myotis • Bank Swallow • Barn Swallow • Common Nighthawk • Horned Grebe • Olive-sided Flycatcher • Rusty Blackbird • Short-eared Owl • Yellow Rail	Alteration and/or loss of habitat.	**Not significant:** The cumulative effect of alteration and/or loss of habitat is not expected to alter the integrity of the Wildlife Species at Risk habitat within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			Change in mortality.	**Not significant:** The cumulative effect of change in mortality is not expected to alter the integrity of the regional populations to the point where they are not sustainable or available to contribute to ecological functions.

~~5~~6 References

Brown, M.B. and Brown, C.R. 2020. Barn Swallow (*Hirundo rustica*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/barswa/cur/introduction). Accessed May 30, 2023.

Caceres, M.C. and Barclay, R.M.R. 2000. *Myotis septentrionalis*. Mammalian Species (634):1–4. DOI: 10.2307/0.634.1

COSEWIC. 2009a. COSEWIC assessment and update status report on the Northern Leopard Frog *Lithobates pipiens*, Rocky Mountain population, Western Boreal/Prairie populations, and Eastern populations, in Canada. Committee on the Status of Endangered Widlife in Canada, Ottawa. vii + 69 pp.

COSEWIC. 2009b. COSEWIC assessment and status report on the Horned Grebe, *Podiceps auritus*, Western population and Magdalen Islands population, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vii + 42 pp.

COSEWIC. 2013a. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis*, and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xxiv + 93 pp.

COSEWIC. 2013b. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xi + 48 pp.

COSEWIC. 2014. COSEWIC assessment and status report on the Wolverine *Gulo gulo* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 76 pp.

COSEWIC. 2015. COSEWIC assessment and status report on the Yellow-banded Bumble Bee *Bombus terricola* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. ix + 60 pp.

COSEWIC. 2016a. COSEWIC assessment and status report on the Nine-spotted Lady Beetle *Coccinella novemnotata* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. x + 57 pp.

COSEWIC. 2016b. COSEWIC assessment and status report on the Transverse Lady Beetle *Coccinella transversoguttata* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xi + 57 pp.

COSEWIC. 2021a. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 60 pp.

COSEWIC 2021b. COSEWIC Assessment and Status Report on the Short-eared Owl *Asio flammeus* in Canada. Committee on the status of Endangered Wildlife in Canada (COSEWIC). Threatened 2021

Environment and Climate Change Canada. 2018. Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), the Northern Myotis (*Myotis septentrionalis*), and the Tri-colored Bat (*Perimyotis subflavus*) in Canada. Environment and Climate Change Canada, Ottawa. ix + 172 pp.

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Environment and Climate Change Canada. 2022a. Management Plan for the Yellow-banded Bumble Bee (*Bombus terricola*) in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. iv + 46 pp.

Environment and Climate Change Canada. 2022b. Recovery Strategy for the Bank Swallow (*Riparia riparia*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. ix + 125 pp.

Environment and Climate Change Canada. 2022c. Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. v + 49 pp.

Environment Canada. 2013. Management Plan for the Northern Leopard Frog (*Lithobates pipiens*), Western Boreal/Prairie Populations, in Canada. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. iii + 28 pp.

Environment Canada. 2012. Management Plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. iv + 23 pp.

Environment Canada. 2015. Management Plan for the Rusty Blackbird (*Euphagus carolinus*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. iv + 26 pp.

Environment Canada. 2016. Recovery Strategy for the Olive-sided Flycatcher (*Contopus cooperi*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 52 pp.

Environmental Protection and Management Guideline. 2024. VERSION 3.1: July 2024. British Columbia Energy Regulator. 104pp.

Garrison, B.A. and Turner, A. 2020. Bank Swallow (*Riparia riparia*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/banswa/cur/introduction). Accessed May 30, 2023.

Government of Canada. 2019a. Description of Residence for Bank Swallow (*Riparia riparia*) in Canada. (https://species-registry.canada.ca/index-en.html#/species/1233-894#residence_description)

Government of Canada. 2019b. Description of Residence for Barn Swallow (*Hirundo rustica*) in Canada. (https://species-registry.canada.ca/index-en.html#/species/1147-790#residence_description)

Government of Canada. 2023. Species at risk public registry. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html). Accessed May 31, 2023.

Henderson, L.E. and Broders, H.G. 2008. Movements and Resource Selection of the Northern Long-Eared Myotis (*Myotis septentrionalis*) in a Forest - Agriculture Landscape. Journal of Mammalogy 89(4):952–963. DOI: 10.1644/07-MAMM-A-214.1

Johnson, J.S., Treanor, J.J., Slusher, A.C., and Lacki, M.J. 2019. Buildings provide vital habitat for little brown myotis (*Myotis lucifugus*) in a high-elevation landscape. Ecosphere 10(11):e02925. DOI: 10.1002/ecs2.2925

Jung, T.S., Thompson, I., and Titman, R.D. 2004. Roost site selection by forest-dwelling male *Myotis* in central Ontario, Canada. Forest Ecology and Management (202):325–335.

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Manitoba Conservation. 2021. Recommended Development Setback Distances and Restricted Activity Periods for Birds by Wildlife Feature Type Manitoba Conservation Data Centre 2021 November

Ministry of Environment (MOE 2017), Fish, Wildlife and Lands Branch. April 2017. Activity Restriction Guidelines for Sensitive Species. Regina, Saskatchewan. 4pp.

Nature Conservancy Canada (NCC). 2023. Northern Leopard Frog. (https://www.natureconservancy.ca/en/what-we-do/resource-centre/featured-species/reptiles-and-amphibians/northern-leopard-frog.html).

Odsen, S. and M. Pyper. 2019. Rusty blackbird forestry fact sheet. Foothills Research Institute. Summaries and Communications Fact Sheets.

Resources Information Standards Committee (RISC). 2022. Inventory Methods for Bats, Standards for Components of British Columbia's Biodiversity No. 20. Version 3.0. B.C. Ministry of Land, Water and Resource Stewardship, Ecosystems Branch, Victoria, B.C.

Saskatchewan Conservation Data Centre. 2023. Saskatchewan Conservation Data Centre. (http://biodiversity.sk.ca/). Accessed May 30, 2023.

Saskatchewan Ministry of the Environment (SME) 2014. Yellow Rail Survey Protocol. Fish and Wildlife Branch Report No. 2014-14.0. 3211 Alberta Street, Regina, Saskatchewan. 8pp.

Saskatchewan Ministry Environment (SME). 2021. Saskatchewan Ministry of the Environment Crown Land Work Authorization (2021). Denison Wheeler Project Area.

Slough, B.G. and Jung, T.S. 2020. Little Brown Bats Utilize Multiple Maternity Roosts Within Foraging Areas: Implications for Identifying Summer Habitat. Journal of Fish and Wildlife Management 11(1):311–320.

Smith, A.R. 1996. Atlas of Saskatchewan Birds. Special Publication No. 22. Saskatchewan Natural History Society (Nature Saskatchewan). Regina, Saskatchewan. 456 pp.

Smith, A.R., C.S. Houston, and J.F. Roy. 2019. Birds of Saskatchewan. Special Publication No. 38. Nature Saskatchewan. Regina, Saskatchewan. 765 pp.

Stedman, S.J. 2020. Horned Grebe (Podiceps auritus), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/horgre/cur/introduction). Accessed May 30, 2023.

Wildlife Division. 2020. Management Plan for the Rusty Blackbird (*Euphagus carolinus*) in Newfoundland and Labrador. Department of Fisheries, Forestry and Agriculture, Government of Newfoundland and Labrador, Corner Brook, Canada. v + 23 pp.

IR-174

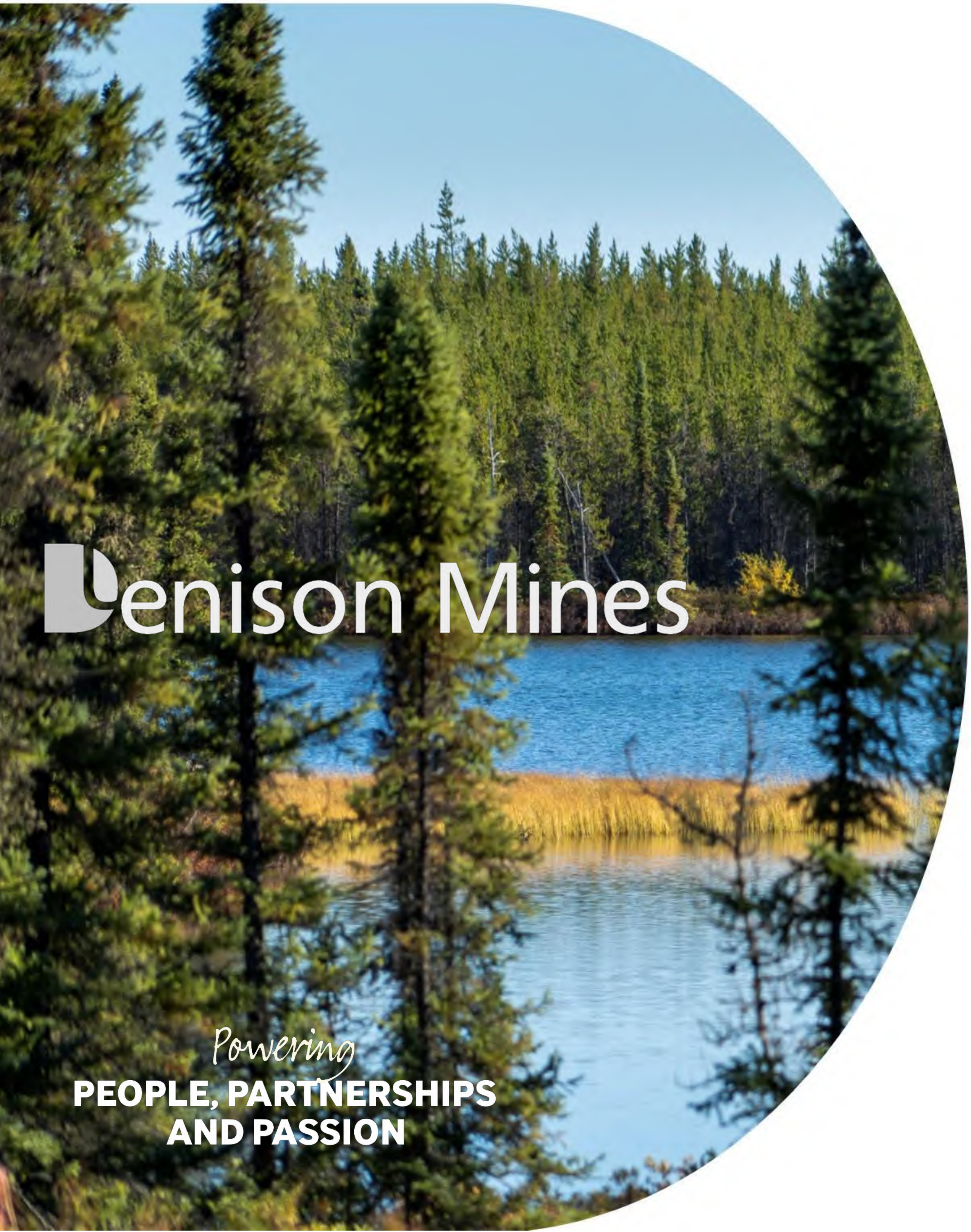
- Department: ECCC
- Project Effects Link: SAR - Bats
- Reference to EIS, appendices, or supporting documentation: Appendix 9-B, Denison Mines Corporation Wheeler River Project, Terrestrial Environment, Wildlife and Vegetation Baseline Inventory, Section 2.1.4 Acoustic Bat Surveys

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 4, 2024)	IR (ROUND 4 Sept. 6, 2024)	Denison Response (ROUND 4, September 27, 2024)
IR-174	-	**Context and Rationale:** The Proponent conducted acoustic surveys for bats and confirmed presence of two Species at Risk Act (SARA) schedule 1 listed bat species in the Project area, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis). However, the Proponent did not do an effects assessment of either of these bat species. Although bats are present in the study area, no work was done to identify hibernaculum or maternal roosting sites. All species at risk that are expected to be present in the Project area should be assessed and species-specific mitigations detailed.	1. Conduct an effects assessment for little brown myotis and northern myotis, including the likelihood that tree clearing during the bat roosting period, is likely to 'kill', 'harm', or 'harass' Little Brown Myotis and Northern Myotis and its ability to carry out its life processes. 2. Describe and map locations of suitable myotis hibernacula and/or maternal roost habitat within the Local Study Area and Regional Study Area and explain how these habitats may be affected by Project activities. 3. Describe what mitigation measures will be taken to avoid the breeding period for bats. 4. Describe any pre-construction/pre- clearing surveys will be conducted to identify any hibernaculum and maternal roosting sites. Describe how monitoring will support adaptive management.	As Key Indicators of Valued Components, the EIS includes terrestrial wildlife and avian species that may occur in the Project study areas and are listed on Schedule 1 of the federal Species at Risk Act. Project effects on these species and their habitats are described and assessed, and mitigation measures are included to avoid or reduce the potential for adverse effects on these species and their habitats. The Project effects and associated mitigation measures described in the draft EIS are broadly applicable to SAR species that occupy the same ecological niches. In response to a variety of IRs, including this IR, further information has been developed that is specific to SAR and included as Attachment IR-131. This includes a listing of all SAR species potentially occurring in the Project study areas, with links to applicable and appropriate mitigation measures described in the EIS. It is proposed the content of Attachment IR-131 will be added as a new appendix (Appendix 9-D) to Section 9 of the final EIS. The information provided in the SAR appendix includes a summary of the life history requirements, the expected Project effects, proposed mitigation measures, and anticipated residual effects on these listed species. This new EIS appendix provides information on little brown myotis and northern myotis. We note Denison's commitment to pre-construction surveys to identify potential for maternity and nursery roosting habitat. Refer to response to IR-134 for the timing of clearing activities outside of roosting periods. Results from pre-construction surveys and continuous monitoring (described in Section 9.3.8) will be used in the adaptive management process to update Project design and additional mitigation measures, if required.	This response has not been accepted. Items 1., 3. And 4. of IR-174 are accepted, however, item 2. Of IR-174, which asked for mapping of suitable myotis habitat, was not addressed. Mapping of suitable habitat or results from baseline studies is required to understand Project impacts to Species At Risk (SAR) bat species. This may include providing mapping of bat acoustic results, including locations along with frequency of detections. See also IR-134 and follow-up 134-R1.	Acoustic bat surveys were completed between July 22 and 23, 2019 with 61 survey points sampled across five ecosite types. The location of the survey points, species detected, and frequency of detections are included in Figure 2-9 of Appendix 9-F of the revised draft EIS. The EA used a habitat-based approach to predict the effects of the Project on bat species. Further, in the event that site clearing is necessary, pre-clearance wildlife sweeps will be completed and appropriate mitigation will be developed and implemented. The pre-construction and pre-clearing surveys will consist of wildlife sweeps conducted by qualified biologists within 7 days prior to any clearing activity at a specific location, and a 100 m buffer, within the Project Footprint. The wildlife sweeps will not be species-specific surveys focused on species at risk but will to be based on timing of Project related activities (i.e., will be completed in advance of site clearing activities). These sweeps are intended to identify sensitive wildlife features (including hibernacula or potential roosting sites for myotis species) that would require specific mitigation measures to avoid or minimize adverse effects on identified features and are not species-specific. The methods associated with these pre-construction and pre-clearing sweeps will be tailored to species at risk (including myotis species) that may potentially be using habitats at certain times of the year. Depending on the results of these surveys, appropriate mitigation measures will be developed and implemented. This is a risk-based approach with the intent of reducing the potential of important wildlife features being adversely affected during vegetation or land disturbance activities. The wildlife sweeps would be conducted within 7 days prior to disturbance activities, year-round, so that sensitive features can be identified, and appropriate mitigation measures (e.g., avoidance, timing delay) can be developed and implemented, as appropriate.	Note to Denison: There is additional text being drafted related to this topic, but it is still under review and may provide clarity on the outstanding request. Items one, three, and four have been accepted, but the response to item 2, regarding describing and mapping of locations of suitable myotis hibernacula and/or maternal roost habitat within the Local Study Area and Regional Study Area and an explanation of how these habitats may be affected by Project activities, is outstanding. In responding to item two, the Proponent has provided a map of species detected and frequency of detection in the local study area over two days on July 22 and 23, 2019. ECCC notes that analysis is lacking for the regional study area, despite a few autonomous recording units (ARUs) that were placed outside the LSA. Data from two consecutive days in the same month is not an accepted method to document baseline occurrences associated with suitable habitat. The legend for Figure 2-9 is not clear in that frequency of detection is mapped based on two criteria: little brown myotis and little brown/northern myotis. The Proponent should use a scientifically defensible method to document baseline occurrences associated with suitable habitat. The Proponent should clarify the legend and explain the values found within it, including if the turquoise dot represent occurrence of both little brown and northern myotis. Baseline data for bat SAR must be adequate to capture within and between year variability and to allow for statistically robust comparison to assess potential impacts on SAR over the lifecycle of the project. In this regard, Denison is expected to provide additional baseline data for bat SAR. If Denison choses to rely on literature data, a justification of applicability to the project is required. Nevertheless, Denison is expected to at a minimum commit to additional baseline monitoring prior to any disturbance, and to provide a description of the monitoring methods for review. These baseline surveys must be focused on suitable habitat for bat SAR that is to be identified through the requested mapping. To close this IR, Denison must: 1. Clarify the legend of Figure 2-9 with respect to frequency of detection 2. Provide suitable bat SAR habitat information in the form of a map 3. Provide additional baseline data for bat SAR based on literature sources and justify applicability to the project 4. Provide a description of proposed methods for bat SAR field monitoring for review	See IR-174 Round 3 Attachment below for supporting maps associated with responses to parts 2 and 3; the round 3 attachment is located at the end of this file. 1. The legend of revised draft EIS Appendix 9-F, Figure 2-9 (with respect to frequency of detection) shows the total number of passes and/or buzzes detected. We note this was available in Appendix 9-B Terrestrial Baseline. For additional reference it is also noted that the acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis. These clarifications are included in the figures below and are included in Appendix 9-F of the final EIS. 2. Refer to IR-174 Round 3 Attachment below for ECCC's requested map edits, that builds on the information presented in the map provided in revised draft EIS Appendix 9-F Figure 2-9 provided with the Round 2 response. Specifically, please see Figure IR-174 Round 3-1 and Figure IR-174 Round 3-2. These maps present the same information from Appendix 9-F Figure 2-9 only at a different spatial scale and with the Project Area unshaded to facilitate review. 3. As noted in Appendix 9-D, habitat for the little brown myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013). Hibernacula and maternity sites are reported as being the main limiting habitat features for this species (COSEWIC 2013), and this, as described below, is consistent with conditions at the Project site and surrounding area. Hibernacula occur in parts of caves, mines (openings to surface for ramps and raises for example), and buildings that have stable and specific temperature (-4 to 13°C) and humidity (>80%) conditions (COSEWIC 2013). Based on existing environment information presented in the EIS including the terrain and vegetation and ecosystem existing environment sections, there are no hibernacula anticipated in the Project Area (i.e., caves, mines, buildings with stable and specific temperatures per COSEWIC 2013). Terrain is low relief due to flat-lying sandstone and almost continuous cover of sandy glacial deposits (i.e., surface is predominately sand textured and there are no rocky outcrops or bedrock at surface for cave habitats); there are no man-made structures (e.g., mine openings or buildings) in the Project Area. As noted in the EIS, the terrain and vegetation communities are fairly uniform throughout the study areas and the habitat considerations in the	Following the supplementary information provided by Denison on July 5th, CNSC staff determined that it is unclear from the proponent's response whether Denison will perform both pre-disturbance surveys **and** additional baseline surveys for bat SAR. In order to resolve this IR, Denison are expected to: 1. Revise Figure 2-9 to re-label frequency as number of detections by time. Clarify regarding the turquoise dots if species data is uncertain in all cases or were detections for some identifiable? 2. Revise Figure IR-174 Round 3-1 and Figure IR-174 Round 3-2 to depict habitat potential for different life stages of the species for different bats. 3. Provide the proposed methods for the additional bat SAR baseline surveys including a description of the statistical approaches to be used. The methods must demonstrate how the baseline data will be of sufficient sample size and duration to obtain a basic understanding of within-year and between-year variation. 4. Provide a commitment to conduct additional bat SAR baseline surveys in their commitments register.	1. The frequency of detections was on a 5 minute interval. This has been clarified in Figure 2-9 of Appendix 9-F. We can confirm the turquoise dots represent passes or buzzes that were uncertain (unable to distinguish echolocation call characteristics between bat species) in all cases. 2. See **Attachment IR-174 (Round 4)** below for the response to this IR along with supporting maps. 3. Methods for future pre-construction baseline bat surveys will build on the 2019 baseline (refer to EIS Appendix 9-B) and methods from the 2019 baseline are provided below along with information on how comparisons within year and between years will be completed. *Methods* Surveys will be commenced one half hour after sunset and ended one half hour before sunrise. Survey stations will be established 500 m apart along linear features where safe night travel was possible. Surveys will only be completed during appropriate weather conditions, with weather attributes (temperature, sky condition and wind (Beaufort scale)) recorded throughout the survey. Each survey site consists of a five-minute listening period using a Wildlife Acoustics Echo Meter Touch 2 Pro. The detector will be held with the microphone at a 45 degree angle and slowly rotated 360 degrees for the duration of the sampling period. If a bat is detected the detector is held stationary for 15 seconds to avoid duplicate counts. Total detector hours will be calculated for the Project area and by ecosite/vegetation cover type. Ecosite/vegetation cover type for each survey point is established by utilizing the dominate ecosite/vegetation cover type within a 50 m radius of the survey point. *Acoustic Bat Call Analysis* Data will be analyzed using Wildlife Acoustics Kaleidoscope software. Echolocation call characteristics will be used to identify bat species. Call characteristics used to establish species included: • minimum frequency • maximum frequency • call duration • call slope • call shape Call characteristics will be compared to reference calls in literature and call libraries (WDNR 2016, WNDD 2016, Keinath 2011, Adams 2003). In addition, reference calls within Omnia's call library will be used where possible. For future monitoring of bat species Denison will continue to inventory bat presence at given sites and this data will be analyzed to characterize: 1. Presence (occupancy) 2. Relative abundance 3. Change metrics to be analyzed include: a. Annual and total change at specific site b. Annual and total change across all sites The analysis will be done using mean and 95% credible interval bars and will include covariates such as time of year

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 4, 2024)	IR (ROUND 4 Sept. 6, 2024)	Denison Response (ROUND 4, September 27, 2024)
							5. Commit to an EA commitment to collect additional bat SAR field baseline data prior to disturbance	Project Area are considered representative of the landscape in the wildlife LSA and RSA. Maternity sites can occur in large-diameter trees, rock crevices, buildings, and bat houses that offer warm and relatively stable microclimate conditions that allow females to avoid going into torpor so they can focus on caring for their young (COSEWIC 2013a, Slough and Jung 2020). As highlighted above, since there are no rock crevices, buildings, or bat houses in the Project Area, a consideration for maternal roost potential was focused on the areas where larger diameter trees may be present. Existing ecosite information was reviewed and ecosites with higher potential for maternity roosts (i.e., larger diameter trees) were selected. The ecosites with the potential for larger diameter trees are shown in Figure 2-10 below, and include ecosites RF1 (regenerating forest >5m tall; per Appendix 9-B), BS3 jack pine/blueberry/lichen, BS4 jack pine – black spruce/feathermoss, BS7 black spruce/blueberry/lichen, BS9 black spruce – jack pine/feathermoss, BS14 white birch/lingonberry – labrador tea, BS16 black spruce/ balsam poplar/river alder swamp, BS17 black spruce treed bog, and BS21 tamarack treed fen. While these ecosites were selected for the *potential* to have larger diameter trees, it is important to note that the majority of these ecosites have trees with diameter at breast height <10 cm. Refer Appendix 9-B for representative photos of the selected ecosites. Based on this conservative mapping exercise, the Project Area contains small areas of suitable potential maternal roost habitat. The total Project Area is around 170 ha and potential bat maternal roost ecosites represent less than 49 ha, when as noted above it is assumed that the ecosites identified above provide trees suitable for maternity roosts across their entirety. The above text has been added to Appendix 9-F of the final EIS along with Figure IR-174 Round 3-3. We reiterate that the additional information collated and displayed in the maps provided to support this IR response is consistent with and does not contradict anything presented in the draft EIS documentation. We also refer the reviewer to Appendix 9-D for a summary of species-specific mitigation measures for bats; text from Section 3.3.3 has been included below in *italicized font* for ease of review: *Bat Species* • *Vegetation clearing activities will occur outside of roosting periods, when practical.* • *Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as maternal rooting sites and hibernacula used by bat species. If features are identified in the Project Footprint,*		(date), precipitation, temperature, forest cover, Ecosite and proximity to water/wetland. Appropriate statistical methods to compare pre-construction baseline and 2019 baseline data spatially and temporally will be employed and accompanied by power analysis. Results of acoustic bat surveys will be submitted to Saskatchewan's Conservation Data Centre. 4. Commitment 9-37 has been updated in version 3 of Denison's commitment register (additions in bold) and now reads: "**Pre-construction baseline** acoustic bat surveys will be completed prior to construction, building on the 2019 surveys (Appendix 9-B). The surveys will determine the presence/non-absence, diversity and relative abundance of bat species in the Project Area. **Results of acoustic bat surveys will be submitted to Saskatchewan's Conservation Data Centre**".

Original IR#	Follow-Up IR #	Context and Rationale	IR (ROUND 1, March 2023)	Denison Response (ROUND 1, August 2023)	IR (ROUND 2, December 2023)	Denison Response (ROUND 2, Feb. 2024)	IR (ROUND 3, May 31, 2024)	Denison Response (ROUND 3, July 4, 2024)	IR (ROUND 4 Sept. 6, 2024)	Denison Response (ROUND 4, September 27, 2024)
								appropriate setbacks and/or timing windows will be implemented in accordance with the SARGSS (SK MOE 2017 (that will also be defined in the Wildlife Management Plan). • *In the event a maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for bats to leave but not the ability to re-enter the roosting site.* • *Locations of these site-specific habitat features used by bats will be communicated to the appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.* • *Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.* 4. Refer to response to IR-142, IR-159, IR-167-R1 for information on the bat-specific pre-clearance sweeps. We also note that Commitment 9-3 outlines Denison's commitment to pre-disturbance wildlife clearance surveys. 5. A commitment to complete pre-construction / disturbance bat surveying has been added to the commitments register as 9-37, as follows: "Acoustic bat surveys will be completed prior to construction, building on the 2019 surveys (Appendix 9-B). The surveys will determine the presence/non-absence, diversity and relative abundance of bat species in the Project Area." For clarity, this additional pre-construction / disturbance data will be used to inform the execution of site development activities and additionally provides further information that can be used within the context of follow-up monitoring as a basis for temporal comparison. At this time, the intent is not to integrate such information into the EIS, nor does Denison and its SMEs believe the additional information is necessary to for EA determination with respect to potential project-related effects on bats. <u>References:</u> COSEWIC. 2013. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis*, and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xxiv + 93 pp. Slough, B.G. and Jung, T.S. 2020. Little Brown Bats Utilize Multiple Maternity Roosts Within Foraging Areas: Implications for Identifying Summer Habitat. Journal of Fish and Wildlife Management 11(1):311–320.		

Related information: Round 1 response – new EIS Appendix 9-D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Appendix 9-D Wildlife Species at Risk

New Appendix to final EIS, Section 9

Version 1

July 2023

Table of Contents

Tables

Acronyms and Abbreviations

Term	Definition
BBS	Breeding Bird Survey
BC	British Columbia
CEA	Cumulative effects assessment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
EMS	Environmental Management System
FIRT	Federal-Indigenous Review Team
IRs	Information requests
ISR	In situ recovery
KI	Key Indicator
LSA	Local Study Area
Project	Wheeler River Project
QP	Qualified Professional
RSA	Regional Study Area
SAR	Species at risk
SARA	*Species at Risk Act*
SARGSS	Saskatchewan Activity Restriction Guidelines for Sensitive Species
SKCDC	Saskatchewan Conservation Data Centre
VC	Valued Component

Introduction

Background

On October 21, 2022, Denison Mines Corp. (Denison) submitted a draft Environmental Impact Statement (EIS) for the proposed Wheeler River Project (the Project). Based on their initial review, the Canadian Nuclear Safety Commission indicated that the submission contained the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review of the draft EIS. On March 20, 2023, the FIRT provided Denison with a list of information requests (IRs) for Denison to respond to and eventually submit a final EIS document.

This Appendix provides additional information to address several IRs provided by Environment and Climate Change Canada (ECCC) as part of the initial round of Federal Indigenous Review Team (FIRT) comments. These IRs were related to 16 wildlife species at risk (SAR) listed under Schedule 1 of the federal *Species at Risk Act* (SARA). The draft EIS approach was conservative in that it considered appropriate representative species as Valued Components (VCs) and Key Indicators (KIs) in sections 9.3 Ungulates, Furbearers, and Woodland Caribou and 9.4 Raptors, Migratory Breeding Birds, and Bird SAR. Of the 16 wildlife SAR listed in Table 0.1, seven had been included as VCs or KIs in the EIS after a thorough scoping process (refer to Section 0 for additional information).

Nine of the sixteen were not included as individual VCs or KIs but are considered important from a regulatory perspective. The SARA-listed species identified by ECCC are listed in Table 0.1. Those noted in bold font indicate those for which further assessment is provided in this appendix.

Table 0.1 Wildlife Species at Risk Listed by Environment and Climate Change Canada

Common Name	Scientific Name	Discussed in the draft EIS
Nine-spotted lady beetle	***Coccinella ovemnotata***	**No**
Transverse lady beetle	***Coccinella transversoguttata***	**No**
Yellow-banded bumble bee	***Bombus terricola***	**No**
Northern leopard frog	***Lithobates pipiens***	**No**
Little brown myotis	***Myotis lucifugus***	**No**
Northern myotis	***Myotis septentrionalis***	**No**
Wolverine	*Gulo gulo*	Yes
Woodland caribou	*Rangifer tarandus caribou*	Yes
Bank Swallow	***Riparia riparia***	**No**
Barn Swallow	***Hirundo rustica***	**No**
Common Nighthawk	*Chordeiles minor*	Yes
Horned Grebe	***Podiceps auritus***	**No**
Olive-sided Flycatcher	*Contopus cooperi*	Yes

Common Name	Scientific Name	Discussed in the draft EIS
Rusty Blackbird	*Euphagus carolinus*	Yes
Short-eared Owl	*Asio flammeus*	Yes
Yellow Rail	*Coturnicops noveboracensis*	Yes

Of the 16 species listed in Table 0.1, seven had been included as VCs or KIs in the EIS after a thorough scoping process, as summarized below.

Valued Component Selection

The VCs considered in the effects assessment for the Project are aspects of the biophysical and human environments that were considered to be likely to be affected (adversely or positively) by the Project. The VCs reflect identified scientific, local knowledge, and Indigenous Knowledge, and community interests regarding the Project and its potential effects. The potential effects are typically identified early in the environmental assessment process as a result of questions and concerns raised through engagement with Indigenous and community groups, government departments and agencies, and the general public.

Denison reviewed and considered all received input to develop a VC list that reflects the key environmental, socio-economic, heritage, and human health components and interests to appropriately focus the EA.

The initial VCs selected to represent bird SAR in the habitat-based assessment that were provided in the Terms of Reference (Denison 2019) were evaluated, consolidated, and organized to allow for the logical assessment of Project effects, and are presented in Table 0.2 and Table 0.3, which formed the basis for the subsequent VC-specific assessment.

Table 0.2 Wildlife Species at Risk Valued Component and Rationale for their Inclusion in the Habitat-based Environmental Assessment for the Denison Wheeler River Project

Valued Component	Rationale
Biophysical Environment	
Terrestrial Environment	
Furbearers	Project activities and infrastructure may affect local furbearer populations, including species at risk (SAR), resulting in non-compliance with permit conditions (e.g., *Species at Risk Act* [SARA; Government of Canada 2022], *The Wildlife Act 1998* [Government of Saskatchewan 2020]).
Woodland Caribou	Project activities and infrastructure may affect woodland caribou populations, resulting in non-compliance with permit conditions (e.g., SARA [Government of Canada 2022], *The Wildlife Act, 1998* [Government of Saskatchewan 2020]).

Valued Component	Rationale
Bird Species at Risk	Project activities and infrastructure may affect bird SAR (specifically disturbance and/or destruction of eggs, young, and adults) resulting in non-compliance with regulatory requirements (e.g., SARA [Government of Canada 2022], *Migratory Birds Convention Act 1994* [Government of Canada 2017], *Saskatchewan Activity Restriction Guidelines for Sensitive Species* [Government of Saskatchewan 2017], *The Wildlife Act 1998* [Government of Saskatchewan 2020]).

Table 0.3 Valued Components, Key Indicators, and Measurable Parameters for the Wildlife Component included in the Habitat-based Environmental Assessment for Denison Wheeler River Project

Valued Component	Key Indicator	Measurable Parameter
Furbearers	Wolverine	Amount of habitat (km^2) (not necessarily occupied) that may be altered or lost relative to its availability in the Regional Study Area (RSA). The number of wolverine mortalities directly or indirectly attributable to the Project.
Woodland Caribou	Woodland caribou	Amount of habitat (km^2) (not necessarily occupied) that may be altered or lost relative to its availability in the RSA. The number of woodland caribou mortalities directly or indirectly attributable to the Project.
Bird Species at Risk	Common Nighthawk	Percentage of habitat for Common Nighthawk altered/lost directly or indirectly as a result of Project activities. The number of Common Nighthawk mortalities directly or indirectly attributable to the Project.
	Rusty Blackbird	Percentage of habitat for Rusty Blackbird altered/lost directly or indirectly as a result of Project activities. The number of rusty blackbird mortalities directly or indirectly attributable to the Project
	Olive-sided Flycatcher	Percentage of habitat for Olive-sided Flycatcher altered/lost directly or indirectly as a result of Project activities. The number of Olive-sided Flycatcher mortalities directly or indirectly attributable to the Project
	Short-eared Owl	Percentage of habitat for Short-eared Owl altered/lost directly or indirectly as a result of Project activities. The number of Short-eared Owl mortalities directly or indirectly attributable to the Project.

Valued Component	Key Indicator	Measurable Parameter
	Yellow Rail	Percentage of habitat for Yellow Rail altered/lost directly or indirectly as a result of Project activities. The number of Yellow Rail mortalities directly or indirectly attributable to the Project.

The five bird species identified in Table 0.3 were selected as SAR VCs for the habitat-based EA in consideration of information/responses received during extensive Indigenous and community engagement completed by Denison, and they represent wildlife species of local importance. For these five species, additional information is not be provided in this Appendix. Rather, the reader is referred to the applicable sections in the EIS where appropriate information on existing conditions (Section 9.4.3.3), potential project-related effects (Section 9.4.4), mitigation measures (Section 9.4.5), residual effects and their significance (Section 9.4.6), and cumulative effects (Section 9.4.7) is provided.

Supplemental Information

As requested by ECCC, the following subsections provide supplemental information for the remaining nine species listed in Table 0.1 that were not included as VCs or KIs in the EIS. For these nine species, a brief overview of life history requirements (existing environment), a discussion on the effects assessment and mitigation measures, and a summary of residual and cumulative effects are included.

Table 0.1 Wildlife Species At Risk Considered in the Wheeler River Project Environmental Impact Statement

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
Arthropods						
Nine-spotted lady beetle	*Coccinella novemnotata*	S4	Endangered	Habitat generalist – uses a diverse range of habitats and consumes a variety of prey. See Section 0 for further details.	~~Unlikely~~ Local Study Area (LSA) is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a Valued Component (VC) in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Transverse lady beetle	*Coccinella transversoguttata*	S4	Special Concern	Habitat generalist – uses a diverse range of habitats and consumes a variety of prey. See Section 0 for further details.	~~Unlikely~~ LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Yellow-banded bumble bee	*Bombus terricola*	S4	Special Concern	Habitat generalist – uses a variety of habitats and consumes nectar and pollen from many different flowering plants. See Section 0 for further details.	~~Unlikely~~ LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Amphibians						
Northern leopard frog	*Lithobates pipiens*	S3	Special Concern	Three district habitats: (1) overwintering waterbodies that are cold, well oxygenated, and do not freeze to	LSA is located within COSEWIC range; no observations in SKCDC	Not included as a VC in the EIS. A review of life history requirements and discussion on

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				bottom; (2) breeding and larval waterbodies with shallow, open habitats, neutral pH, and no fish; and (3) summering areas in shallow marshes, moist upland meadows where grass height is less than 1 m. See Section 0 for further details.	and no Project-specific observations to date. Amphibian nocturnal call and visual search surveys were completed in the LSA and Regional Study Area (RSA) as part of the baseline program; however, only boreal chorus frogs (*Pseudacris maculata*) were detected (Appendix 9-C).	effects assessment are included in this Appendix.
Bats						
Little brown myotis	*Myotis lucifugus*	S4B, S4N	Endangered	Seasonal habitat requirements: (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies. See Section 0 for further details.	Documented during the acoustic bat surveys as part of the baseline field program as present in the LSA and RSA, and previously observed in the RSA (SKCDC 2023).	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.
Northern myotis	*Myotis septentrionalis*	S3	Endangered	Seasonal habitat requirements: (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging	Documented during the acoustic bat surveys as part of the baseline field program as	Not included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in this Appendix.

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				areas and suitable locations for roosting and maternity colonies. See Section 0 for further details.	present in the LSA and RSA (Appendix 9-C).	
Terrestrial Wildlife Species						
Wolverine	*Gulo gulo*	S2	Special Concern	See Section 9.3.3.2 of the EIS for details.	LSA is located within COSEWIC range; no observations in SKCDC and no Project-specific observations to date.	Included as a Key Indicator (KI) of the Furbearer VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Woodland caribou	*Rangifer tarandus caribou*	S3	Threatened	See Section 9.3.3.3 of the EIS for details.	Documented within the RSA during the baseline field program (Appendix 9-C)	Included as a VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Avian Species						
Bank Swallow	*Riparia riparia*	S4B, S5M	Threatened	Nesting colonies are typically characterized by steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows. They are often adjacent to slow-moving or still waterbodies and may occur in natural habitats or in anthropogenic features. Bank Swallows are aerial insectivores that forage over a variety of	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Not included as a KI of the Bird Species at Risk (SAR) VC in the EIS (Common Nighthawk was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
				open habitats. See Section 0 for further details.		
Barn Swallow	*Hirundo rustica*	S4B	Threatened	Breeding habitat typically requires a suitable nesting site with a vertical or horizontal surface underneath a roof of some sort, open areas for foraging, and a waterbody with mud for nest building. Anthropogenic features such as barns, houses, bridges, and culverts are commonly used nesting sites. See Section 0 for further details.	Documented during the breeding bird surveys as part of the baseline field program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	Not included as a KI of the Bird SAR VC in the EIS (Common Nighthawk was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5).
Common Nighthawk	*Chordeiles minor*	S4B	Special Concern	See Section 9.4.3.3 of the EIS for details.	Documented during the baseline field program as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Horned Grebe	*Podiceps auritus*	S5B	Special Concern	Breeding habitat consists of small to medium-sized freshwater lakes, ponds, and marshes that are shallow with open water (at least 40%), emergent vegetation, anchorage for nests, and concealment for nests and young. See Section 0 for further details.	Documented during the baseline field program as present in the LSA (Appendix 9-C).	Not included as a KI of the Bird SAR VC in the EIS (Yellow Rail was used as a surrogate species). A review of life history requirements and discussion on effects assessment are included in this Appendix. Any new species-specific mitigation measures identified in this appendix will be added to the final EIS (Section 9.4.5)..
Olive-sided Flycatcher	*Contopus cooperi*	S4B	Special Concern	See Section 9.4.3.3 of the EIS for details.	Documented during the baseline field program	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and

Common Name	Scientific Name	Provincial Status	Federal Status[1]	Preferred Habitat	Documented Occurrence in the Local Study Area[2]	Reference in the Environmental Impact Statement (EIS)
					as present in the LSA (Appendix 9-C), and previously observed in the RSA (SKCDC 2023)	discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Rusty Blackbird	*Euphagus carolinus*	S3B, SUN	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Short-eared Owl	*Asio flammeus*	S3B, S2N	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.
Yellow Rail	*Coturnicops noveboracensis*	S3B	Special Concern	See Section 9.4.3.3 of the EIS for details.	LSA is located within COSEWIC range; no historical observations documented by the SKCDC (2023) and no Project-specific observations to date.	Included as a KI of the Bird SAR VC in the EIS. A review of life history requirements and discussion on effects assessment are included in the EIS (Section 9.3). Additional information for this species is not provided in this Appendix.

Note: shaded rows indicate SAR was included as a VC or KI in the draft EIS

1 Schedule 1 under the *Species at Risk Act*.

2 Potential for Occurrence – based on known species occurrence data from Saskatchewan Conservation Data Centre (2023), Omnia (Appendix 9-C), Birds of Saskatchewan (2019), and Atlas of Saskatchewan Birds (Smith 1996) and/or presence of suitable habitat.

Arthropods

Nine-Spotted Lady Beetle

Source: COSEWIC (2016a).

The nine-spotted lady beetle is a small beetle species found across southern Canada and the continental United States (COSEWIC 2016a). Its northern range limit in Saskatchewan is reported to occur near Lake Athabasca (COSEWIC 2016a). Based on records provided by the Saskatchewan Conservation Data Centre Hunting, Angling and Biodiversity of Saskatchewan (HABISask) database (SKCDC 2023), there are no historical observations of this species documented in the Regional Study Area (RSA).

The nine-spotted lady beetle is a habitat generalist that uses a diverse range of habitats (e.g., open to semi-open forests, grasslands, riparian areas) and consumes a variety of prey (e.g., many species of arthropods [particularly aphids], sap, nectar and pollen) (COSEWIC 2016a). Being a habitat generalist allows the nine-spotted lady beetle to exploit seasonally available prey sources, with prey availability influencing the species' distribution more than habitat availability (COSEWIC 2016a).

The nine-spotted lady beetle has four life stages (i.e., egg, larva, pupa, and adult) and may produce two generations per year (i.e., spring and fall) depending on regional climate conditions (COSEWIC 2016a). Lady beetles, in general, are highly mobile and may undertake short (few hundred metres) and long-distance (18 to 120 km) movements (COSEWIC 2016a). The nine-spotted lady beetle is not migratory nor does it display strong site fidelity (COSEWIC 2016a). The nine-spotted lady beetle overwinters in aggregations in well-ventilated habitats (e.g., in rock crevices, grass tussocks, or leaf litter, or under stones or tree bark), becoming active in the early spring when temperatures start to increase (COSEWIC 2016a).

The nine-spotted lady beetle is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). The species has undergone significant population declines in Canada since 1975, going from one of the more common lady beetles collected to being rarely collected relative to other lady beetles, despite comprehensive and targeted surveys (COSEWIC 2016a). Reasons for these population declines are currently unknown but are thought to be driven by competition, predation, and introduced diseases from non-native species (including non-native lady beetles), agricultural pesticide use to control aphids, habitat loss via urban expansion, and other human disturbances (COSEWIC 2016a).

Transverse Lady Beetle

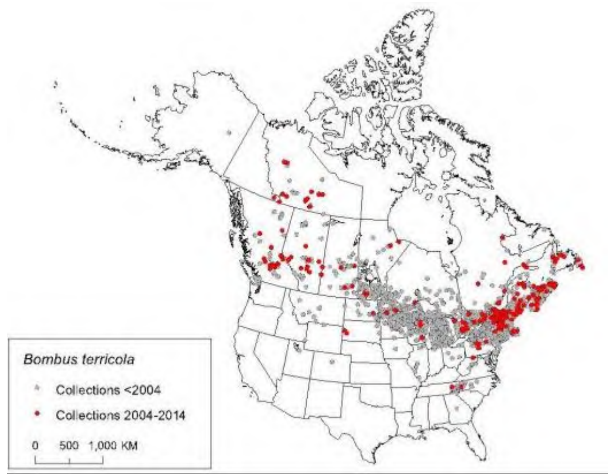
Source: COSEWIC (2016b).

The transverse lady beetle is a small beetle species found across the United States and Canada, including all provinces and territories (COSEWIC 2016b). The species is a habitat generalist and uses similar habitat types and consumes similar prey as the nine-spotted lady beetle, which means it is also able to exploit seasonally available prey sources (COSEWIC 2016b). According to the information from the HABISask database, there are no historical observations of this species documented in the RSA.

The transverse lady beetle has four life stages (i.e., egg, larva, pupa, and adult) and may produce two generations per year (i.e., spring and fall) depending on regional climate conditions (COSEWIC 2016b). Lady beetles in general are highly mobile and may undertake short (few hundred metres) and long-distance (18 to 120 km) movements (COSEWIC 2016b). The transverse lady beetle is not migratory nor does it display strong site fidelity (COSEWIC 2016b). The transverse lady beetle overwinters in aggregations in well-ventilated habitats (e.g., in rock crevices, grass tussocks, or leaf litter, or under stones or tree bark), becoming active in the early spring when temperatures start to increase (COSEWIC 2016b).

The transverse lady beetle is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). The species was once abundant across its range in Canada and was one of the most common lady beetles collected; however, since 1986, the species is now absent, below detection limits, or present in low numbers in many parts of its range (COSEWIC 2016b). The transverse lady beetle has not been detected in Saskatchewan since 2001 (COSEWIC 2016b). Reasons for these population declines are currently unknown but are thought to be driven by the same factors listed for the nine-spotted lady beetle in Section **Error! Reference source not found.**.

Yellow-banded Bumble Bee



Source: COSEWIC (2015).

The yellow-banded bumble bee is a medium-sized bumble bee species found throughout eastern North America, from eastern British Columbia (BC) to Newfoundland and Labrador and from the northern United States up to the southern portion of the territories (COSEWIC 2015). The species is a habitat generalist (e.g., boreal habitats, mixed woodlands, montane meadows) and consumes nectar and pollen from many different flowering plants (COSEWIC 2015). According to the information from the HABISask database, there are no historical observations of this species documented in the RSA.

The yellow-banded bumble bee has four life stages (i.e., egg, larva, pupa, and adult) and produces one generation per year, with mated queens establishing new colonies each year (COSEWIC 2015).

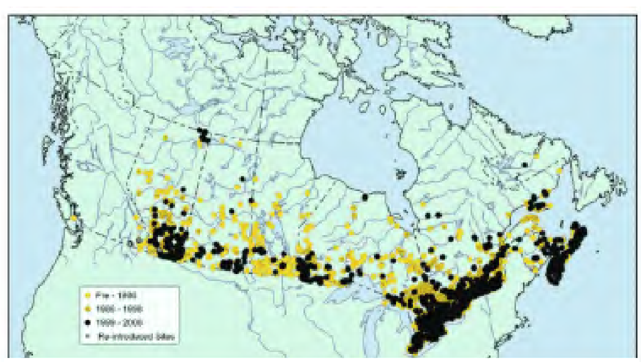
After overwintering underground in loose soil or decomposing organic material, the mated queens emerge in the spring and search for potential nest sites, which are typically located underground in existing cavities (e.g., abandoned rodent burrows, rotten logs, openings in dead wood, and grassy hummocks) (COSEWIC 2015). Once a queen has found a suitable nest site, she forages for nectar and pollen and then returns to her nest site to lay eggs, which will develop into her future workers (i.e., unmated daughters that do not typically reproduce) (COSEWIC 2015). After the initial eggs hatch and the larva and pupa develop into adult workers, the workers take over nest and brood care, foraging duties, and colony protection while the queen continues to lay eggs (COSEWIC 2015). Males and potential queens are produced by late summer once the colony reaches maximum worker production, at which point they leave the colony and mate (COSEWIC 2015). All males and workers die by fall while the mated queens hibernate through the winter in suitable overwintering sites (COSEWIC 2015).

The yellow-banded bumble bee is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S4 species in Saskatchewan (i.e., Apparently Secure) (Saskatchewan Conservation Data Centre 2023). Prior to the 1990s, the yellow-banded bumble bee was one of the more common bumble bees collected in eastern and boreal Canada (COSEWIC 2015, Environment and Climate Change Canada 2022a). Population declines started to occur in the early 1990s, with an average rate of decline of 66.5% in proportional abundance across central and southern Canada between 1992 and 2011 (COSEWIC 2015, Environment and Climate Change Canada 2022a). The species is no longer found at several historical collection sites (COSEWIC 2015).

The status of the yellow-banded bumble bee in boreal habitats and Arctic regions is unknown (COSEWIC 2015, Environment and Climate Change Canada 2022a). Reasons for these population declines are currently unknown but are thought to be driven by introduced diseases from managed bumble bee species, agricultural pesticide use, habitat loss via urban and agricultural expansion, and climate change (COSEWIC 2015).The species' unique type of sex determination, where colonies must reach maximum worker production to produce males and potential queens, has been identified as a limiting factor (COSEWIC 2015, Environment and Climate Change Canada 2022a).

Amphibians

Northern Leopard Frog



Source: COSEWIC (2009a).

The northern leopard frog is found across most of west-central and northeastern North America (COSEWIC 2009a). The species is widespread in Canada, ranging from southeastern BC to Labrador, and from southcentral Northwest Territories (COSEWIC 2009a, NCC 2023).

Three district habitats are used by the northern leopard frog on an annual basis: (1) overwintering waterbodies that are cold, well oxygenated, and do not freeze to bottom (e.g., rivers, streams, deep lake ponds and creeks, and spillways below dams); (2) breeding and larval waterbodies with shallow, open habitats (e.g., ponds, lakeshores, marshes, and slow-moving streams; may be permanent or semi-permanent), neutral pH, well vegetated, and no fish; and (3) summering areas in shallow marshes, moist upland meadows, forests and grasslands where grass height is less than 1 m (COSEWIC 2009a, NCC 2023). These habitats must be in proximity with suitable dispersal corridors interconnecting them (e.g., riparian areas and waterways) as the species is not capable of long-distance movements (COSEWIC 2009a, Environment Canada 2013).

Northern leopard frogs emerge from their overwintering waterbodies in early spring shortly after ice off (COSEWIC 2009a). The breeding season extends from mid-April to June, with exact timing dependent on location and latitude (COSEWIC 2009a). Females lay several thousand eggs, attaching them to submerged vegetation, which develop into tadpoles within two weeks depending on water temperatures (COSEWIC 2009a). The tadpoles in turn develop into small frogs over a two-to-three-month period, after which they migrate to their summering areas and forage on a variety of arthropods, worms, and snails, sometimes preying on small birds and smaller frogs (COSEWIC 2009a).

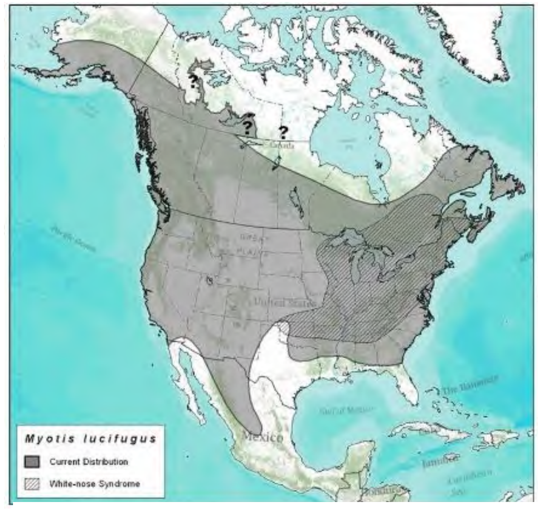
Three populations are recognized for the northern leopard frog in Canada: the Rocky Mountain, the Western Boreal/Prairie, and the Eastern (COSEWIC 2009a, NCC 2023). The Western Boreal/Prairie population is found in Alberta, Saskatchewan, Manitoba, and the Northwest Territories (COSEWIC 2009a, NCC 2023). The Western Boreal/Prairie population is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S3 species in Saskatchewan (i.e., Vulnerable) (Saskatchewan Conservation Data Centre 2023).

Population data are limited for the northern leopard frog in Canada (COSEWIC 2009a, Environment Canada 2013). Large-scale population declines occurred in the early 1970s, with populations in western Canada (i.e., BC and Alberta) most dramatically affected (COSEWIC 2009a). Information is lacking on the current status of northern leopard frog populations in Saskatchewan (COSEWIC 2009a, Environment Canada 2013).

Threats to the northern leopard frog include emerging diseases (e.g., *Chytridiomycosis*), introduced non-native species, habitat loss and fragmentation, environmental contamination, and increased frequency and severity of droughts (COSEWIC 2009a). The species' specific habitat requirements and vulnerability to diseases and prolonged periods of drought have been identified as limiting factors (Environment Canada 2013).

Bats

Little Brown Myotis



Source: COSEWIC (2013a).

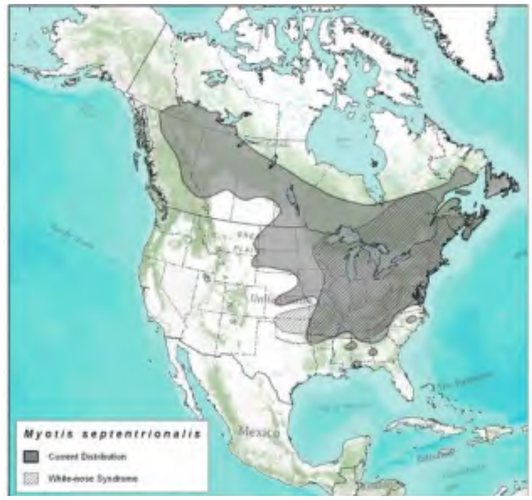
The little brown myotis is a small bat species found across North America, including across Canada south of the treeline (COSEWIC 2013a). The species is considered a short-distance regional migrant between its summer and winter ranges, with the distance travelled dependent on the location of suitable overwintering hibernacula (COSEWIC 2013a).

Habitat for the little brown myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013a). Hibernacula and maternity sites are the main limiting habitat features for this species (COSEWIC 2013a). Hibernacula occur in parts of caves, mines, and buildings that have stable and specific temperature (-4 to 13°C) and humidity (>80%) conditions (COSEWIC 2013a). Maternity sites occur in large-diameter trees, rock crevices, buildings, and bat houses that offer warm and relatively stable microclimate conditions that allow females to avoid going into torpor so they can focus on caring for their young (COSEWIC 2013a, Slough and Jung 2020). Males are more versatile in their summer roosting requirements and use tree cavities, raised bark, foliage, rock crevices, buildings, and bridges with a broader range of microclimate conditions (COSEWIC 2013a, Johnson et al. 2019). Foraging areas for the little brown myotis include a variety of habitats situated close to roosting and maternity sites, including over water (e.g., wetlands, lakes, ponds, and rivers), along riparian areas and forest edges, and in forest gaps (COSEWIC 2013a).

The little brown myotis is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S4B, S4N species in Saskatchewan (i.e., Apparently Secure breeding population, Apparently Secure non-breeding population) (Saskatchewan Conservation Data Centre 2023).

The current size of the little brown myotis population in Canada is unknown. Prior to the arrival of White-nose Syndrome in 2010, the population in Canada was estimated to be over one million individuals (COSEWIC 2013a, Environment and Climate Change Canada 2018). White-nose Syndrome is a disease the causes high rates of mortality among hibernating bats, and it has been identified as the main threat for bat populations in Canada (COSEWIC 2013a). Other threats to the little brown myotis include habitat loss, colony eradication, chemical contamination, and wind turbines (COSEWIC 2013a).

Northern Myotis



Source: COSEWIC (2013a).

The northern myotis is a small bat species found across North America, including across Canada south of the treeline (COSEWIC 2013a). The species is considered a short-distance regional migrant between its summer and winter ranges, with the distance travelled dependent on the location of suitable overwintering hibernacula (COSEWIC 2013a).

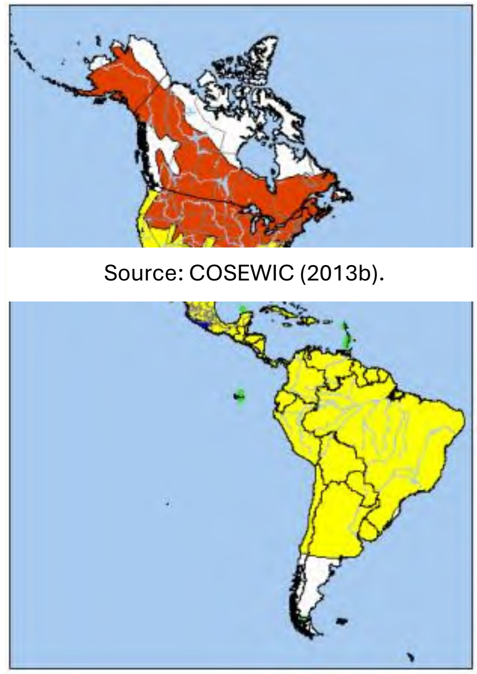
Habitat for the northern myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013a). Hibernacula and maternity sites are the main limiting habitat features for this species (COSEWIC 2013a). Hibernacula occur in parts of caves, mines, and buildings that have stable and specific temperature (0.6 to 14°C) and humidity (>80%) conditions (COSEWIC 2013a). Summer roosting trees are typically found in mature to old-growth forests, swamps, and riparian areas, although retained older trees and snags in younger forests may occasionally provide suitable roosting habitat (Environment and Climate Change Canada 2018). Females strongly prefer tall, large-diameter trees (both living and dead, typically deciduous) with early- to mid-decay for maternity sites (COSEWIC 2013a, Environment and Climate Change Canada 2018). Anthropogenic features (e.g., barns) may occasionally be used as maternity sites in fragmented landscapes with few potential roost trees (Environment and Climate Change Canada 2018). Maternity sites that maintain warm and relatively stable microclimate conditions are important to reproductive females and young as they allow more energy to be directed toward growth and development (Caceres and Barclay 2000, COSEWIC 2013a). Males are more versatile in their summer roosting requirements; they most frequently roost under exfoliating, raised bark but may also roost in the cavities and crevices of trees and snags with early- to mid-decay (Jung et al. 2004, COSEWIC 2013a).

The northern myotis is well adapted to flying in areas of dense or structurally complex vegetation where it catches flying insects on the wing or feeds by gleaning prey from foliage (Caceres and Barclay 2000, Henderson and Broders 2008). The species typically forages within the interior of mature to old-growth deciduous and mixedwood forests, but may also forage in forest gaps, along forest edges and riparian areas, and over rivers (Henderson and Broders 2008, COSEWIC 2013a).

The northern myotis is federally listed under Schedule 1 of SARA as Endangered (Government of Canada 2023) and is designated as an S3 species in Saskatchewan (i.e., Vulnerable) (Saskatchewan Conservation Data Centre 2023). The current size of the northern myotis population in Canada is unknown. Prior to the arrival of White-nose Syndrome in 2010, the population in Canada was estimated to be over one million individuals (COSEWIC 2013a, Environment and Climate Change Canada 2018). White-nose Syndrome has been identified as the main threat for northern myotis populations in Canada (COSEWIC 2013a). . Other threats to the northern myotis include habitat loss, colony eradication, chemical contamination, and wind turbines (COSEWIC 2013a)

Avian Species

Bank Swallow



Source: COSEWIC (2013b).

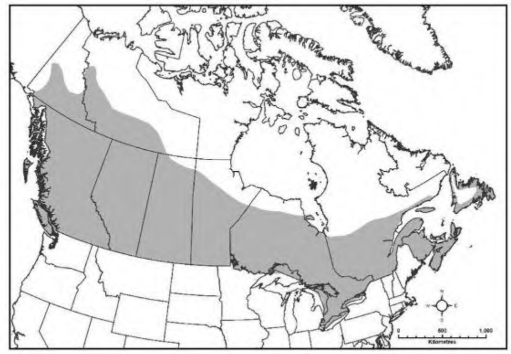
The Bank Swallow is a small songbird that occurs on every continent (except Antarctica and Australia), breeds throughout Canada, and winters primarily in South America (COSEWIC 2013b). Nesting colonies are typically characterized by steep embankments with a sand, silt, or clay substrate that can be easily excavated for burrows (COSEWIC 2013b, Government of Canada 2019a). These steep sand, silt, or clay embankments are frequently subject to erosion or slumping (COSEWIC 2013b, Garrison and Turner 2020).

Nesting colonies are often adjacent to slow-moving or still waterbodies (e.g., low gradient rivers or lakes) and may occur in natural habitats or in anthropogenic features (e.g., quarries or road cuts) (COSEWIC 2013b, Government of Canada 2019a, Garrison and Turner 2020). Colony size can range from less than half a dozen burrows to hundreds or thousands of burrows (COSEWIC 2013b, Government of Canada 2019a). Individual burrows within colonies may be recolonized in subsequent years if the integrity of the colony remains intact (i.e., does not erode and collapse) (Garrison and Turner 2020). Bank Swallows are aerial insectivores that forage over a variety of open habitats such as lakes, ponds, rivers, wetlands, grasslands, and agricultural areas (COSEWIC 2013b, Garrison and Turner 2020).

The Bank Swallow is federally listed under Schedule 1 of SARA as Threatened (Government of Canada 2023) and is designated as an S4B, S5M species in Saskatchewan (i.e., Apparently Secure breeding population, Secure aggregating transient population [migrants]) (Saskatchewan Conservation Data Centre 2023). The most recent breeding population estimate for Canada is 2.4 million individuals (Environment and Climate Change Canada 2022b). Based on Breeding Bird Survey (BBS) data collected between 1970 and 2019, the Bank Swallow population in Canada has declined at a rate of 5.3% per year, for an overall decline of 98.0% (Environment and Climate Change Canada 2022b). The long-term population decline appears to be driven by several threats acting cumulatively, including loss of nesting and foraging habitats, incidental take during anthropogenic activities (e.g., aggregate extraction and erosion control), large-scale declines in aerial insect populations, and climate change (COSEWIC 2013b). Bank Swallows are also particularly vulnerable to collisions with vehicles partly due to the attraction of individuals to intraspecific carcasses; one swallow hit by a vehicle could attract several individuals to a road, potentially resulting in subsequent collisions and large mortality events (COSEWIC 2013b, Garrison and Turner 2020).

Although colonial nesting may provide advantages (e.g., predation protection and assistance with thermoregulation), it has been identified as a limiting factor for the Bank Swallow, potentially making them more vulnerable to natural events or anthropogenic activities, which may result in mass mortality events (Environment and Climate Change Canada 2022b).

Barn Swallow



Source: COSEWIC (2021).

The Barn Swallow is a medium-sized songbird that occurs on every continent (except Antarctica), breeds throughout Canada, and winters in the southern United States, Mexico, and southwards (COSEWIC 2021). Breeding habitat typically requires a suitable nesting site with a vertical or horizontal surface underneath a roof of some sort, open areas for foraging (e.g., grasslands, fields, wetlands, and shorelines), and a waterbody with mud for nest building (Government of Canada 2019b, Brown and Brown 2020, COSEWIC 2021). Historically, suitable nesting sites were likely provided by caves, cliff faces, rock leges, tree branches, and hollow trees (Brown and Brown 2020, COSEWIC 2021). Today, nesting sites are usually located within agricultural and rural areas, and along roads and highways (Brown and Brown 2020, COSEWIC 2021). Anthropogenic features such as barns, houses, bridges, and culverts are commonly used for nesting sites (COSEWIC 2021). Barn Swallows nest in colonies or independently and typically return to the same nesting sites each year and may reuse old nests (Government of Canada 2019b, Brown and Brown 2020, COSEWIC 2021).

The Barn Swallow is federally listed under Schedule 1 of SARA as Threatened (Government of Canada 2023) and is designated as an S4B species in Saskatchewan (i.e., Apparently Secure breeding population) (Saskatchewan Conservation Data Centre 2023). An estimated 6.4 million individuals currently breed in Canada, with over 60% of the population breeding throughout the prairie provinces (COSEWIC 2021). Based on BBS data collected between 1970 and 2019, the Barn Swallow population in Canada has declined at a rate of 2.34% per year, for an overall decline of 68.6% (COSEWIC 2021). Intensification of agriculture, loss of nesting sites, large-scale declines in aerial insect populations, and climate change are cited as the most imminent threats for the Barn Swallow, and its dependence on aerial insects for prey and low post-fledging survival rates are cited as limiting factors for the species (COSEWIC 2021). The repeated use of anthropogenic features for nesting makes Barn Swallows vulnerable to incidental take, especially if the anthropogenic features require routine maintenance. In addition, their frequent use of anthropogenic features for nesting makes Barn Swallows vulnerable to entrapment (e.g., buildings, pipes, vents, other enclosed spaces) as they search for potential locations to build a nest (COSEWIC 2021).

Horned Grebe

The Horned Grebe is a small waterbird that occurs in North America and Eurasia (COSEWIC 2009b). Within North America, the species breeds across western Canada from BC and Yukon across to the Magdalen Islands in Quebec and winters along the Pacific and Atlantic coasts (COSEWIC 2009b).

Breeding habitat for the Horned Grebe consists of small to medium-sized freshwater lakes, ponds, and marshes that are shallow with open water (at least 40%), emergent vegetation, anchorage for nests, and concealment for nests and young (COSEWIC 2009b, Stedman 2020). Horned Grebes use a range of waterbody sizes for breeding, but typically prefer waterbodies between 0.3 and 2.0 ha in size (COSEWIC 2009b). Most pairs are solitary, but loose colonies of up to 20 pairs have been found on larger waterbodies with abundant food resources (COSEWIC 2009b, Stedman 2020). Nests are typically located in shallow water near shore on a floating or emerging mass of vegetation (COSEWIC 2009b). Horned Grebes are diving birds that feed on a variety of aquatic arthropods and fish (COSEWIC 2009b, Stedman 2020).

Source: COSEWIC 2009b

The Western population of the Horned Grebe is federally listed under Schedule 1 of SARA as Special Concern (Government of Canada 2023) and is designated as an S5B species in Saskatchewan (i.e., Secure breeding population) (Saskatchewan Conservation Data Centre 2023). An estimated 200,000 to 500,000 individuals occur in the Western population, with most breeding in southern Alberta and Saskatchewan (COSEWIC 2009b, Environment and Climate Change Canada 2022c). Based on BBS data collected between 1970 and 2019, the Western population of the Horned Grebe in Canada has declined at a rate of 1.7% per year, for an overall decline of 57.0% (Environment and Climate Change Canada 2022c). The reasons for this population decline are unknown. Probable threats include permanent habitat loss, temporary loss of habitat during droughts, eutrophication and degradation of habitat due to fertilizers, predator expansion on the prairies, Type E botulism in the Great Lakes, entanglement in commercial fishing gear, climate change and extreme weather, and oil spills on wintering grounds (COSEWIC 2009b).

Mitigation Measures

The Project will require the construction, operation, and decommissioning of several components (as described in Section 2 of the EIS). Expected interactions between these Project components and activities and the wildlife VCs and their associated KIs are summarized by Project phase and activity in Tables 9.3-6 and 9.4-5 of the EIS. Based on the timing and nature of interactions identified in Tables 9.3-6 and 9.4-5 of the EIS, the following adverse effects on the wildlife VCs, including SAR, are likely to occur during the lifetime of the Project:

- alteration and/or loss of habitat; and
- change in mortality.

These potential effects apply to Wildlife SAR as well. The potential effects are described in Sections 9.3.4.2 and 9.4.4.2 of the EIS for each Project phase as they may affect the wildlife VCs and associated KIs.

Mitigation in this EIS is defined as the elimination, reduction, or control of potential adverse effects of the Project on the environment throughout all Project phases. Project-specific mitigation measures include: Project design; implementation of best management practices; development of management plans; implementation of emergency response programs; and provision of training, education and awareness (Denison 2020). Mitigation measures for each potential effect are described in Sections 9.3.5 and 9.4.5 of the EIS. The following subsections summarize mitigation measures that will be implemented to avoid or minimize adverse effects on the Wildlife SAR.

Project Design Measures

Potential adverse effects on Raptors, Migratory Breeding Birds, and Bird SAR VCs will be avoided or minimized to the extent practical through Project design. All of the Project design measures listed here are consistent with those presented in Section 9 of the EIS (i.e., there are no new Project design measures proposed in this appendix):

- The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent practicable resulting in reduced habitat disturbance and noise propagation.
- Much of the proposed footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
- The powerline to the main substation at the site is relatively short (i.e., approximately 7 km) and will be constructed from the existing provincial power line adjacent to Highway 914.
- During Operation, progressive reclamation activities will be completed where possible, and the progress and success of these activities will be assessed annually.
- Cleared brush will be stockpiled when possible, to be used in progressive reclamation.
- Ongoing decommissioning of Project components will be completed when possible.
- Dust deposition on vegetation and waterbodies (including potential deposition of trace metals and radionuclides) will be reduced by:
    - directing processing plant exhaust from drying and packaging areas through a stack prior to release outside of the building;

  - designing the stack height based on results of air dispersion modelling to be an appropriate height for optimal dispersion;
  - controlling access to the property with both a north and south security gate (the north gate is on a decommissioned road and the south gate is manned);
  - making a wash bay available to clean items, equipment and vehicles that may have been in contact with potentially contaminated materials. Contaminated water from the wash bay will be collected in a sump tank and routed to the water treatment plant for treatment and discharge;
  - conducting radiological clearance scanning as required for any items, equipment, and vehicles leaving the Project Area; and.
  - watering and traffic controls on roads.

- Battery-powered light vehicles and mobile equipment, and an AC powered dual rotary drill for ISR wellfield development instead of a traditional diesel-powered unit, will be employed, where practical, to reduce air emissions and noise levels and improve energy efficiency.
- The main sources of noise will be related to transport of people and goods, drilling of holes for the freeze wall and wellfield, operation of the batch plant, operation of the processing plant, and operation of the pumphouses. The use of high-quality, low sound emission equipment and regular maintenance will reduce noise associated with Project activities.
- Bulk storage tanks for processing chemicals such as sulphuric and/or hydrochloric acid, sodium hydroxide, and hydrogen peroxide will sit inside appropriately designed and sized secondary containment basins, physically separated from the containment basins for other chemical systems.
- Surface pipelines will be designed to have secondary containment or catchment and have leak detection systems in place at key locations.
- A freeze wall will be established around the uranium deposit to reduce groundwater disturbance.
- Mining solution and process water will be reused throughout the mining process, reducing water use requirements to the extent feasible and reducing the volume of treated effluent requiring discharge. Make-up water will be preferentially sourced from site runoff where possible.
- Double-walled, high-density polyethylene or equivalent piping will be used in the wellfields and will be freeze protected and secured to minimize pipe movement.
- Contaminated wastes (e.g., mineralized drill cuttings, solid impurities removed from mining solution, dewatered reject solids) will be properly contained on a double lined waste pad with leak detection capabilities and an associated monitoring program. An adjacent pond will be used to collect runoff from the pad and water in the waste pond will be piped to the water treatment plant. Such waste will be disposed of either on site or off site at an approved facility.
- The ISR wellfield and processing plant will be designed to re-use most of the solutions inside each circuit; any excess water will be released to a surface water body once acceptable water quality is achieved. All treated effluent released to surface water will meet federal and provincial regulatory discharge limits.

- All contaminated areas, such as waste ponds and pads, and the domestic landfill will be fenced to avoid contact with workers and wildlife. Fences will be monitored and maintained.

General Mitigation Measures for Wildlife Species at Risk

Mitigation measures specific to the Wildlife SAR, in accordance with the *Migratory Birds Convention Act* and tailored to Project features will be incorporated into various Project management and monitoring plans such as the erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring and Waste Management Plan.

The management plans within the Environmental Management System (EMS) will provide specific mitigation measures based on proven and accepted mitigation measures following standard industry guidelines and best management practices. The EMS will provide guidance to avoid or minimize potential adverse effects of the Project on avian species and their habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered. The Project management plans provide direction on monitoring and adaptive management so that responses are timely and effective.

The following subsections provides a description of the mitigation measures that will be applicable during all Project phases and expected to be effective immediately following implementation. Additional mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in **bold text**.

Work Timing Windows and Habitat Disturbance

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. **The nesting season for many Wildlife SAR in Saskatchewan spans a period from March 15 to August 31; however, the dates differ for certain species. The Wildlife Management Plans within the EMS will provide details on nesting windows for avian species, as well as other sensitive time periods (e.g., caribou calving periods) occurring in the Terrestrial RSA based on the Saskatchewan Activity Restriction Guidelines for Sensitive Species (SARGSS), which were established to support the avoidance of sensitive species' habitats during sensitive periods (SK MOE 2017).**
- **Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting and breeding season, pre-disturbance wildlife clearance surveys will be conducted a by a Qualified Professional (QP) at that location within the Project Area to identify sensitive species and habitat features (e.g., nests as well as roosts and hibernacula used by bat species).**
- **Active and/or suspected breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations). If guidelines cannot be met, due to safety or operational concerns, SK MOE will be contacted for advice on the appropriate response to the situation.**

Wildlife Education and Awareness

- Employees and contractors will be provided with wildlife education and awareness training, including education about potential Wildlife SAR issues on site and training on the mitigation measures to avoid or minimize potential adverse Project effects on Wildlife SAR and their habitats.
- Employees and contractors will be educated on waste management policies that limit human-avian interactions.
- Designated employees will be trained in appropriate avian deterrent techniques to minimize avian interactions with the Project.
- **Employees and contractors will be requested to report avian observations on site, injured or dead birds (which will be reported to SK MOE). Avian encounters and outcomes will be monitored, and logbooks will be used to record observations. Logbooks and reports will be available to employees.**

Wildlife and Habitat Protection

- Personal firearms will be prohibited for employees and contractors within the Project Area to prevent hunting activities.
- If any individual were seeking access around the Project area to undertake Aboriginal and/or Treaty Rights, Denison staff would facilitate this, provided it were safe to do so given activities in the area.
- Policies will be implemented prohibiting employees and contractors from feeding, approaching, or harassing avian species within the Project Area.
- To support habitat regeneration, progressive reclamation and ecosystem-based revegetation will be conducted on disturbed areas as soon as practicable in accordance with the Reclamation and Closure Plan.

Wildlife Deterrence and Prevention of Wildlife Entrapment

- **Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as possible. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.**
- **Physical, visual, and/or auditory deterrents will be used to discourage bird and bat use of buildings and other Project infrastructure (e.g., water or waste treatment ponds) for refuge, shelter, breeding, and roosting, and to deter birds and bats from potentially becoming entrapped.**
- **Noise emitting Project activities will be managed to minimize sensory disturbance of wildlife SAR species, especially during sensitive time periods (i.e., breeding and nesting).**
- Low sound emission equipment, regular maintenance of equipment, and the use of silencers or mufflers (whenever practical) will be used to reduce noise associated with Project activities, to the extent practical.
- **Directed lighting or light shielding, rather than broad lighting, will be implemented to minimize sensory disturbance on the wildlife SAR, and lighting will be focused on work sites and not surrounding areas.**

- Dust generation and subsequent deposition on vegetation and in waterbodies (including potential deposition of trace metals and radionuclides) will be limited through dust suppression techniques such as road watering and traffic management.

Road and Traffic Management

- Traffic and access control measures will be implemented will include reducing traffic volume by scheduling truck convoys, using high-volume haul trucks, and restricting public access to the Project site and roads (e.g., private vehicles, snowmobiles, all-terrain vehicles, and foot traffic). It is important to note that if any individual were seeking access around the Project area to undertake Aboriginal and / or Treaty Rights, Denison staff would facilitate this, provided it were safe to do so given activities in the area.
- Appropriate road signage will be installed (e.g., speed limits) along Project roads to raise awareness and minimize the potential for wildlife SAR-vehicle collisions.
- Wildlife will have the right-of-way on Project roads, unless it is unsafe to stop (i.e., if a collision is imminent). Vehicles will not be used to encourage wildlife to move off Project roads.
- Processes will be implemented for employees and contractors to slow down and/or stop vehicles/equipment to allow animals to move away or off the road before resuming normal road speeds for the area.
- Employees and contractors will report and communicate the location and circumstances of any roadkill observed on or alongside Project roads. Large-bodied wildlife carcasses found will be reported to SK MOE and disposed of as directed to discourage avian scavengers.
- **Vegetation management, such as mowing and brush cutting, will be implemented along Project roads to reduce site attractiveness for wildlife SAR and maintain appropriate sightlines for drivers to minimize wildlife-vehicle collisions.**
- Alternative measures on Project roads for de-icing and winter traction (e.g., sand, gravel) or dust suppression (e.g., water) will be implemented, whenever practicable.
- Appropriately sized gaps in the roadside snowbanks during winter will be maintained to facilitate wildlife crossing and escape thereby reducing the risk of wildlife-vehicle collisions.
- New Project site and access roads will be designed to minimize sightlines for predators, whenever practicable, while still maintaining general road safety.
- Ditches and culverts along Project roads will be designed and maintained to minimize pooling of water. Roadside pools that form may attract wildlife.

Waste and Hazardous Materials Management

- A "no littering policy" for employees and contractors will be implemented within the Project Area.
- **Vegetation management will be incorporated in the vicinity of waste ponds to discourage wildlife SAR use of potentially affected vegetation.**
- Waste will be collected and temporarily stored in wildlife-proof containers to avoid attracting scavengers and with that increase the risk for human-wildlife interact.
- The wildlife-proof containers will be inspected regularly for evidence of avian presence (e.g., gull species) or access to waste disposal facilities. If evidence of avian presence or

access to waste disposal facilities is detected, modified systems will be implemented and/or off-site waste disposal frequencies will be increased.
- The use of hazardous materials will be limited as much as possible.
- Hazardous materials will be handled, stored, and disposed of appropriately and in accordance with a Waste Management Plan to avoid attracting avian scavengers (e.g., wildlife-proof containers, exclusion fencing).
- Physical deterrents (e.g., fencing) will be employed around contaminated areas (e.g., waste ponds and waste pads), the domestic landfill, or hazardous materials storage areas to discourage wildlife use.
- Appropriate hazardous materials management practices will be implemented in accordance with industry guidelines and a Waste Management Plan to minimize the risk of accidental spills or leakage.
- Appropriate spill response kits will be positioned adjacent to areas where hazardous materials are stored in accordance with the Spill Response Plan.
- A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing in accordance with the Spill Response Plan.
- Appropriate fuel, chemical, and materials management practices will be followed in accordance with the Spill Response Plan to minimize the risk of accidental spills or leakage of diesel fuel, other hydrocarbons, and other hazardous materials.
- Air emissions will be reduced to the extent practical through implementation of an air quality monitoring plan within the EMS.
- All vehicles and equipment will be equipped with industry-standard emission control systems; unnecessary idling of vehicles will be prohibited.
- Vehicles and equipment will be maintained in good working condition (e.g., no leaks) and furnished with industry-standard spill response kits.
- Mitigation measures to reduce the potential for dispersion of radiological contaminants of potential concern to vegetation will be implemented in accordance with the Radiation Protection Plan.
- Education on and enforcement of proper waste and hazardous materials management practices will be provided to employees and contractors.

Species-Specific Mitigation Measures for Wildlife Species at Risk

The following provides a summary of the species-specific mitigation measures that will be implemented during Project activities. Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in **bold text**. These will be added to the final EIS.

Arthropod Species

- Mitigation measures designed for the Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5) VCs are expected to mitigate adverse effects on the arthropod species that are considered SAR (i.e., nine-spotted lady beetle, transverse lady beetle, and yellow-banded bumble bee) primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:

- The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.
- Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
- During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.

- **Herbicide use as part of vegetation management will be limited to the immediate Project Footprint and applied by licensed professional applicators, when necessary, to limit the potential for adverse effects on arthropod species.**

Amphibian Species

- Mitigation measures designed for the Wetlands VC (Section 9.2.5) are expected to mitigate adverse effects on the northern leopard frog primarily related to limiting the loss and/or disruption of suitable habitat for these species. These include:
    - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation.
    - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.
    - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually.
- **Pre- disturbance wildlife clearance surveys will be conducted to identify site-specific habitat features (e.g., amphibian breeding ponds) and implement the setbacks and/or timing windows (that will be defined in the Wildlife Management Plan).**
- **Locations of site-specific habitat features used by amphibians will be communicated to Project personnel and the requirement to limit disturbance in these areas will be implemented.**
- **Appropriate setback and buffer distances from wetland features where amphibians are known to occur will be implemented and maintained under the direction of a wildlife QP.**
- **Vehicle traffic and construction activities will be restricted to the approved access routes and work areas and will not cross or enter a watercourse or wetland**.

Bat Species

- Vegetation clearing activities will occur outside of roosting periods, when practical.
- **Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as maternal rooting sites and hibernacula used by bat species. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented in accordance with the SARGSS (SK MOE 2017 (that will also be defined in the Wildlife Management Plan).**

- **In the event a maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for bats to leave but not the ability to re-enter the roosting site.**
- **Locations of these site-specific habitat features used by bats will be communicated to the appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.**
- **Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.**

Avian Species

- Site clearing and other works that involve disturbance of vegetation and/or soil will be conducted outside of the nesting season, when practical. The breeding and nesting season for most avian species in Saskatchewan typically spans a period from March 15 to August 31; however, the dates differ for certain species.
- **In the event Project activities such as vegetation clearing and/or soil disturbance are required during the breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted by a QP at that location within the Project Area before activities commence to identify the presence of avian SAR and/or their nests.**
- **Active and/or suspected breeding and roosting locations identified during the pre-disturbance wildlife clearance surveys will be protected with a no-disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in Saskatchewan) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).**
- **Locations of nesting sites used by bank swallows, barn swallows, and horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.**
- **Deterrents designed to discourage or prevent barn swallows from using buildings and other Project infrastructure have been described in Section 3.2.4 of the EIS.**
- **Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as practical. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces.**

Residual and Cumulative Effects Summary

The approach to assessing residual Project effects on wildlife VCs followed the methodology outlined in Section 5.8 of the EIS, which included a habitat-based approach. For each VC and associated KI, each residual effect was assessed in the context of the Project activities that will occur within each Project phase. Each residual effect was then characterized based on the combined predicted residual effect for all phases. See Sections 9.3.6 and 9.4.6 of the EIS for specific details regarding the residual effects assessment for wildlife VCs (i.e., residual effect characterization and significance determination). A summary of the environmental assessment considerations and determination for predicted residual effects for Wildlife SAR is provided in Table 0.1. Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text. These will be added to the final EIS.

The cumulative effects assessment (CEA) followed standard methodology as per provincial (e.g., Guidelines for an Environmental Assessment under the [Saskatchewan] *Environmental Assessment Act* 1980) and federal (e.g., Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act 2012*) guidance, and is discussed in detail in Section 5.9 of the EIS. Similar to the residual effects assessment, the CEA included a habitat-based approach. See Sections 9.3.7 and 9.4.7 of the EIS for specific details regarding the CEA for wildlife VCs. A summary of the significance determination of the cumulative effects on Wildlife SAR is provided in Table 0.2.

Table 0.1 Summary of the Environmental Assessment Considerations and Determination for Predicted Residual Effects for Wildlife Species At Risk

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Nine-spotted lady beetle Transverse lady beetle Yellow-banded bumble bee	Amount of habitat that is altered or lost relative to its availability in the Terrestrial Regional Study Area (RSA).	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • Waste management (composting, domestic and industrial landfill operation, recycling). • Water management (including treatment). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• The proposed mitigation measures outlined in the EIS, particularly those designed for the Valued Components (VCs) Soil and Organic Matter / Peat (Section 9.1.5) and Vegetation and Ecosystems (Section 9.2.5), adequately and appropriately address potential for adverse effects on these species, primarily related to limiting the loss and/or disruption of suitable habitat. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, and fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for the arthropod SAR within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to groundwater and/or surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			

[1] Mitigation measures specific to the Wildlife SAR that were not included or that were revised from what was described in the draft EIS are provided in bold text.

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
			• Site water management, treatment, and release • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning	previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually. • **Herbicide use as part of vegetation management will be limited to the immediate Project Footprint applied by licensed professional applicators when necessary to limit the potential for adverse effects on arthropod species.**		
		Mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, levelling, and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction		Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of the arthropod SAR to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
Terrestrial Environment	Northern leopard frog	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials.	Construction	• The proposed mitigation measures outlined in the EIS, particularly those designed for the Wetlands VC (Section 9.2.5), adequately and appropriately address potential adverse effects on northern leopard frogs, primarily related to limiting the loss and/or disruption of suitable habitat for this species. These include the following: - The Project Area (i.e., the area of maximum physical disturbance) has been reduced to the extent safely practicable resulting in reduced habitat disturbance and noise propagation. - Much of the proposed Project Footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for northern leopard frog within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		Mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials.	Construction	additional habitat disturbance. - During Operation, progressive reclamation will be completed where possible, and the progress and success of these activities will be assessed annually. • **Pre- disturbance wildlife clearance surveys will be conducted to identify site-specific habitat features (e.g., amphibian breeding ponds) and implement the setbacks and/or timing windows (that will be defined in the Wildlife Management Plan).** • **Locations of site-specific habitat features used by amphibians will be communicated to Project personnel and the requirement to limit disturbance in these areas will be implemented.** • **Appropriate setback and buffer distances from wetland features where**	Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of northern leopard frog to the point where they are not sustainable or available to contribute to ecological functions
			• Water withdrawal from groundwater or surface water body. • Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials	Operation			
			• Site water management, treatment, and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • Reclamation of disturbed areas). • On-site and off-site operation of vehicles and transport of materials.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
					amphibians are known to occur will be implemented and maintained under the direction of a wildlife QP. • **Vehicle traffic and construction activities will be restricted to the approved access routes and work areas and will not cross or enter a watercourse or wetland.**		
Terrestrial Environment	Little brown myotis Northern myotis	Amount of habitat that is altered or lost relative to its availability in the Terrestrial RSA.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• **Vegetation clearing activities will occur outside of roosting periods, when practical.** • **Pre- disturbance wildlife clearance surveys will be completed to identify site-specific habitat features such as maternal rooting sites and hibernacula used by bat species. If features are identified in the Project Footprint, appropriate setbacks and/or timing windows will be implemented in accordance with the SARGSS (SK MOE 2017 (that will also be defined in the Wildlife Management Plan).**	Alteration and/or loss of habitat: predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	Not Significant: the predicted residual effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for bat species within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		Mortalities directly or indirectly attributable to the Project.	• Development of access roads and air strip. • Site preparation and earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Construction	• **In the event a maternal roosting site is identified on the Project Footprint, exclusionary methods (e.g., installing a one-way bat exit) will be implemented following the summer maternity roost season. This installation would allow for bats to leave but not the ability to re-enter the roosting site.** • **Locations of these site-specific habitat features used by bats will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.** • **Specific exclusion methods will be added as mitigation measures (Section 9.4.5 of the final EIS) to prevent access to buildings and other infrastructure.**	Change in mortality: predicted to be low magnitude, local in geographical extent, long-term duration, infrequent, and fully reversible.	The predicted residual effect of change in mortality is not expected to alter the integrity of the regional populations of the bat species to the point where they are not sustainable or available to contribute to ecological functions
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
Terrestrial Environment	Bank Swallow	Amount of habitat that is altered or	• Development of access roads and air strip.	Construction	• Site clearing and other works that involve disturbance of	Alteration and/or loss of habitat:	Not Significant: the predicted residual

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
	Barn Swallow Common Nighthawk Horned Grebe Olive-sided Flycatcher Rusty Blackbird Short-eared Owl Yellow Rail	lost relative to its availability in the Terrestrial RSA.	• Site preparation an earthworks; clearing, leveling and grading of the Project Area. • Water management (including treatment and site runoff). • Surface water withdrawal. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		vegetation and/or soil will be conducted outside of the nesting season, when practical. The breeding and nesting season for most avian species in Saskatchewan typically spans a period from March 15 to August 31; however, the dates differ for certain species. • **In the event Project activities such as vegetation clearing and/or soil disturbance are required during the breeding and nesting season, pre-disturbance wildlife clearance surveys will be conducted a by a QP at that location within the Project Area before activities commence to identify the presence of avian SAR and/or their nests.** • **Active and/or suspected breeding and roosting locations identified during the pre- disturbance wildlife clearance surveys will be protected with a no-**	predicted to be low magnitude, local geographical extent, long-term duration, frequent, fully reversible.	effect of alteration and/or loss of habitat is not expected to alter the integrity of the habitat for the avian SAR within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			• Management of surface water (including seepage and site runoff). • Water release to surface water body. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Site water management, treatment, and release. • Process water treatment and release. • Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			
		Mortalities directly or indirectly	• Development of access roads and air strip.	Construction		Change in mortality:	The predicted residual effect of

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
		attributable to the Project.	• Site preparation an earthworks; clearing, leveling and grading of the Project Area. • On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.		**disturbance setback buffer consistent with regulatory guidelines (e.g., the 2017 SARGSS [SK MOE 2017]) for other grebe species (as there is currently no activity restriction guidelines for horned grebe in Saskatchewan) in accordance with the level of the disturbance and species until the young have successfully fledged, the nest is confirmed as no longer active (e.g., abandoned or depredated), or the nesting window has passed (for suspected nest locations).** • **Locations of nesting sites used by bank swallows, barn swallows, and horned grebe will be communicated to appropriate Project personnel and the requirement to limit disturbance in these areas will be implemented.** • **Deterrents designed to discourage or prevent barn swallows from using**	predicted to be low magnitude, regional in geographical extent, long-term duration, infrequent, and fully reversible.	change in mortality is not expected to alter the integrity of the regional populations of the avian SAR to the point where they are not sustainable or available to contribute to ecological functions.
			• On-site and off-site operation of vehicles and transport of materials. • Air transportation for workers.	Operation			
			• Demolition and disposal of non-salvageable surface infrastructure and materials. • On-site and off-site operation of vehicles and transport of materials. • Reclamation of disturbed areas.	Decommissioning			

Component	Wildlife SAR	Measurable Parameters	Project Activities Resulting in Primary Interactions	Project Phase	Species-Specific Mitigation Measures[1]	Predicted Residual Effect	Significance
					buildings and other Project infrastructure have been previously described in Section 3.2.4 of the EIS. • Buildings and other Project infrastructure will be designed and maintained to exclude birds (e.g., barn swallows) and bats as much as practical. This would include installing solid barriers (e.g., corner slope panels, wooden panels) or flexible barriers (e.g., netting, tarps or geotextiles) under roof eaves or other exterior surfaces • Minimize height of salvaged soil stockpiles and avoid vertical slopes to deter bank swallows from creating nesting cavities.		

Table 0.2 Summary of Significance of the Cumulative Effects on Wildlife Species At Risk

Component	Valued Component	Key Indicator	Cumulative Effects	Summary of Significance of the Cumulative Effects
Terrestrial Environment	Wildlife Species at Risk	• Nine-spotted lady beetle • Transverse lady beetle • Yellow-banded bumble bee • Northern leopard frog • Little brown myotis • Northern myotis • Bank Swallow • Barn Swallow • Common Nighthawk • Horned Grebe • Olive-sided Flycatcher • Rusty Blackbird • Short-eared Owl • Yellow Rail	Alteration and/or loss of habitat.	**Not significant:** The cumulative effect of alteration and/or loss of habitat is not expected to alter the integrity of the Wildlife Species at Risk habitat within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions.
			Change in mortality.	**Not significant:** The cumulative effect of change in mortality is not expected to alter the integrity of the regional populations to the point where they are not sustainable or available to contribute to ecological functions.

References

Brown, M.B. and Brown, C.R. 2020. Barn Swallow (*Hirundo rustica*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/barswa/cur/introduction). Accessed May 30, 2023.

Caceres, M.C. and Barclay, R.M.R. 2000. *Myotis septentrionalis*. Mammalian Species (634):1–4. DOI: 10.2307/0.634.1

COSEWIC. 2009a. COSEWIC assessment and update status report on the Northern Leopard Frog *Lithobates pipiens*, Rocky Mountain population, Western Boreal/Prairie populations, and Eastern populations, in Canada. Committee on the Status of Endangered Widllife in Canada, Ottawa. vii + 69 pp.

COSEWIC. 2009b. COSEWIC assessment and status report on the Horned Grebe, *Podiceps auritus*, Western population and Magdalen Islands population, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vii + 42 pp.

COSEWIC. 2013a. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis*, and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xxiv + 93 pp.

COSEWIC. 2013b. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xi + 48 pp.

COSEWIC. 2015. COSEWIC assessment and status report on the Yellow-banded Bumble Bee *Bombus terricola* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. ix + 60 pp.

COSEWIC. 2016a. COSEWIC assessment and status report on the Nine-spotted Lady Beetle *Coccinella novemnotata* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. x + 57 pp.

COSEWIC. 2016b. COSEWIC assessment and status report on the Transverse Lady Beetle *Coccinella transversoguttata* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xi + 57 pp.

COSEWIC. 2021. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 60 pp.

Environment and Climate Change Canada. 2018. Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), the Northern Myotis (*Myotis septentrionalis*), and the Tri-colored Bat (*Perimyotis subflavus*) in Canada. Environment and Climate Change Canada, Ottawa. ix + 172 pp.

Environment and Climate Change Canada. 2022a. Management Plan for the Yellow-banded Bumble Bee (*Bombus terricola*) in Canada [Proposed]. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. iv + 46 pp.

Environment and Climate Change Canada. 2022b. Recovery Strategy for the Bank Swallow (*Riparia riparia*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. ix + 125 pp.

Environment and Climate Change Canada. 2022c. Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa. v + 49 pp.

Environment Canada. 2013. Management Plan for the Northern Leopard Frog (*Lithobates pipiens*), Western Boreal/Prairie Populations, in Canada. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa. iii + 28 pp.

Garrison, B.A. and Turner, A. 2020. Bank Swallow (*Riparia riparia*), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/banswa/cur/introduction). Accessed May 30, 2023.

Government of Canada. 2019a. Description of Residence for Bank Swallow (*Riparia riparia*) in Canada. (https://species-registry.canada.ca/index-en.html#/species/1233-894#residence_description)

Government of Canada. 2019b. Description of Residence for Barn Swallow (*Hirundo rustica*) in Canada. (https://species-registry.canada.ca/index-en.html#/species/1147-790#residence_description)

Government of Canada. 2023. Species at risk public registry. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html). Accessed May 31, 2023.

Henderson, L.E. and Broders, H.G. 2008. Movements and Resource Selection of the Northern Long-Eared Myotis (*Myotis septentrionalis*) in a Forest - Agriculture Landscape. Journal of Mammalogy 89(4):952–963. DOI: 10.1644/07-MAMM-A-214.1

Johnson, J.S., Treanor, J.J., Slusher, A.C., and Lacki, M.J. 2019. Buildings provide vital habitat for little brown myotis (*Myotis lucifugus*) in a high-elevation landscape. Ecosphere 10(11):e02925. DOI: 10.1002/ecs2.2925

Jung, T.S., Thompson, I., and Titman, R.D. 2004. Roost site selection by forest-dwelling male *Myotis* in central Ontario, Canada. Forest Ecology and Management (202):325–335.

Nature Conservancy Canada (NCC). 2023. Northern Leopard Frog. (https://www.natureconservancy.ca/en/what-we-do/resource-centre/featured-species/reptiles-and-amphibians/northern-leopard-frog.html).

Saskatchewan Conservation Data Centre. 2023. Saskatchewan Conservation Data Centre. (http://biodiversity.sk.ca/). Accessed May 30, 2023.

Slough, B.G. and Jung, T.S. 2020. Little Brown Bats Utilize Multiple Maternity Roosts Within Foraging Areas: Implications for Identifying Summer Habitat. Journal of Fish and Wildlife Management 11(1):311–320.

Smith, A.R. 1996. Atlas of Saskatchewan Birds. Special Publication No. 22. Saskatchewan Natural History Society (Nature Saskatchewan). Regina, Saskatchewan. 456 pp.

Smith, A.R., C.S. Houston, and J.F. Roy. 2019. Birds of Saskatchewan. Special Publication No. 38. Nature Saskatchewan. Regina, Saskatchewan. 765 pp.

Stedman, S.J. 2020. Horned Grebe (Podiceps auritus), version 1.0. In Birds of the World (S. M. Billerman, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. (https://birdsoftheworld.org/bow/species/horgre/cur/introduction). Accessed May 30, 2023.

Related information: Round 2 response – new EIS Appendix 9-F, Figure 2.9

Species At Risk – *Myotis* Species

The following information is intended to provide additional context to the responses provided in the IR tracking sheet for IR-174.

Acoustic bat surveys were completed between July 22 and 23, 2019 with 61 survey points sampled across five ecosite types. The location of the survey points, species detected, and frequency of detections are included in Figure .

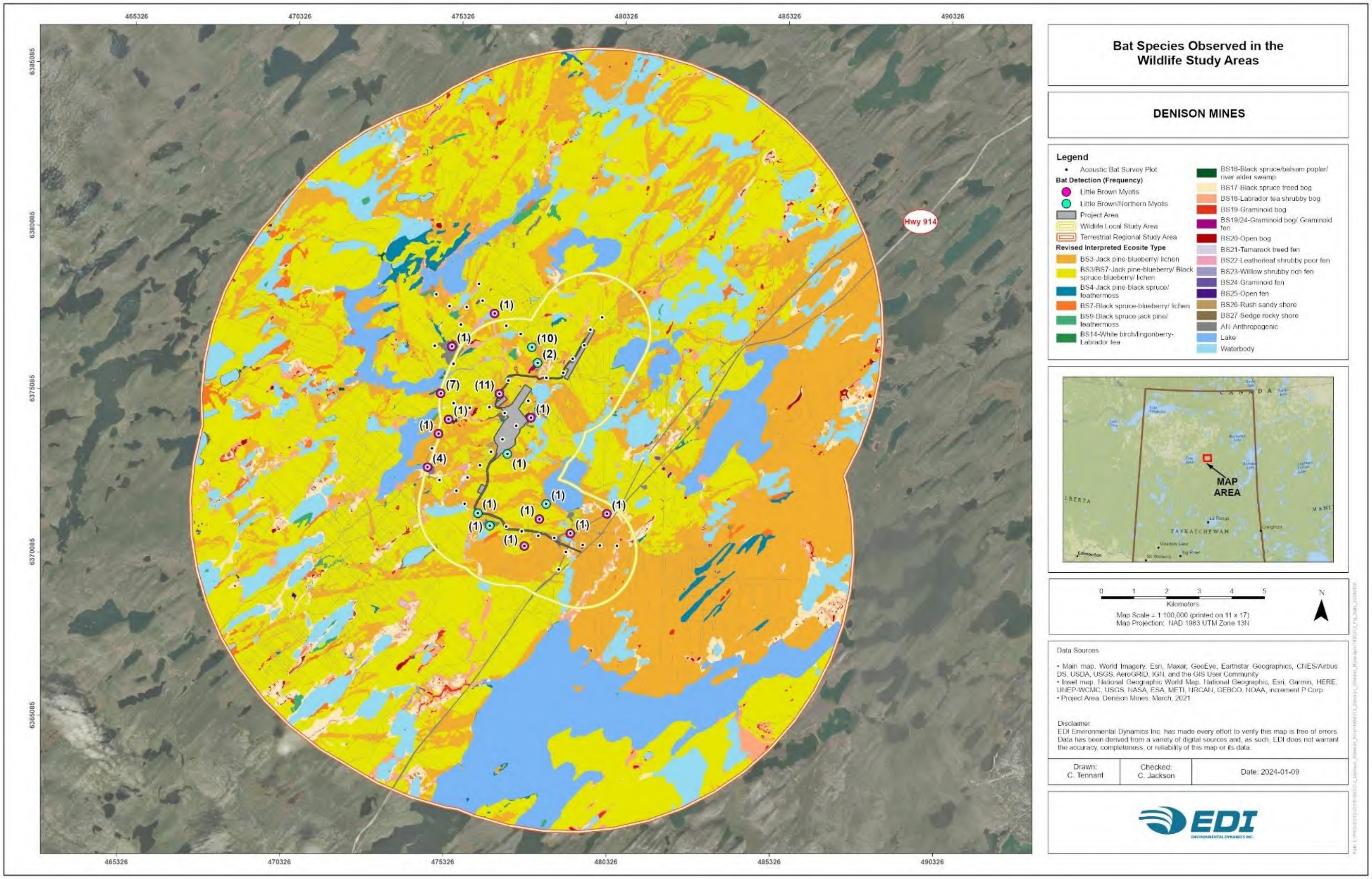


Figure 2-9: Bat Species Observed within the Wildlife Study Areas

IR-174, Round 3 Attachment:

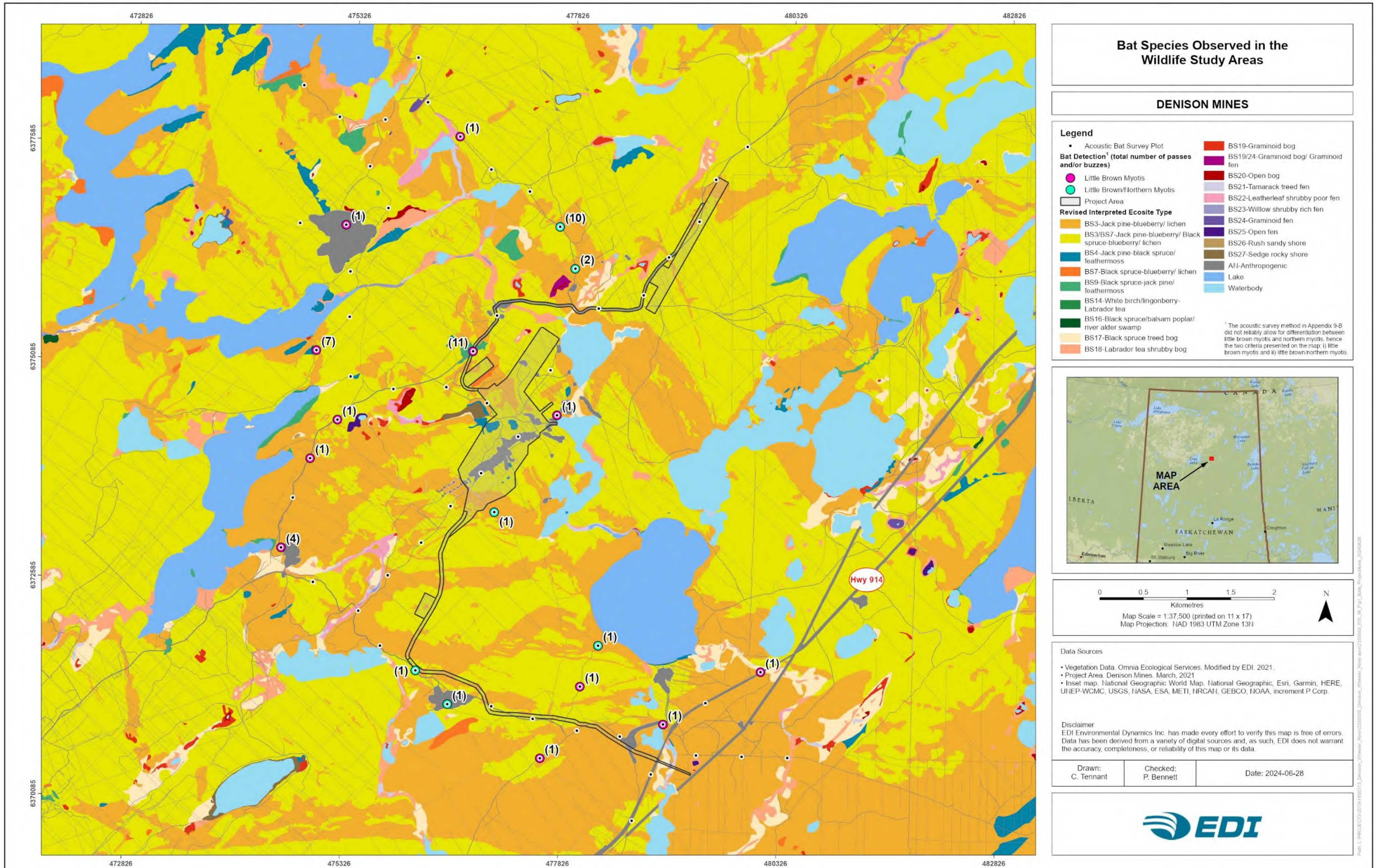


Figure IR-174 Round 3-1: Bat Species Observed within the Wildlife Study Areas

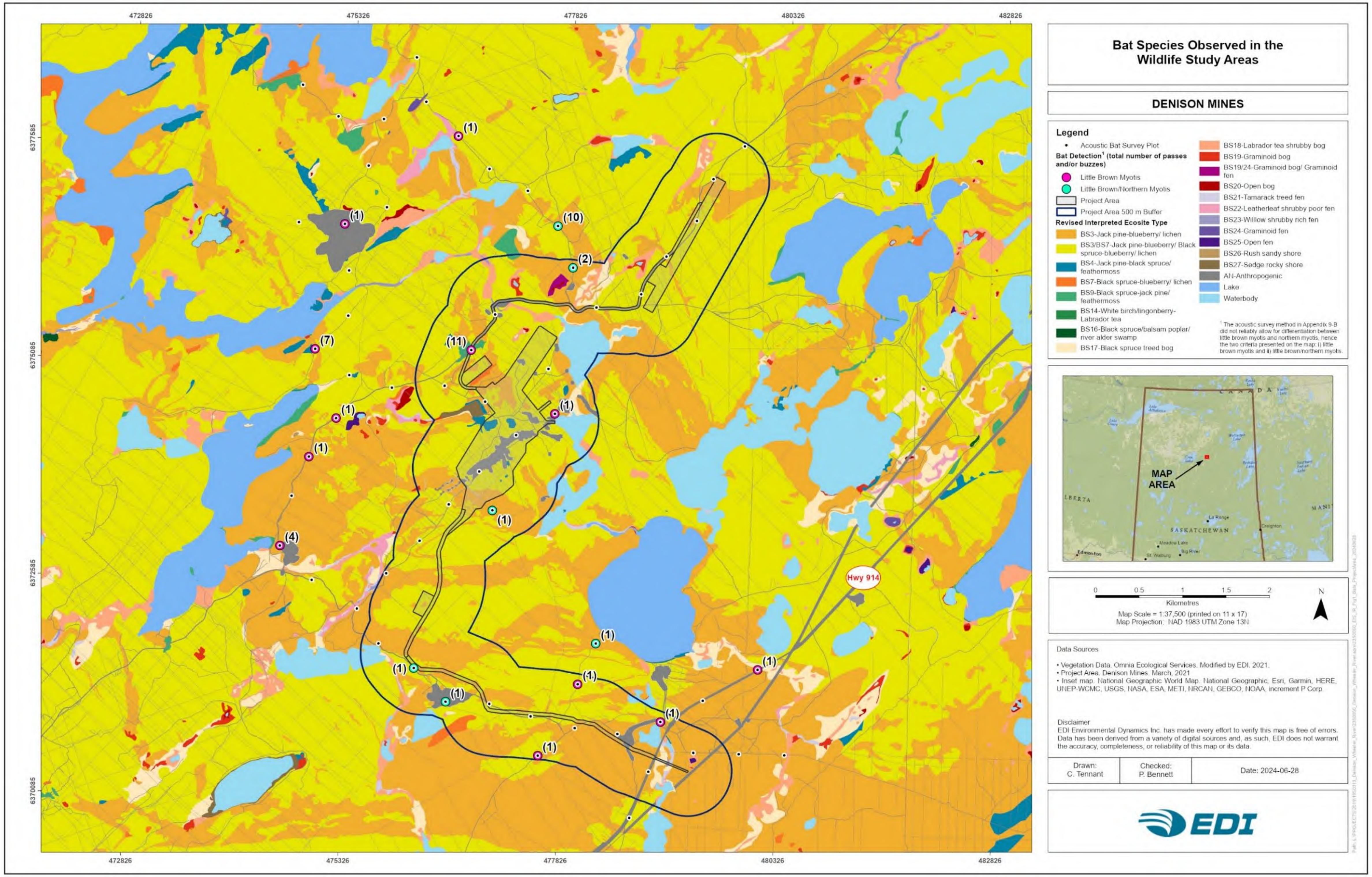


Figure IR-174 Round 3-2: Bat Species Observed within the Wildlife Study Areas (with 500m disturbance buffer shown)

Note: the above figure is provided as Figure 2-9 in Appendix 9-F of the final EIS

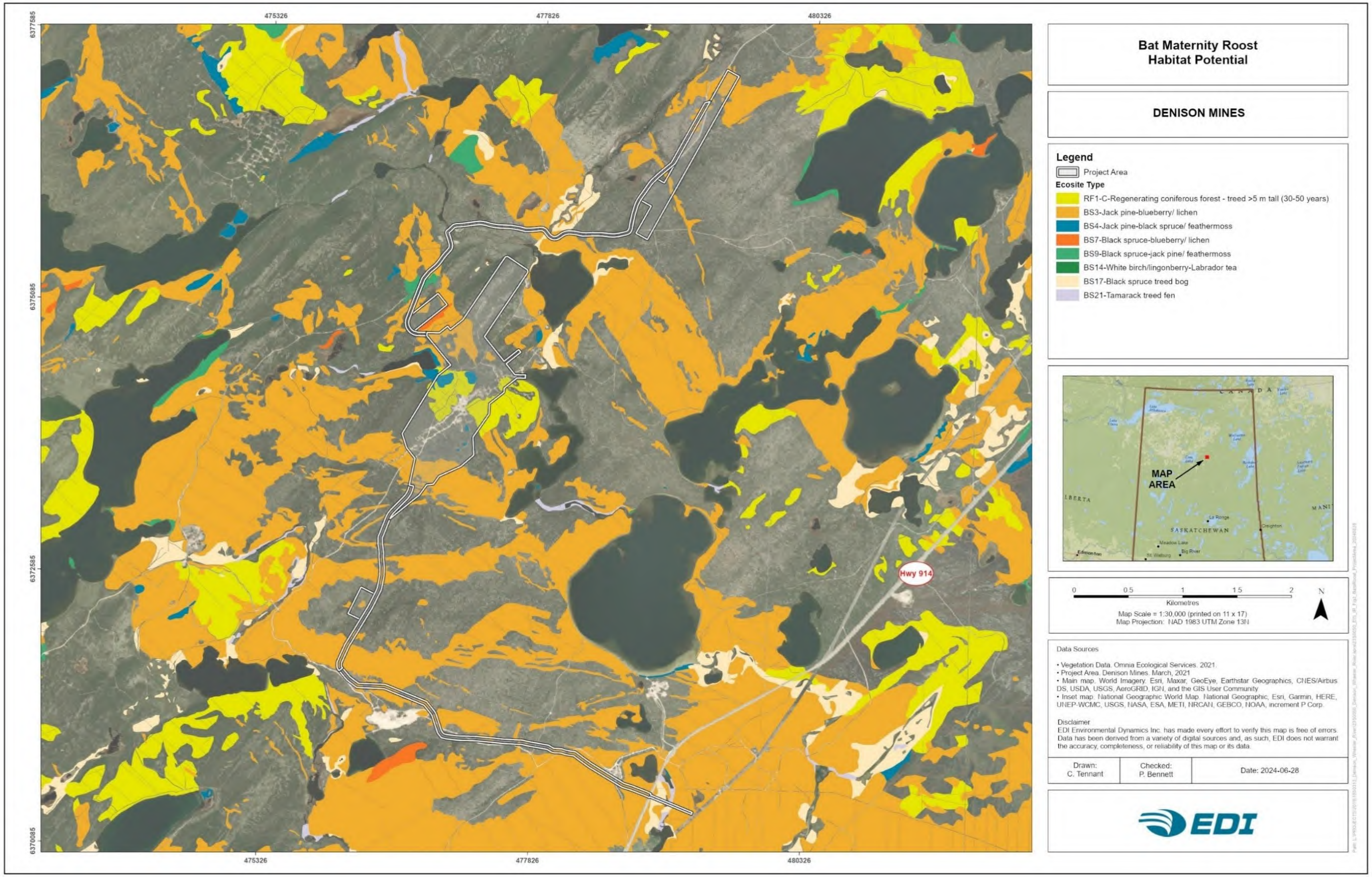


Figure IR-174 Round 3-3: Bat Maternity Roost Habitat Potential

Note: the above figure is provided as Figure 2-10 in Appendix 9-F of the final EIS

Attachment IR-174 (Round 4):

To address this Round 4 IR, a series of 16 maps are provided in this attachment. There are 4 different life stages shown (i.e., forage habitat potential, overwinter hibernacula potential, maternity roost habitat potential, and summer roost habitat potential) for each bat species (little brown myotis and northern myotis) with both the 1) Project footprint and 2) project footprint plus 500 m buffer. The following list summarizes the map numbers and content:

- Little Brown Myotis Forage Habitat Potential within the…
    - Figure 1: Wildlife Study Areas
    - Figure 2: Wildlife Study Areas (with 500m disturbance buffer shown)
- Northern Myotis Forage Habitat Potential within the…
    - Figure 3: Wildlife Study Areas
    - Figure 4: Wildlife Study Areas (with 500m disturbance buffer shown)
- Little Brown Myotis Overwinter Hibernacula Habitat Potential within the…
    - Figure 5: Wildlife Study Areas
    - Figure 6: Wildlife Study Areas (with 500m disturbance buffer shown)
- Northern Myotis Overwinter Hibernacula Habitat Potential within the…
    - Figure 7: Wildlife Study Areas
    - Figure 8: Wildlife Study Areas (with 500m disturbance buffer shown)
- Little Brown Myotis Maternity Roost Habitat Potential within the…
    - Figure 9: Wildlife Study Areas
    - Figure 10: Wildlife Study Areas (with 500m disturbance buffer shown)
- Northern Myotis Maternity Roost Habitat Potential within the…
    - Figure 11: Wildlife Study Areas
    - Figure 12: Wildlife Study Areas (with 500m disturbance buffer shown)
- Little Brown Myotis Summer Roost Habitat Potential within the…
    - Figure 13: Wildlife Study Areas
    - Figure 14: Wildlife Study Areas (with 500m disturbance buffer shown)
- Northern Myotis Summer Roost Habitat Potential within the…
    - Figure 15: Wildlife Study Areas
    - Figure 16: Wildlife Study Areas (with 500m disturbance buffer shown)

The rationale for each of the 4 life stages is provided below.

<u>Foraging habitat:</u>

> Based on information in Appendix 9-D, both species of bats could potentially forage anywhere and as such, all ecosites were shown as providing potential foraging habitat in Figures 1 to 4.

Overwinter hibernacula habitat:

As noted in Appendix 9-D, hibernacula occur in parts of caves, mines (openings to surface for ramps and raises for example), and buildings that have stable and specific temperature (-4 to 13°C) and humidity (>80%) conditions (COSEWIC 2013). Based on existing environment information presented in the EIS including the terrain and vegetation and ecosystem existing environment sections, there are no caves anticipated in the wildlife study areas. Terrain is low relief due to flat-lying sandstone and almost continuous cover of sandy glacial deposits (i.e., surface is predominately sand textured and there are no rocky outcrops or bedrock at surface for cave habitats). There are no mine openings in the wildlife study areas. We do note that there are buildings in the wildlife study areas are Denison's exploration camp which is located out of the Project Area; this area is shown as providing overwinter hibernacula habitat potential in Figures 5 to 8.

Maternity roost habitat:

Maternity sites can occur in large-diameter trees, rock crevices, buildings, and bat houses that offer warm and relatively stable microclimate conditions that allow females to avoid going into torpor so they can focus on caring for their young (COSEWIC 2013, Slough and Jung 2020). The only buildings in the wildlife study area are buildings at Denison's existing exploration camp, which are outside of the Project Area. There are no known bat houses in the wildlife study areas. An evaluation of maternal roost potential in trees was focused on the areas where larger diameter trees may be present. Existing ecosite information was reviewed and ecosites with higher potential for maternity roosts (i.e., larger diameter trees) were selected. The ecosites with the potential for larger diameter trees are shown in Figures 9, 10, 11, and 12 below, and include ecosites RF1 (regenerating forest >5m tall; per Appendix 9-B), BS3 jack pine/blueberry/lichen, BS4 jack pine – black spruce/feathermoss, BS7 black spruce/blueberry/lichen, BS9 black spruce – jack pine/feathermoss, BS14 white birch/lingonberry – labrador tea, BS16 black spruce/ balsam poplar/river alder swamp, BS17 black spruce treed bog, and BS21 tamarack treed fen. While these ecosites were selected for the potential to have larger diameter trees, it is important to note that the majority of these ecosites have trees with diameter at breast height <10 cm. Refer Appendix 9-B for representative photos of the selected ecosites.

Summer roost habitat potential:

Litle Brown Myotis: Males are more versatile in their summer roosting requirements and use tree cavities, raised bark, foliage, rock crevices, buildings, and bridges with a broader range of microclimate conditions (COSEWIC 2013a, Johnson et al. 2019).

Northern Myotis: Summer roosting trees are typically found in mature to old-growth forests, swamps, and riparian areas, although retained older trees and snags in younger forests may occasionally provide suitable roosting habitat (Environment and Climate Change Canada 2018).

Considering the above information, Figures 13 to 16 show ecosites with trees and the existing exploration camp (i.e., buildings). The rationale is that in the summer bats can roost anywhere there are trees. As such, ecosites where trees are not expected are not included in the summer roost habitat potential (e.g., waterbodies, bogs, fens with the exception of BS21 tamarack treed fen are not included in Figures 13 to 16).

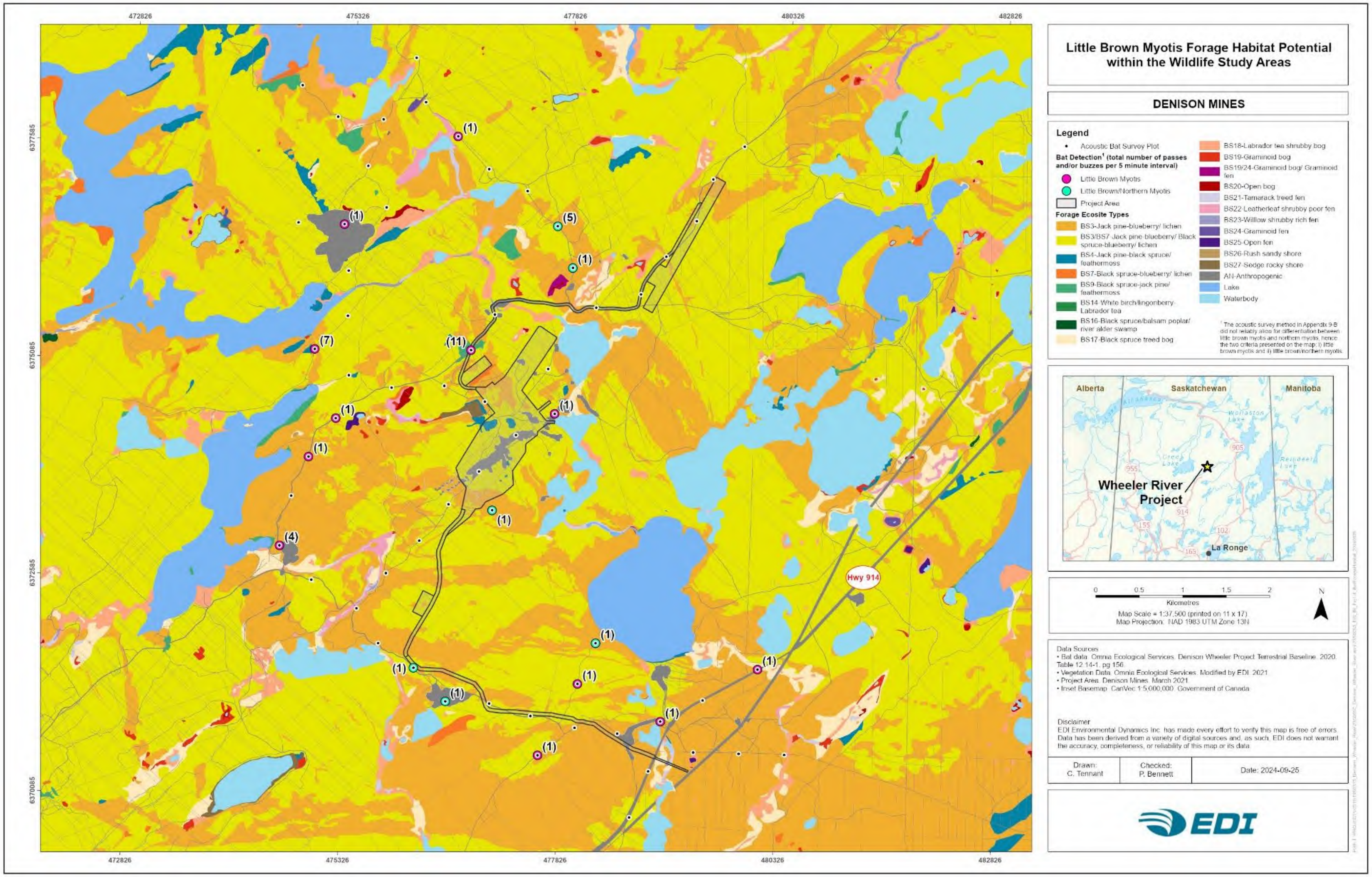
References:

COSEWIC. 2013. COSEWIC assessment and status report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis, and Tri-colored Bat Perimyotis subflavus in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xxiv + 93 pp.

Environment and Climate Change Canada. 2018. Recovery Strategy for the Little Brown Myotis (Myotis lucifugus), the Northern Myotis (Myotis septentrionalis), and the Tri-colored Bat (Perimyotis subflavus) in Canada. Environment and Climate Change Canada, Ottawa. ix + 172 pp.

Johnson, J.S., Treanor, J.J., Slusher, A.C., and Lacki, M.J. 2019. Buildings provide vital habitat for little brown myotis (Myotis lucifugus) in a high-elevation landscape. Ecosphere 10(11):e02925. DOI: 10.1002/ecs2.2925

Slough, B.G. and Jung, T.S. 2020. Little Brown Bats Utilize Multiple Maternity Roosts Within Foraging Areas: Implications for Identifying Summer Habitat. Journal of Fish and Wildlife Management 11(1):311–320.



Little Brown Myotis Forage Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Forage Ecosite Types
BS3-Jack pine-blueberry/ lichen
BS3/BS7-Jack pine-blueberry/ Black spruce-blueberry/ lichen
BS4-Jack pine-black spruce/ feathermoss
BS7-Black spruce-blueberry/ lichen
BS9-Black spruce-jack pine/ feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS18-Labrador tea shrubby bog
BS19-Graminoid bog
BS19/24-Graminoid bog/ Graminoid fen
BS20-Open bog
BS21-Tamarack treed fen
BS22-Leatherleaf shrubby poor fen
BS23-Willlow shrubby rich fen
BS24-Graminoid fen
BS25-Open fen
BS26-Rush sandy shore
BS27-Sedge rocky shore
AN-Anthropogenic
Lake
Waterbody
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
Alberta
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Kilometres
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Map Scale = 1:37,500 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N
Data Sources
• Bat data: Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data: Omnia Ecological Services. Modified by EDI. 2021.
• Project Area: Denison Mines. March 2021.
• Inset Basemap: CanVec 1:5,000,000. Government of Canada.
Disclaimer
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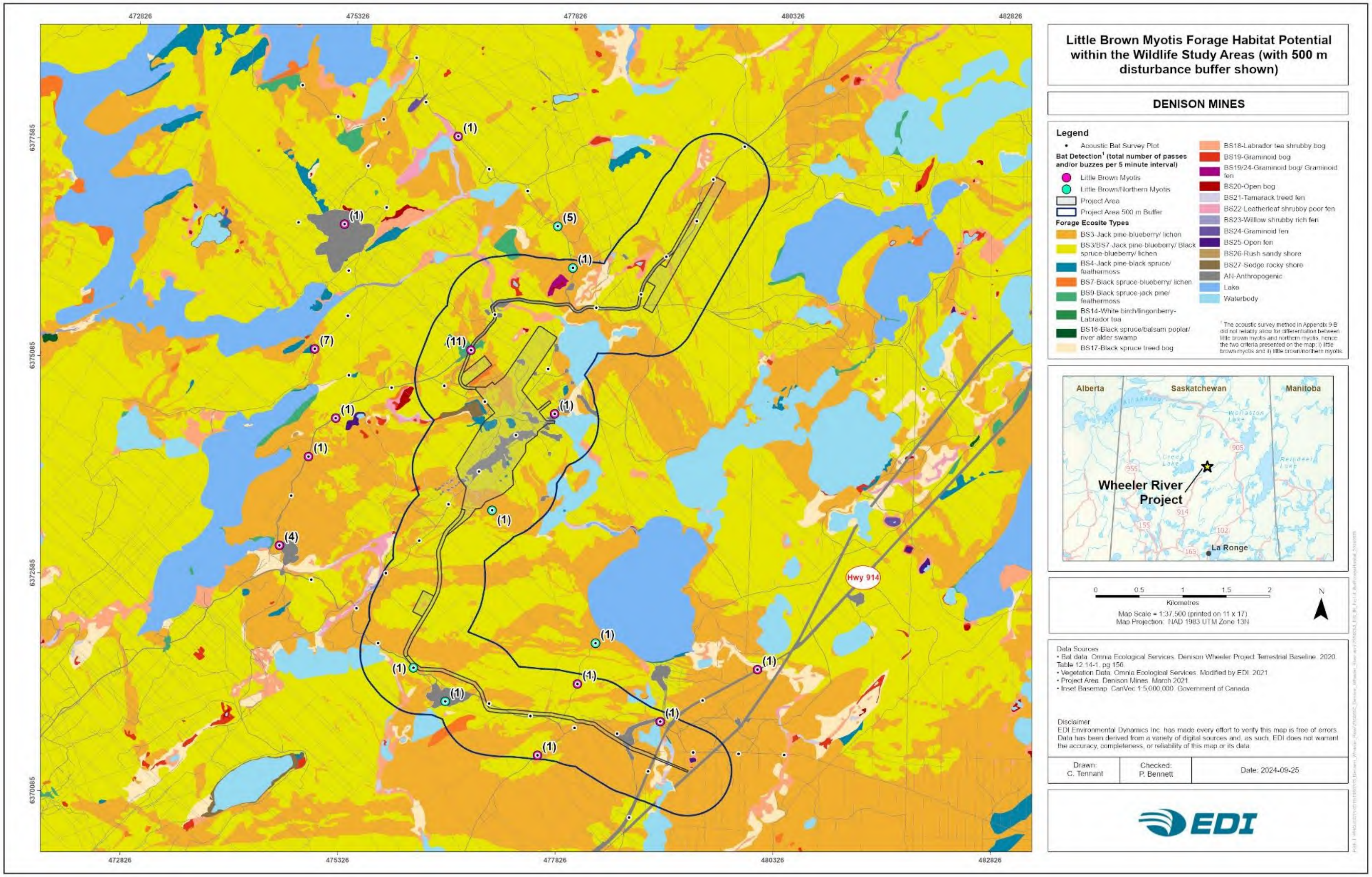
Figure 1



Little Brown Myotis Forage Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Project Area 500 m Buffer
Forage Ecosite Types
BS3-Jack pine-blueberry/ lichen
BS3/BS7-Jack pine-blueberry/ Black spruce-blueberry/ lichen
BS4-Jack pine-black spruce/ feathermoss
BS7-Black spruce-blueberry/ lichen
BS9-Black spruce-jack pine/ feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS18-Labrador tea shrubby bog
BS19-Graminoid bog
BS19/24-Graminoid bog/ Graminoid fen
BS20-Open bog
BS21-Tamarack treed fen
BS22-Leatherleaf shrubby poor fen
BS23-Willlow shrubby rich fen
BS24-Graminoid fen
BS25-Open fen
BS26-Rush sandy shore
BS27-Sedge rocky shore
AN-Anthropogenic
Lake
Waterbody
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Scale = 1:37,500 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N
Data Sources
• Bat data: Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
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• Project Area: Denison Mines. March 2021
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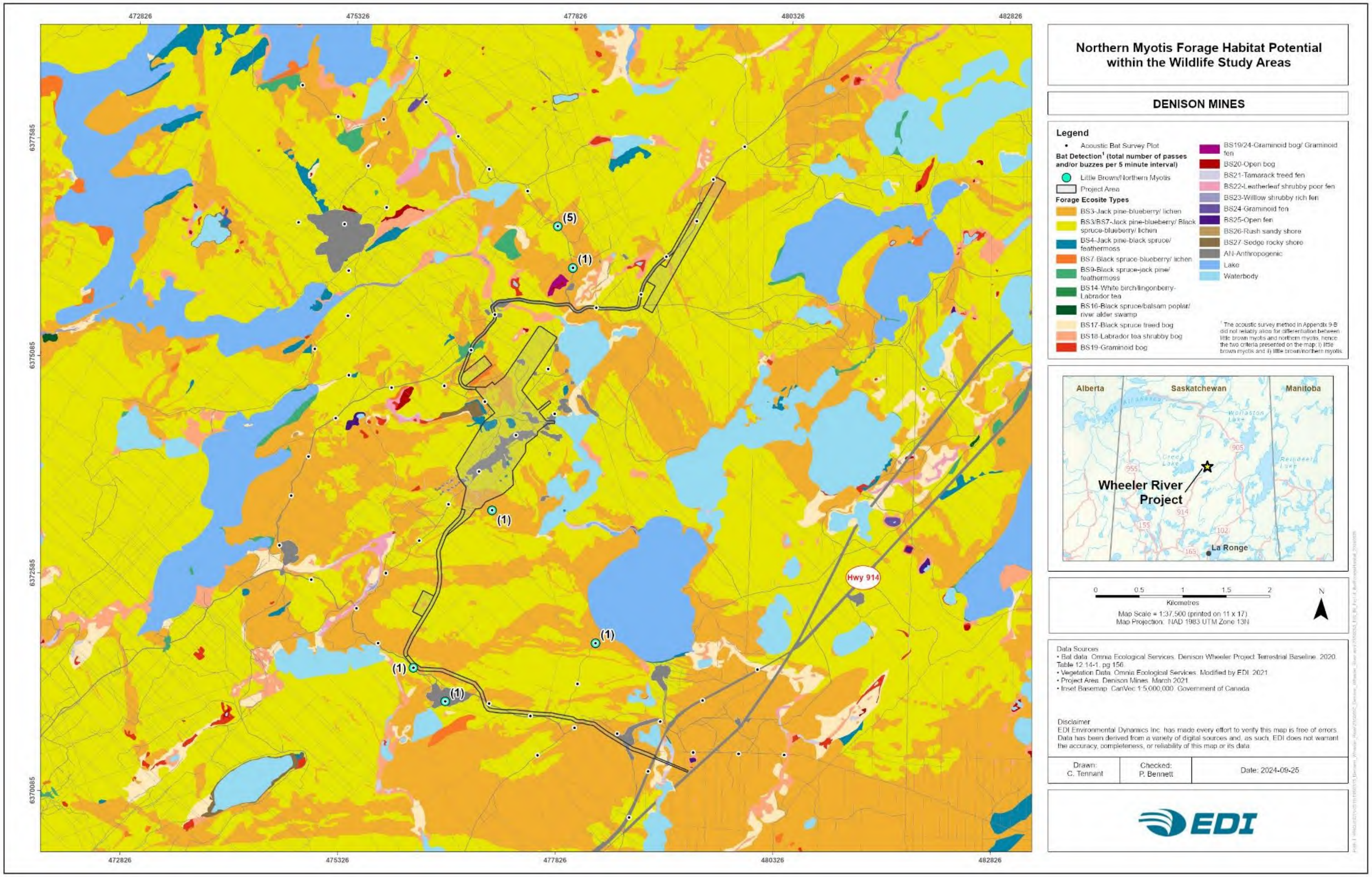
Checked: P. Bennett
Date: 2024-09-25

Figure 2



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Northern Myotis Forage Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown/Northern Myotis
Project Area
Forage Ecosite Types
BS3-Jack pine-blueberry/ lichen
BS3/BS7-Jack pine-blueberry/ Black spruce-blueberry/ lichen
BS4-Jack pine-black spruce/ feathermoss
BS7-Black spruce-blueberry/ lichen
BS9-Black spruce-jack pine/ feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS18-Labrador tea shrubby bog
BS19-Graminoid bog
BS19/24-Graminoid bog/ Graminoid fen
BS20-Open bog
BS21-Tamarack treed fen
BS22-Leatherleaf shrubby poor fen
BS23-Willlow shrubby rich fen
BS24-Graminoid fen
BS25-Open fen
BS26-Rush sandy shore
BS27-Sedge rocky shore
AN-Anthropogenic
Lake
Waterbody
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Projection: NAD 1983 UTM Zone 13N
Data Sources
• Bat data: Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data: Omnia Ecological Services. Modified by EDI. 2021
• Project Area: Denison Mines. March 2021
• Inset Basemap: CanVec 1:5,000,000. Government of Canada
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Checked: P. Bennett
Date: 2024-09-25
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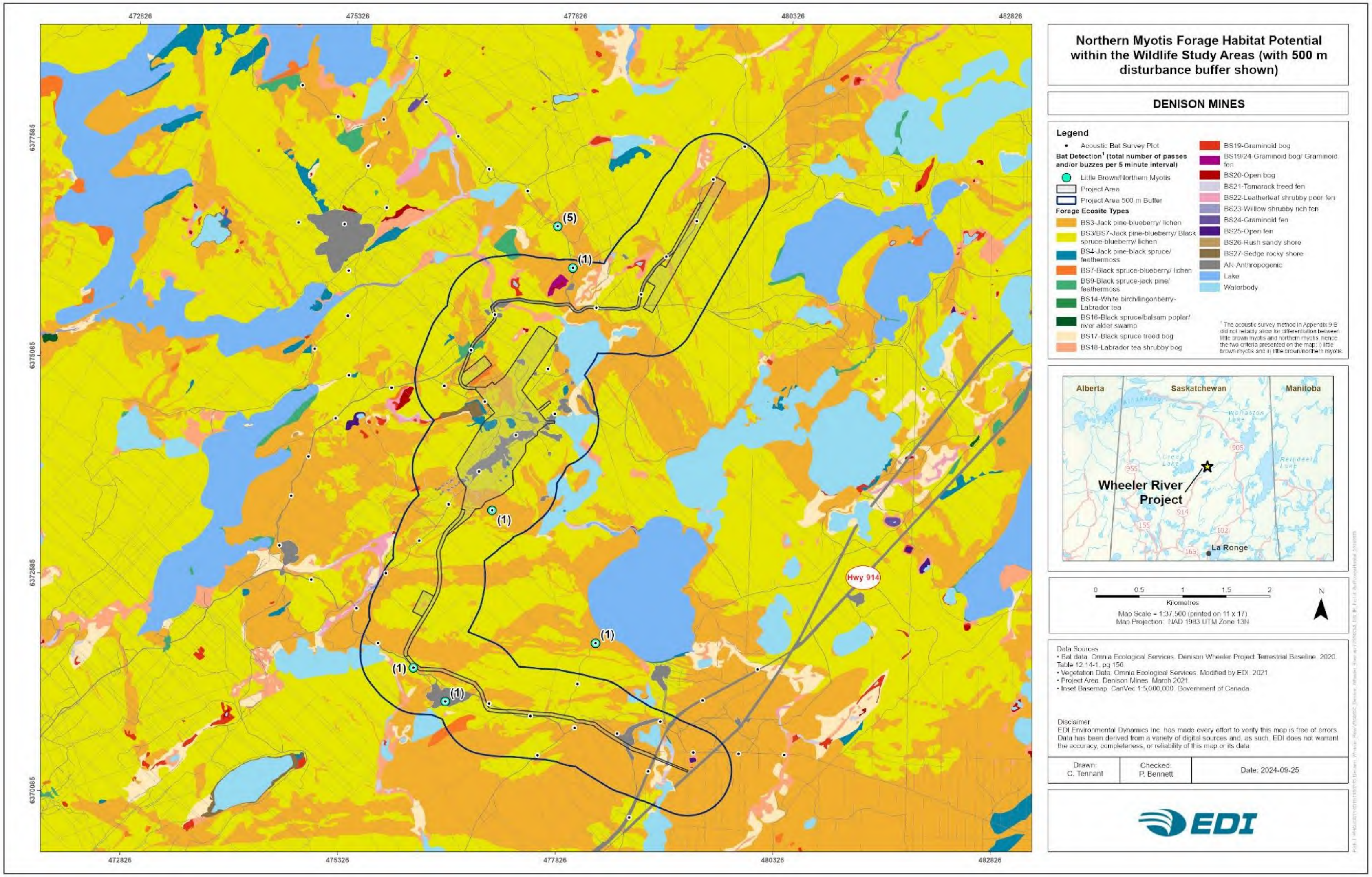
Figure 3



Northern Myotis Forage Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown/Northern Myotis
Project Area
Project Area 500 m Buffer
Forage Ecosite Types
BS3-Jack pine-blueberry/ lichen
BS3/BS7-Jack pine-blueberry/ Black spruce-blueberry/ lichen
BS4-Jack pine-black spruce/ feathermoss
BS7-Black spruce-blueberry/ lichen
BS9-Black spruce-jack pine/ feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS18-Labrador tea shrubby bog
BS19-Graminoid bog
BS19/24-Graminoid bog/ Graminoid fen
BS20-Open bog
BS21-Tamarack treed fen
BS22-Leatherleaf shrubby poor fen
BS23-Willow shrubby rich fen
BS24-Graminoid fen
BS25-Open fen
BS26-Rush sandy shore
BS27-Sedge rocky shore
AN-Anthropogenic
Lake
Waterbody
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Projection: NAD 1983 UTM Zone 13N
Data Sources
• Bat data: Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1. pg 156.
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• Project Area: Denison Mines. March 2021.
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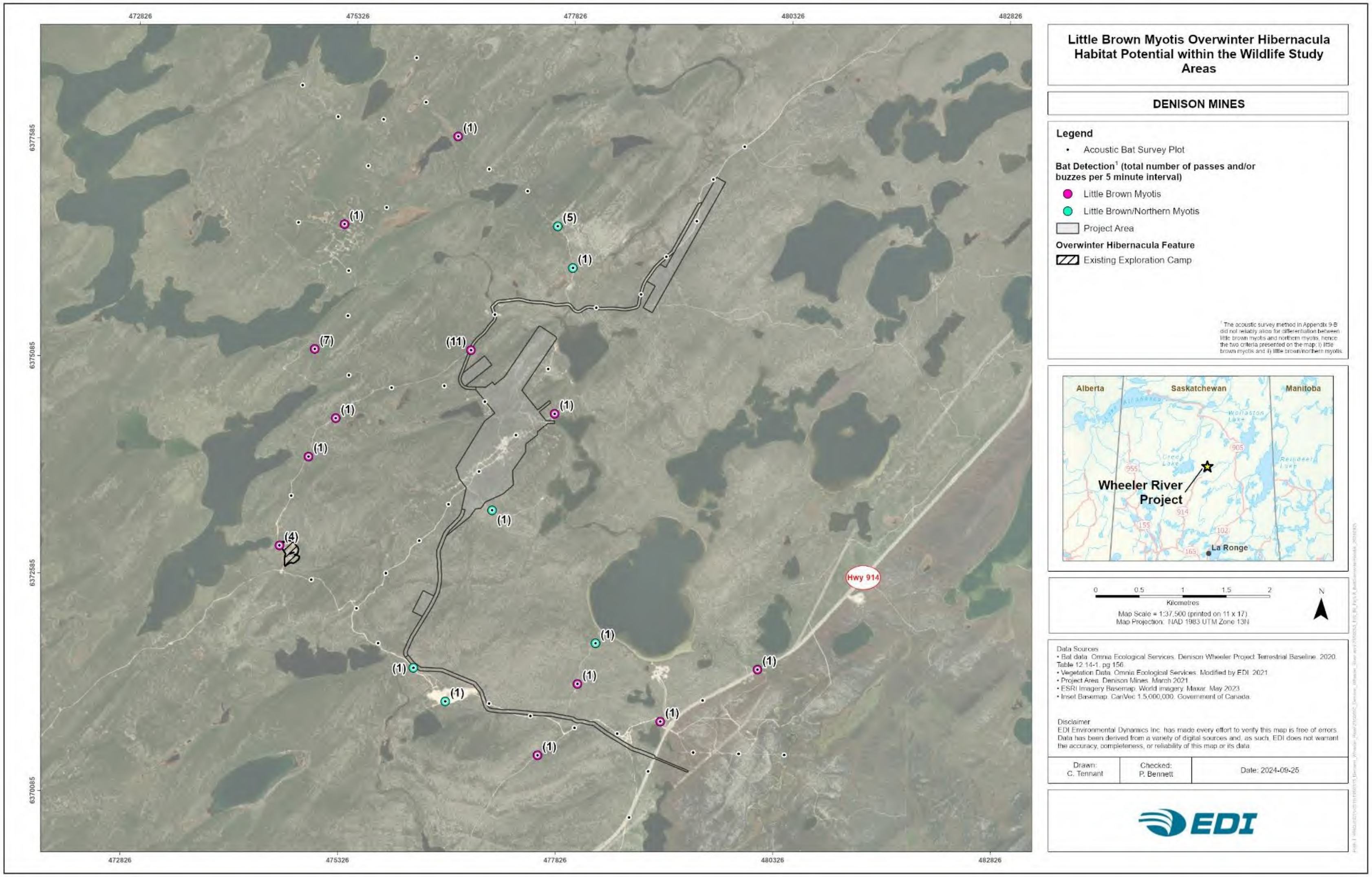
Date: 2024-09-25

Figure 4



Little Brown Myotis Overwinter Hibernacula Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Overwinter Hibernacula Feature
Existing Exploration Camp
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Data Sources
• Bat data. Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data. Omnia Ecological Services. Modified by EDI. 2021.
• Project Area. Denison Mines. March 2021.
• ESRI Imagery Basemap. World imagery. Maxar. May 2023.
• Inset Basemap. CanVec 1.5,000,000. Government of Canada.
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Checked: P. Bennett
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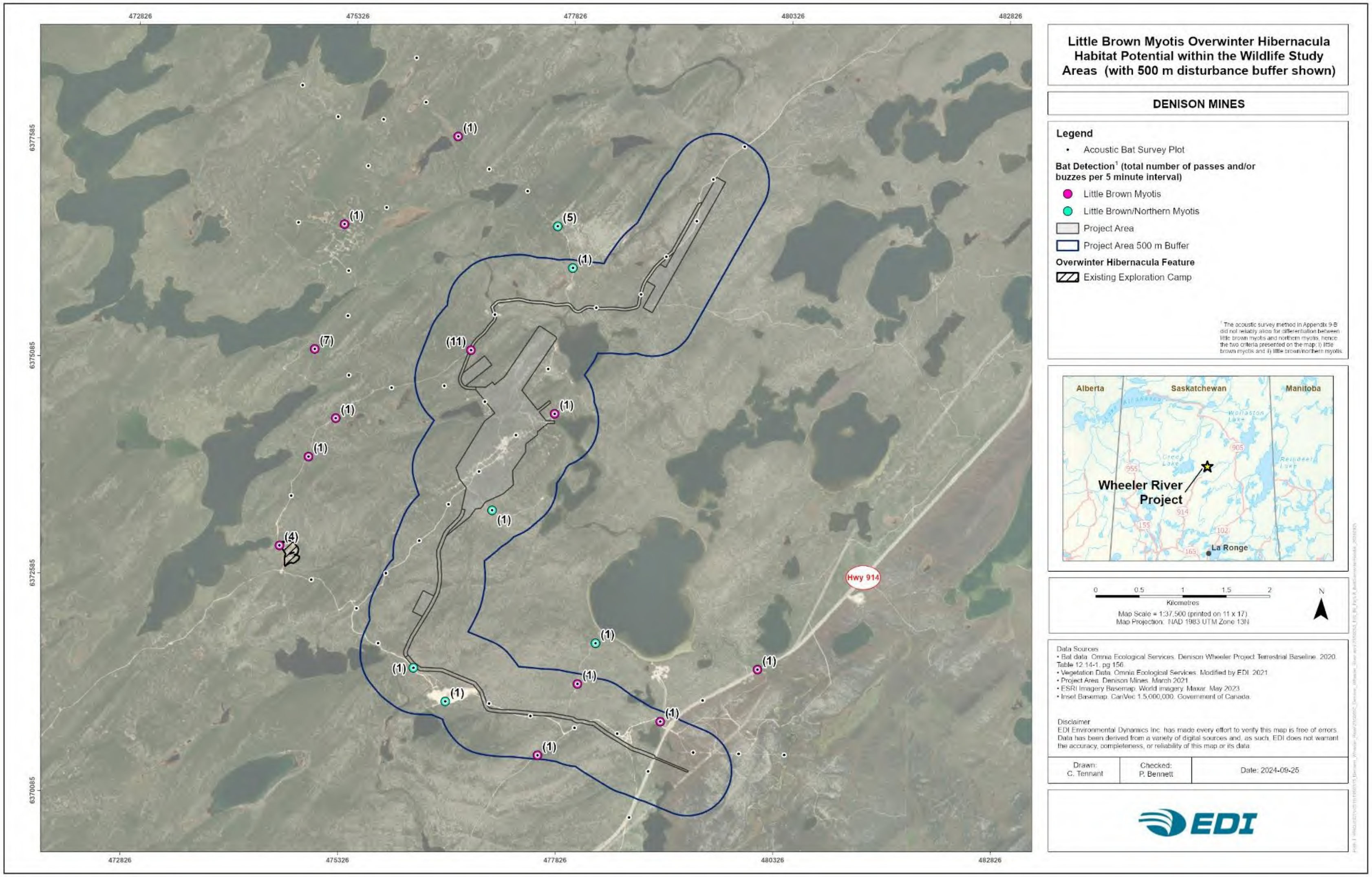
Figure 5



Little Brown Myotis Overwinter Hibernacula Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Project Area 500 m Buffer
Overwinter Hibernacula Feature
Existing Exploration Camp
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Projection: NAD 1983 UTM Zone 13N
Data Sources
• Bat data. Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1. pg 156.
• Vegetation Data. Omnia Ecological Services. Modified by EDI. 2021
• Project Area. Denison Mines. March 2021
• ESRI Imagery Basemap. World imagery. Maxar. May 2023
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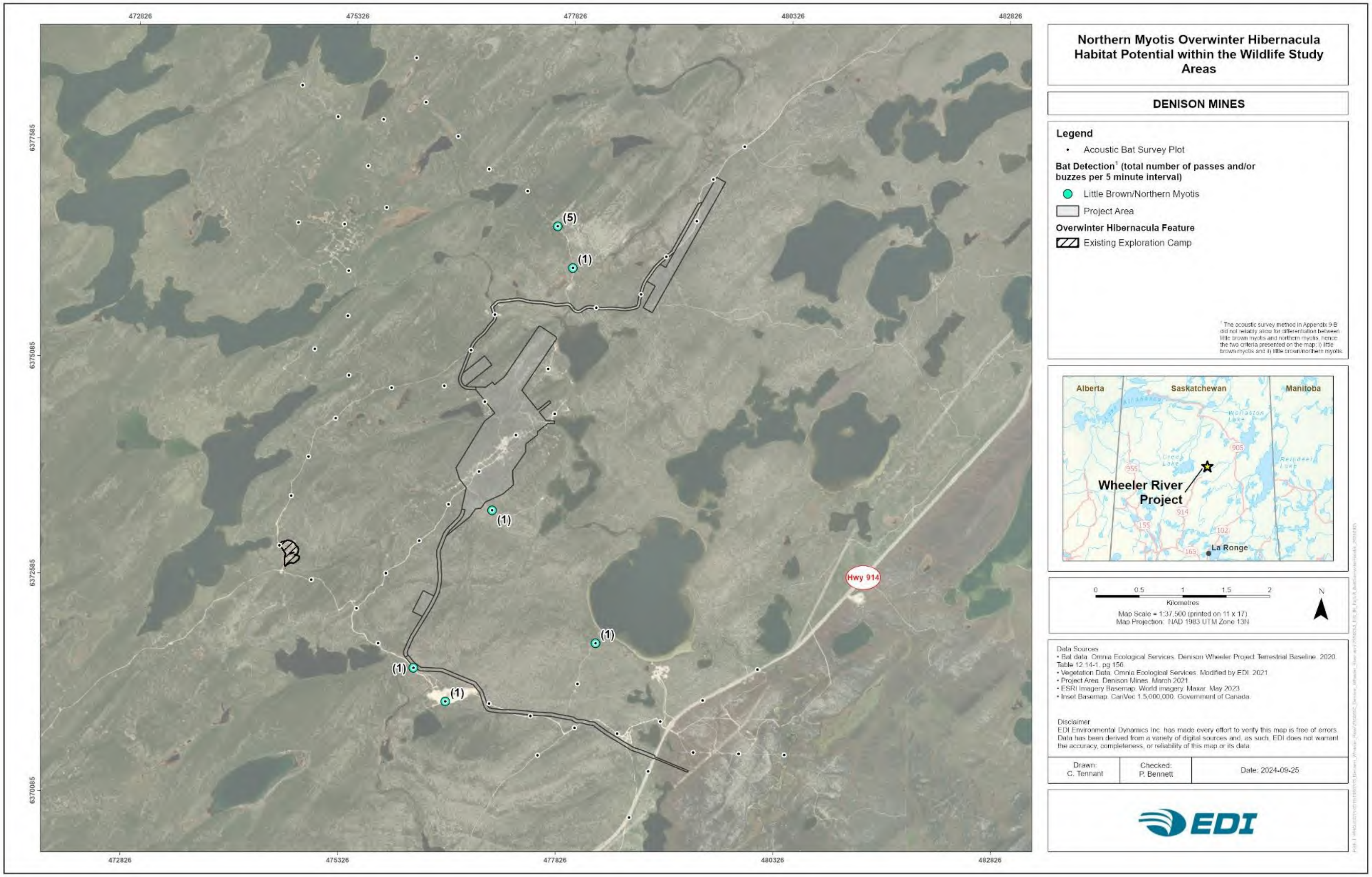
Figure 6



Northern Myotis Overwinter Hibernacula Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown/Northern Myotis
Project Area
Overwinter Hibernacula Feature
Existing Exploration Camp
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Projection: NAD 1983 UTM Zone 13N
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Data Sources
• Bat data. Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data. Omnia Ecological Services. Modified by EDI. 2021
• Project Area. Denison Mines. March 2021
• ESRI Imagery Basemap. World imagery. Maxar. May 2023
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Drawn: C. Tennant
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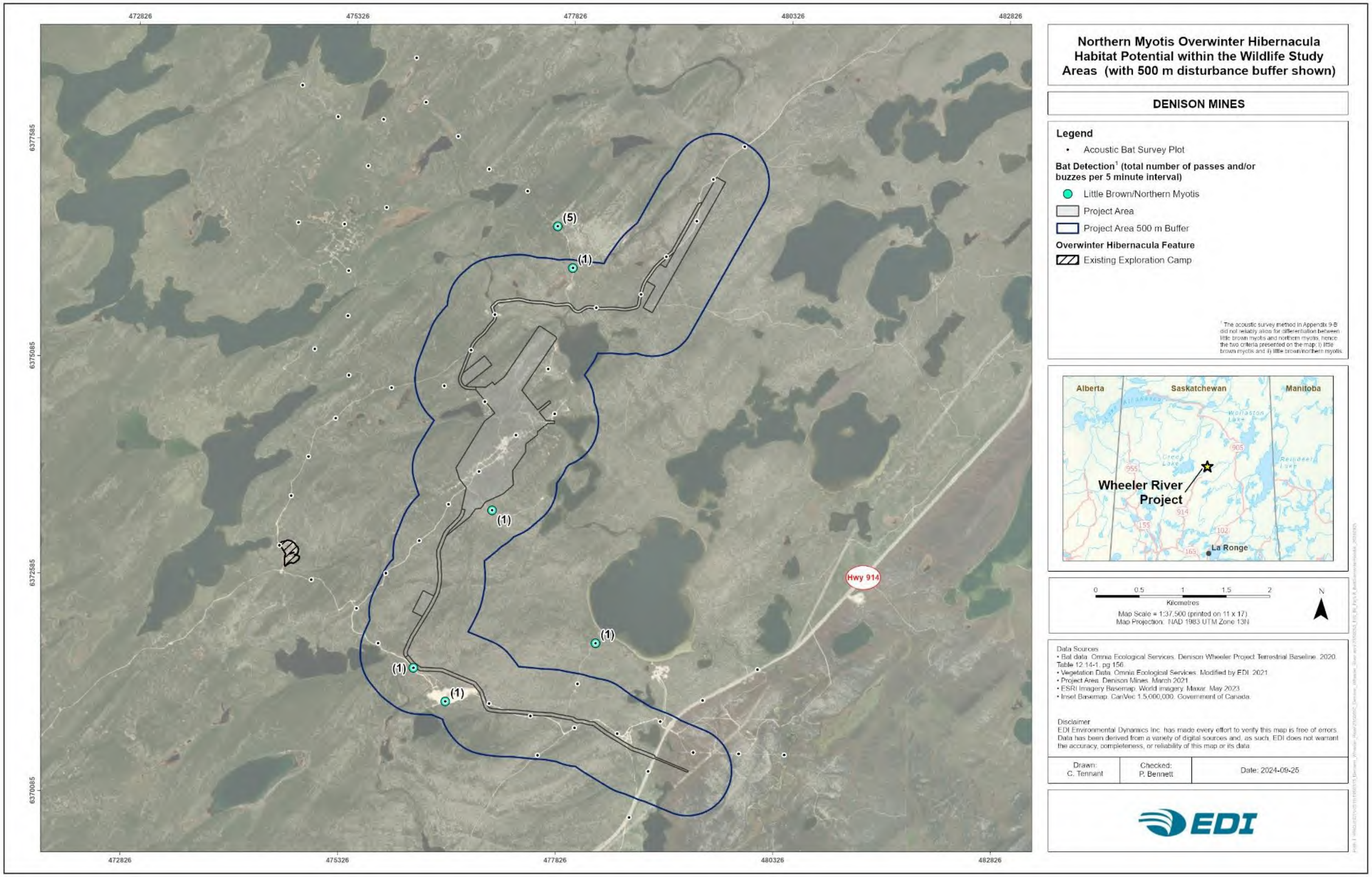
Figure 7



Northern Myotis Overwinter Hibernacula Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown/Northern Myotis
Project Area
Project Area 500 m Buffer
Overwinter Hibernacula Feature
Existing Exploration Camp
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Projection: NAD 1983 UTM Zone 13N
Data Sources
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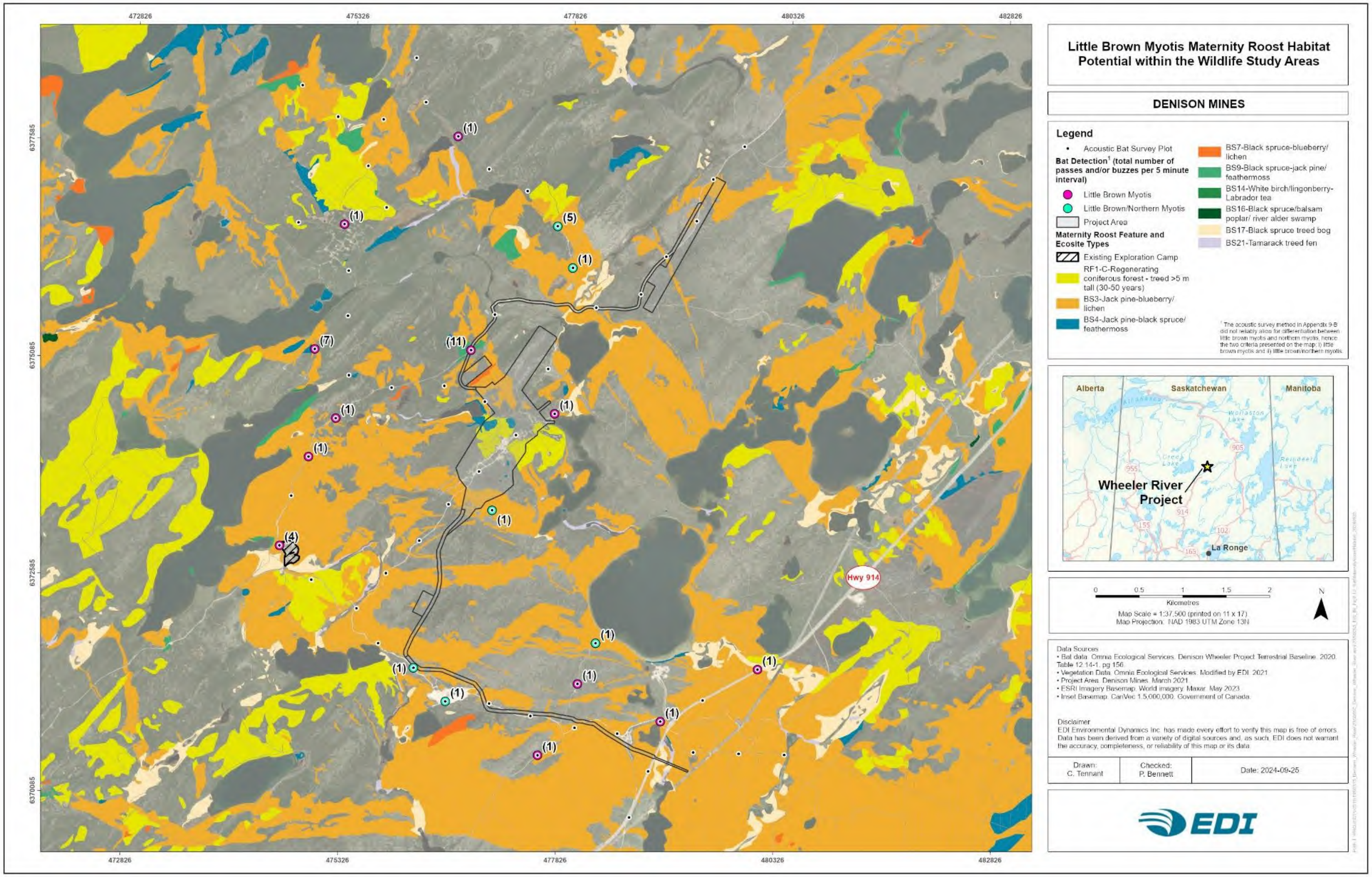
Date: 2024-09-25
EDI

Figure 8



Little Brown Myotis Maternity Roost Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Maternity Roost Feature and Ecosite Types
Existing Exploration Camp
RF1-C-Regenerating coniferous forest - treed >5 m tall (30-50 years)
BS3-Jack pine-blueberry/ lichen
BS4-Jack pine-black spruce/ feathermoss
BS7-Black spruce-blueberry/ lichen
BS9-Black spruce-jack pine/ feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS21-Tamarack treed fen
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
Alberta
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Map Projection: NAD 1983 UTM Zone 13N
Data Sources
• Bat data. Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data. Omnia Ecological Services. Modified by EDI. 2021.
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• ESRI Imagery Basemap. World imagery. Maxar. May 2023.
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Checked: P. Bennett
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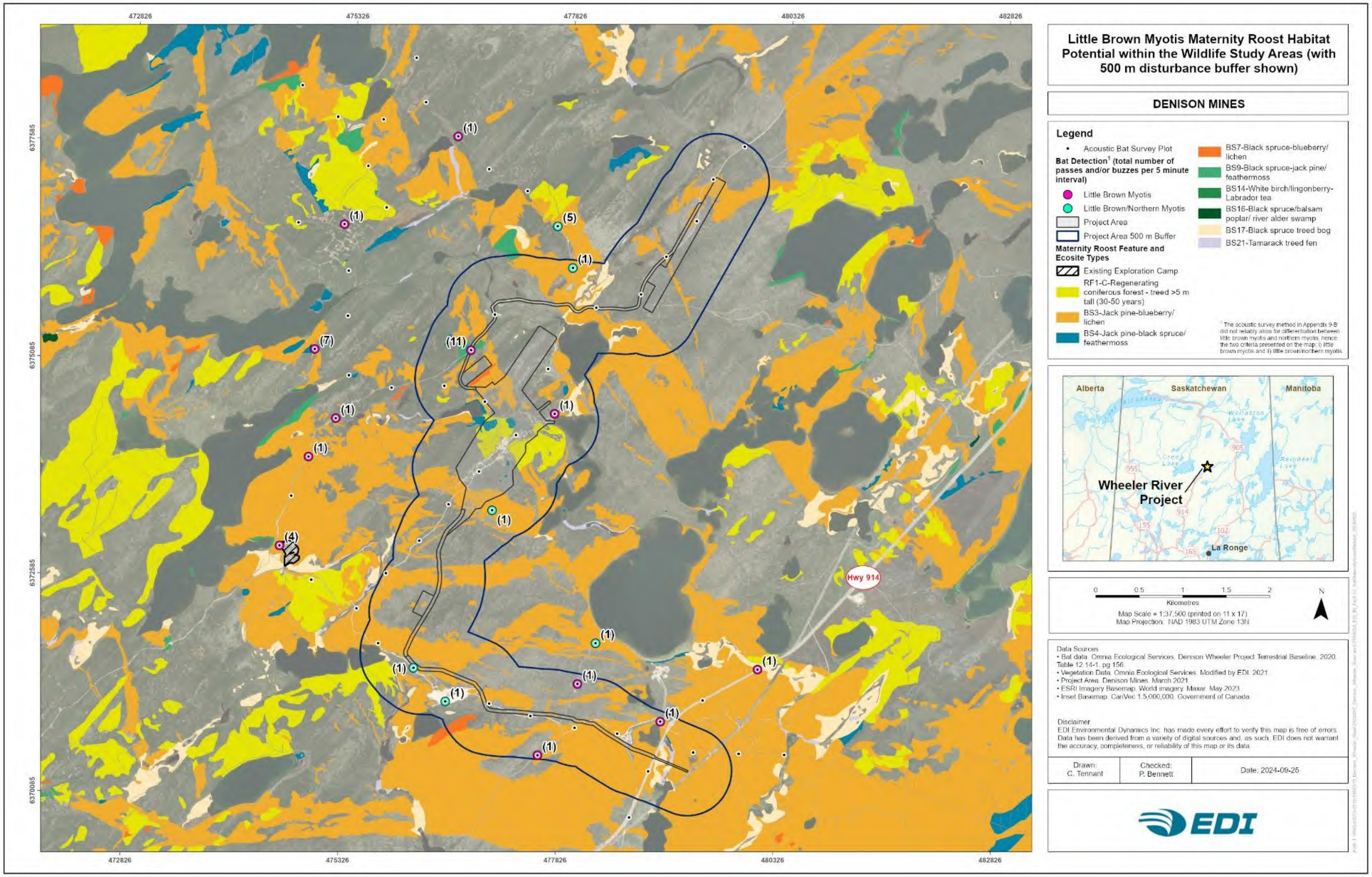
Figure 9



Little Brown Myotis Maternity Roost Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Project Area 500 m Buffer
Maternity Roost Feature and Ecosite Types
Existing Exploration Camp
RF1-C-Regenerating coniferous forest - treed >5 m tall (30-50 years)
BS3-Jack pine-blueberry/lichen
BS4-Jack pine-black spruce/feathermoss
BS7-Black spruce-blueberry/lichen
BS9-Black spruce-jack pine/feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS21-Tamarack treed fen
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Data Sources
• Bat data. Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data. Omnia Ecological Services. Modified by EDI. 2021.
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• Inset Basemap. CanVec 1:5,000,000. Government of Canada.
Disclaimer
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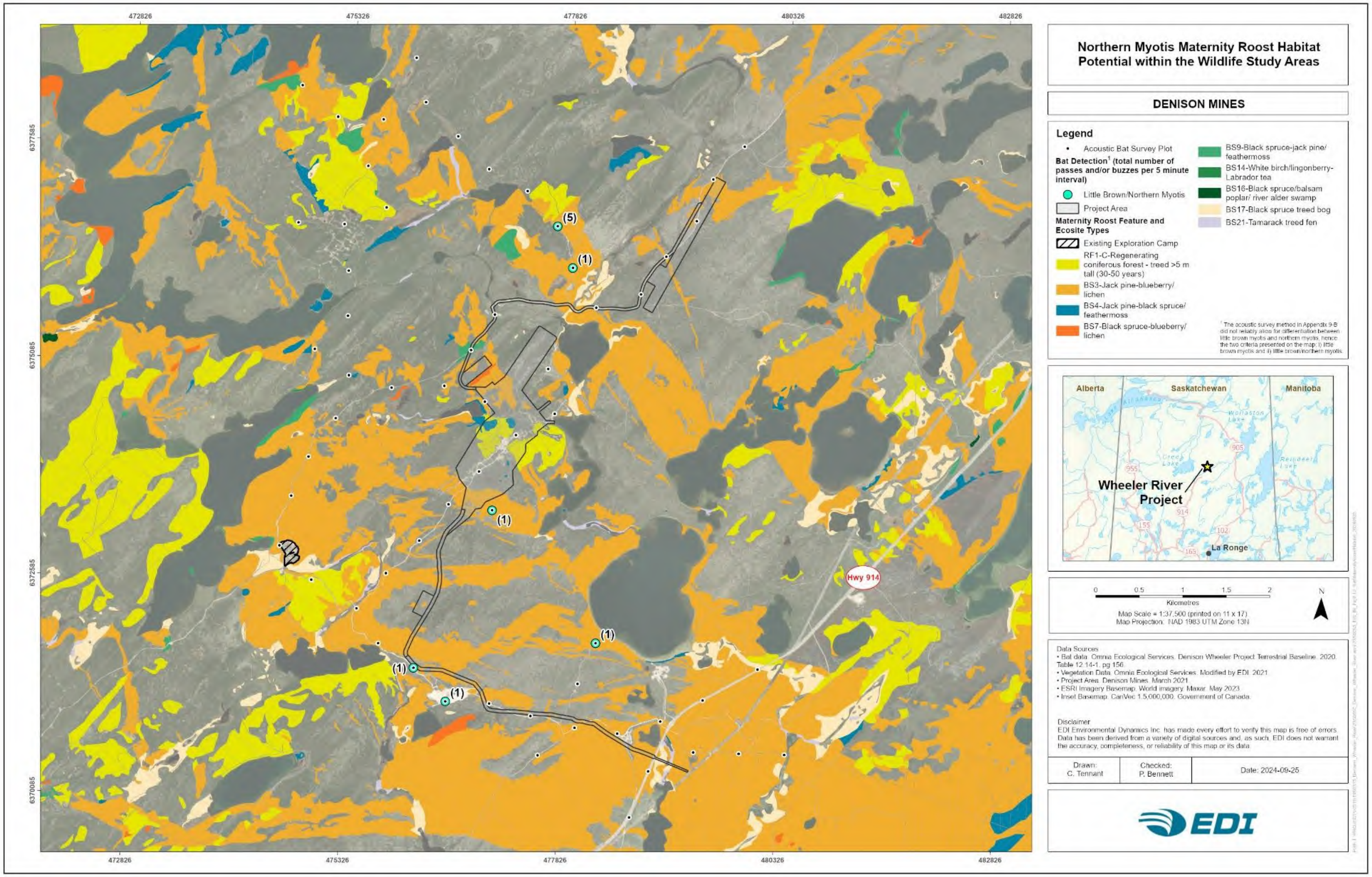
Drawn: C. Tennant
Checked: P. Bennett
Date: 2024-09-25

Figure 10


Northern Myotis Maternity Roost Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown/Northern Myotis
Project Area
Maternity Roost Feature and Ecosite Types
Existing Exploration Camp
RF1-C-Regenerating coniferous forest - treed >5 m tall (30-50 years)
BS3-Jack pine-blueberry/ lichen
BS4-Jack pine-black spruce/ feathermoss
BS7-Black spruce-blueberry/ lichen
BS9-Black spruce-jack pine/ feathermoss
BS14-White birch/lingonberry-Labrador tea
BS16-Black spruce/balsam poplar/ river alder swamp
BS17-Black spruce treed bog
BS21-Tamarack treed fen
[1] The acoustic survey method in Appendix 9-B did not reliably allow for differentiation between little brown myotis and northern myotis, hence the two criteria presented on the map: i) little brown myotis and ii) little brown/northern myotis.
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Map Scale = 1:37,500 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 13N
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Data Sources
• Bat data. Omnia Ecological Services. Denison Wheeler Project Terrestrial Baseline. 2020. Table 12.14-1, pg 156.
• Vegetation Data. Omnia Ecological Services. Modified by EDI. 2021.
• Project Area. Denison Mines. March 2021.
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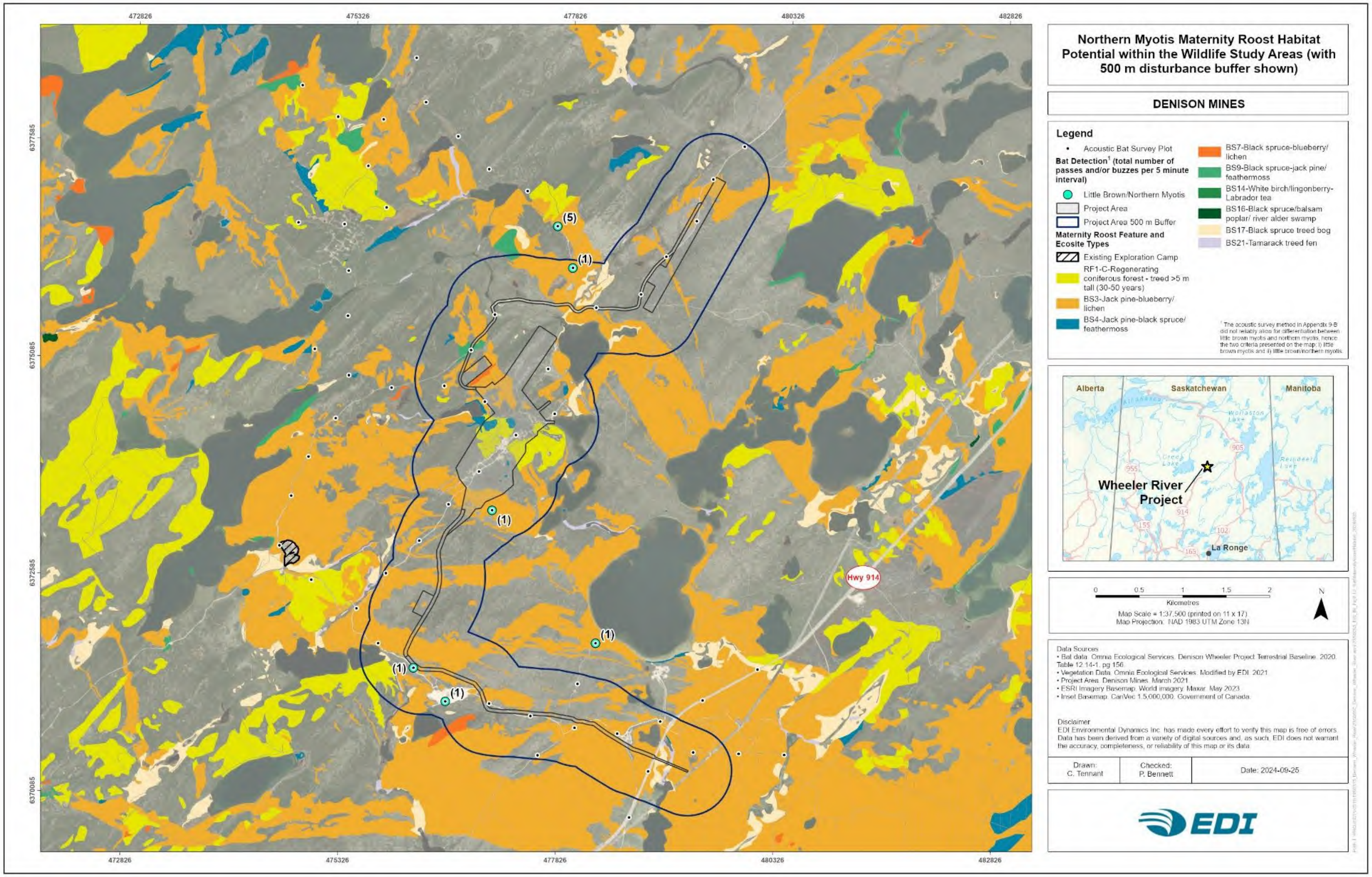
Figure 11



Northern Myotis Maternity Roost Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown/Northern Myotis
Project Area
Project Area 500 m Buffer
Maternity Roost Feature and Ecosite Types
Existing Exploration Camp
RF1-C-Regenerating coniferous forest - treed >5 m tall (30-50 years)
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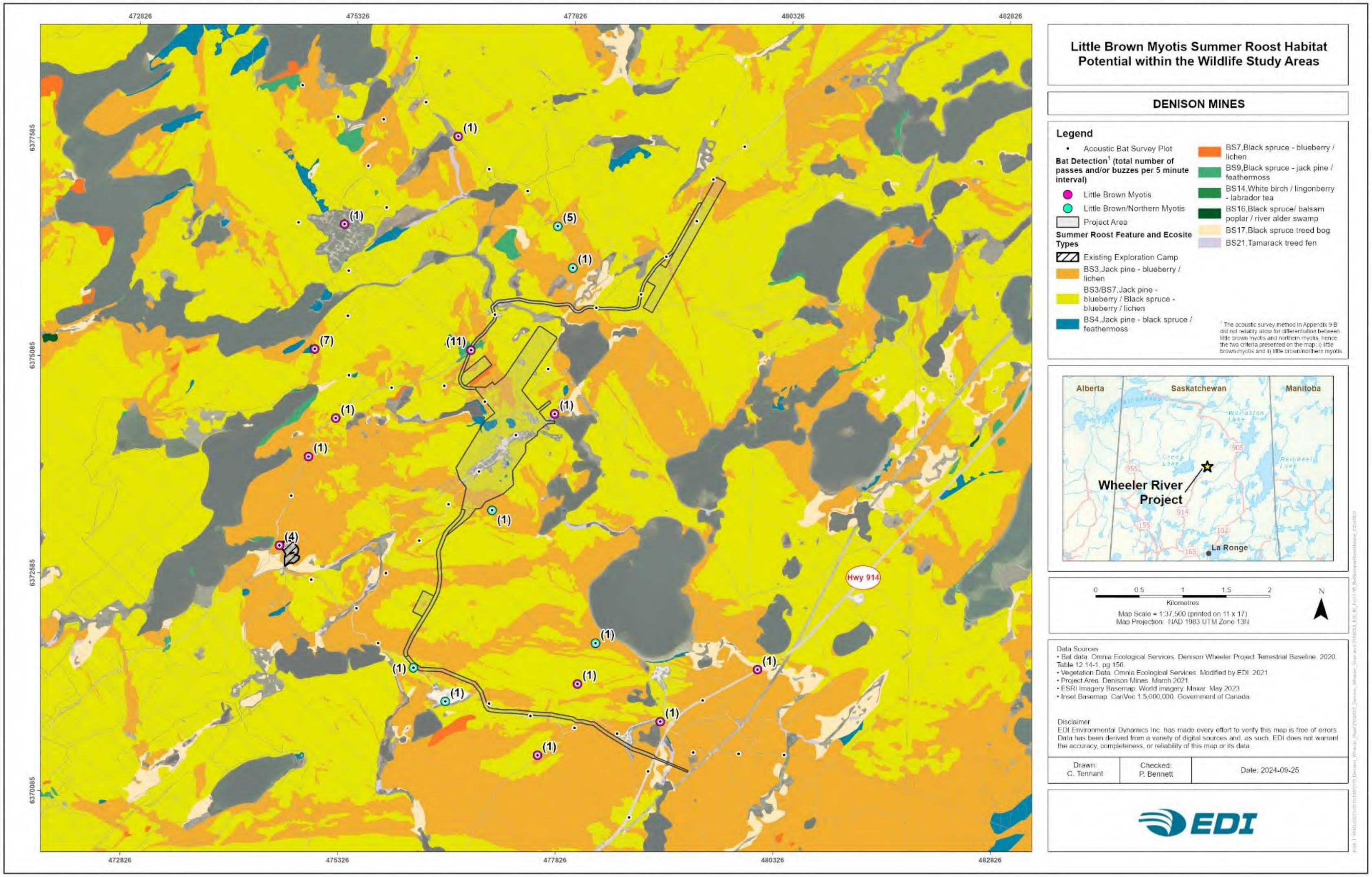
Figure 12



Little Brown Myotis Summer Roost Habitat Potential within the Wildlife Study Areas
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Little Brown Myotis
Little Brown/Northern Myotis
Project Area
Summer Roost Feature and Ecosite Types
Existing Exploration Camp
BS3,Jack pine - blueberry / lichen
BS3/BS7,Jack pine - blueberry / Black spruce - blueberry / lichen
BS4,Jack pine - black spruce / feathermoss
BS7,Black spruce - blueberry / lichen
BS9,Black spruce - jack pine / feathermoss
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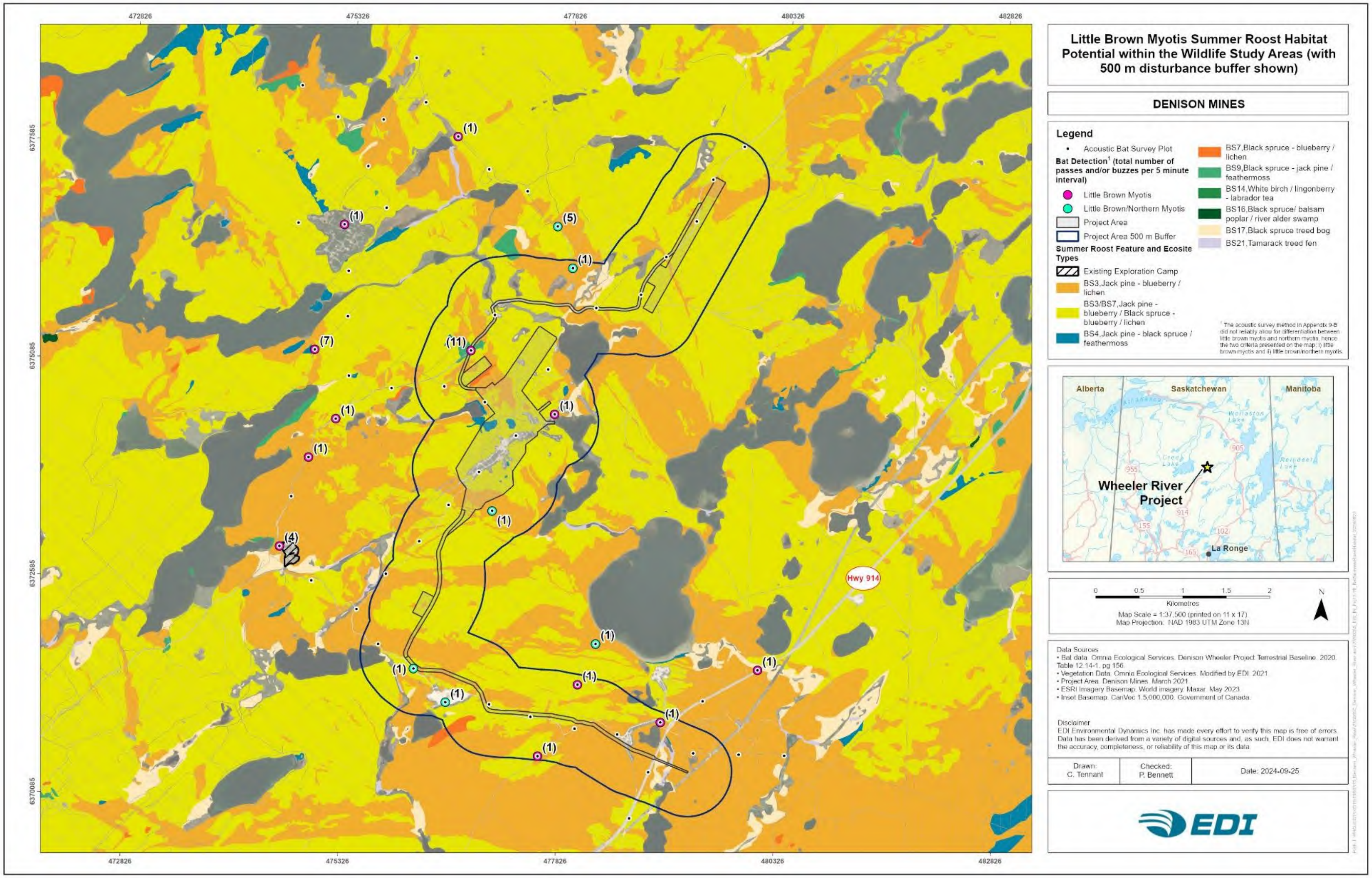
Figure 13



Little Brown Myotis Summer Roost Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
DENISON MINES
Legend
Acoustic Bat Survey Plot
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
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Little Brown/Northern Myotis
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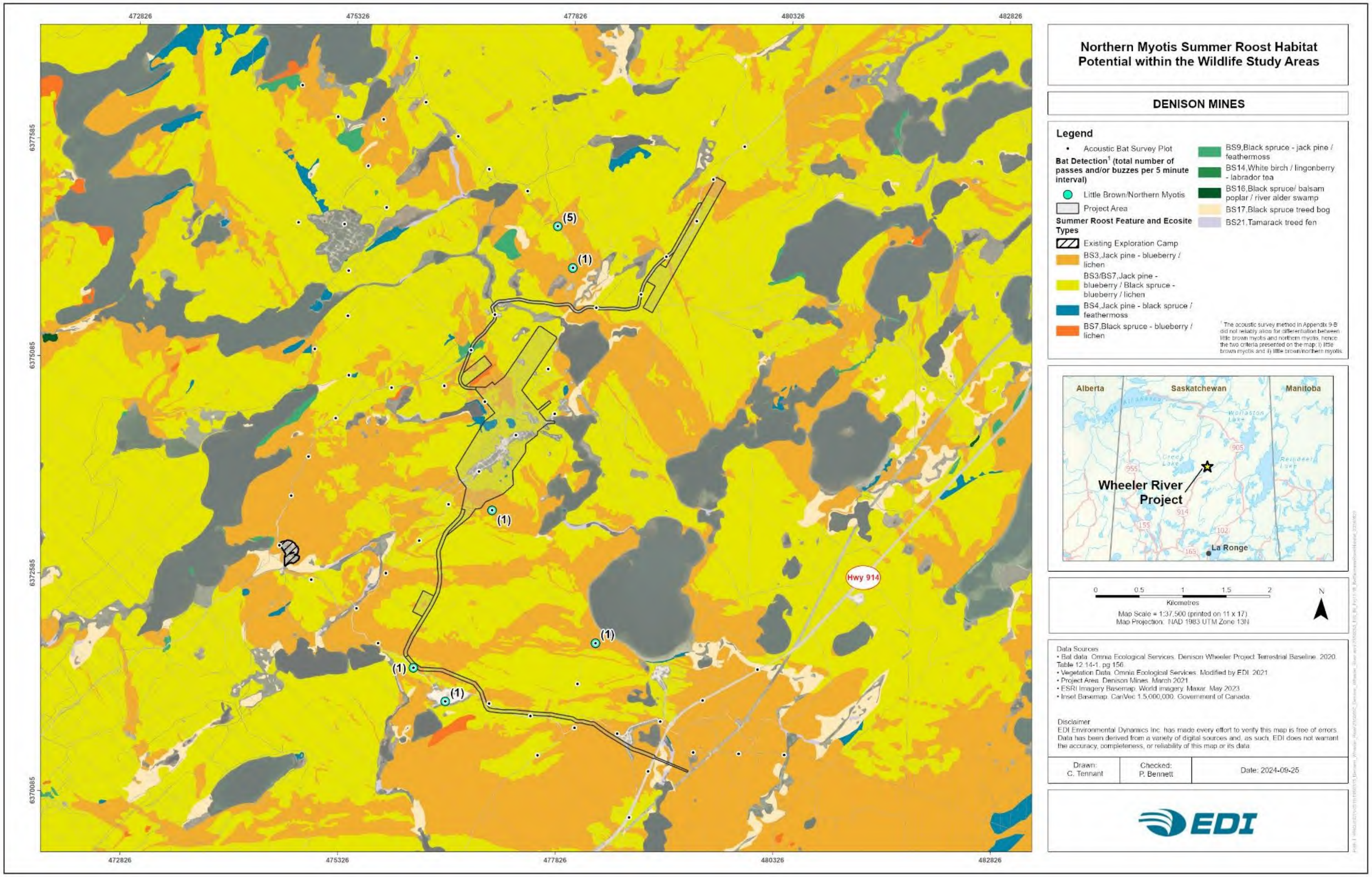
Figure 14



Northern Myotis Summer Roost Habitat Potential within the Wildlife Study Areas
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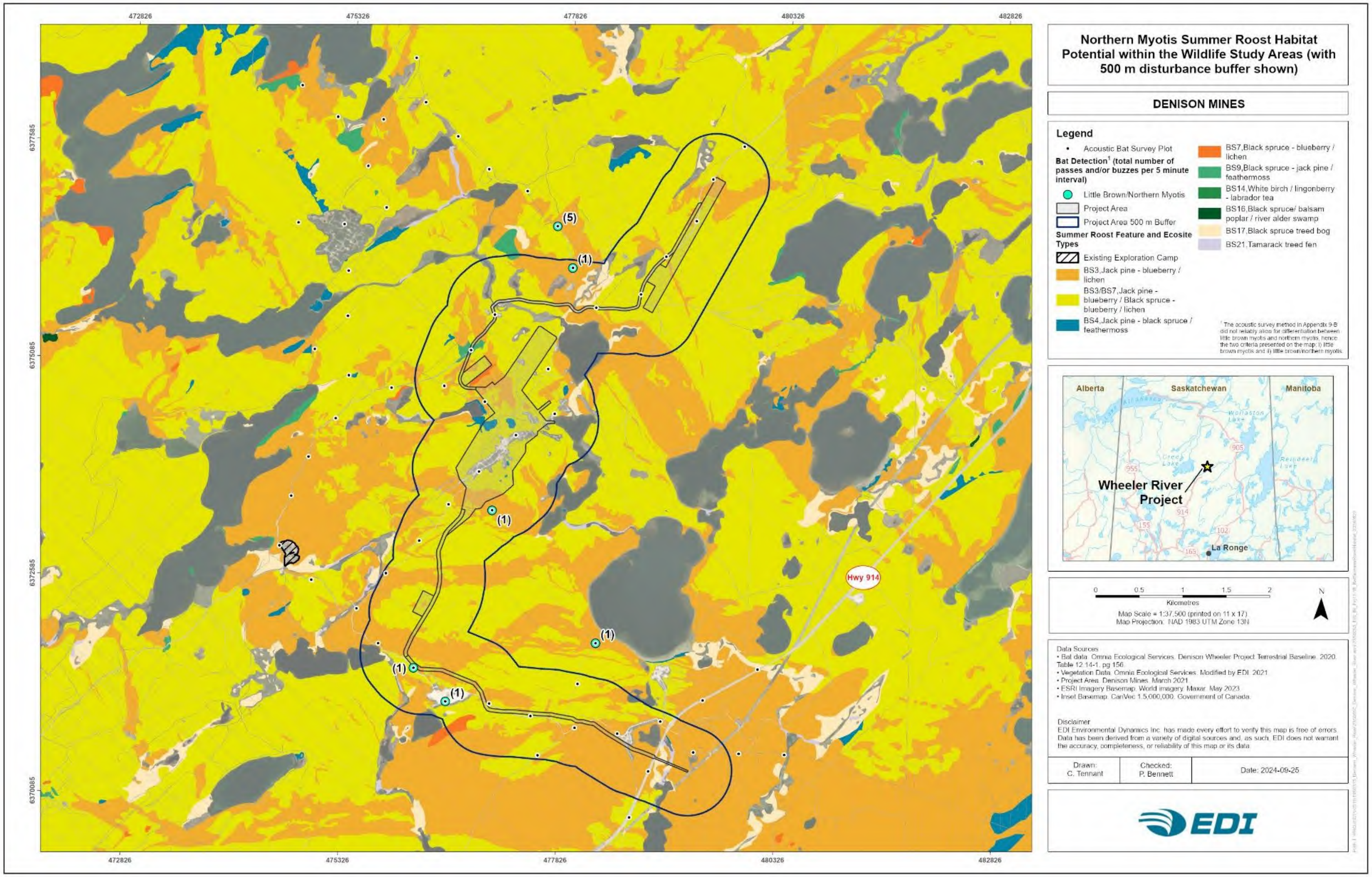
Figure 15



Northern Myotis Summer Roost Habitat Potential within the Wildlife Study Areas (with 500 m disturbance buffer shown)
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Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
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Figure 16


Denison Mines
Powering
PEOPLE, PARTNERSHIPS
AND PASSION

Denison Mines Corp.

Appendix 9-F Supplemental Information

~~New Appendix to Revised Draft EIS, Updated for Final EIS, Section 9~~

Version 3~~2~~

~~July 2024~~October 2024

Denison Mines

Table of Contents

List of Figures

1 Introduction

On October 21, 2022, Denison Mines Corp. (Denison) submitted a draft Environmental Impact Statement (EIS) for the proposed Wheeler River Project (the Project). Based on their initial review, the Canadian Nuclear Safety Commission indicated that the submission contained the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review of the draft EIS. On March 20, 2023, the FIRT provided Denison with an initial list of information requests (IRs) for Denison to respond to and eventually submit a final EIS document. Denison compiled a list of responses to these initial IRs and provided the FIRT with a revised draft on August 18, 2023. Following the review of these documents, the FIRT provided Denison with a subsequent list of IRs on November 27, 2023. This Appendix provides additional information to address several IRs provided by Environment and Climate Change Canada (ECCC) related to woodland caribou, migratory songbird species, and species at risk (SAR) listed under Schedule 1 of the federal *Species at Risk Act* (SARA).

2 Supplemental Information

2.1 Woodland Caribou

The following information is intended to provide additional context to the responses provided in the IR tracking sheet, particularly in regard to the following: IR-137, IR-143, IR 144, IR 145, IR-143/144R1, IR-143/145R1, IR-149, IR-149-R1A and R1B, IR-151, IR-155, and IR-156.

Figure 2-1 illustrates the location of woodland caribou observed during the baseline field program in association with the ecosite types as classified by the Saskatchewan Ministry of Environment as having the potential to develop into low, moderate, or high-quality habitat to support woodland caribou in relation to the SK1 range. These habitat potential categories are based on the overall habitat suitability ranking for the life history requirements, including forage, refuge, and calving habitat for caribou (Saskatchewan Ministry of Environment 2019). Figure 2-2 provides further insight as to the woodland caribou observed during the baseline field program in association with the ecosite types as classified by the Saskatchewan Ministry of Environment but in context with the Wildlife Study Areas.

To provide further context on the biophysical attributes for woodland caribou, as referenced in the 2020 Amended Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (ECCC 2020), Figure 2-3 to Figure 2-8 illustrate the location of caribou observations from the baseline field program in relation to calving, foraging, and refuge habitat, based on information received from the Saskatchewan Ministry of Environment (2023). These figures present the information at two different scales: (1) in context with the Wildlife Study Areas, and (2) in relation to the Project Footprint.

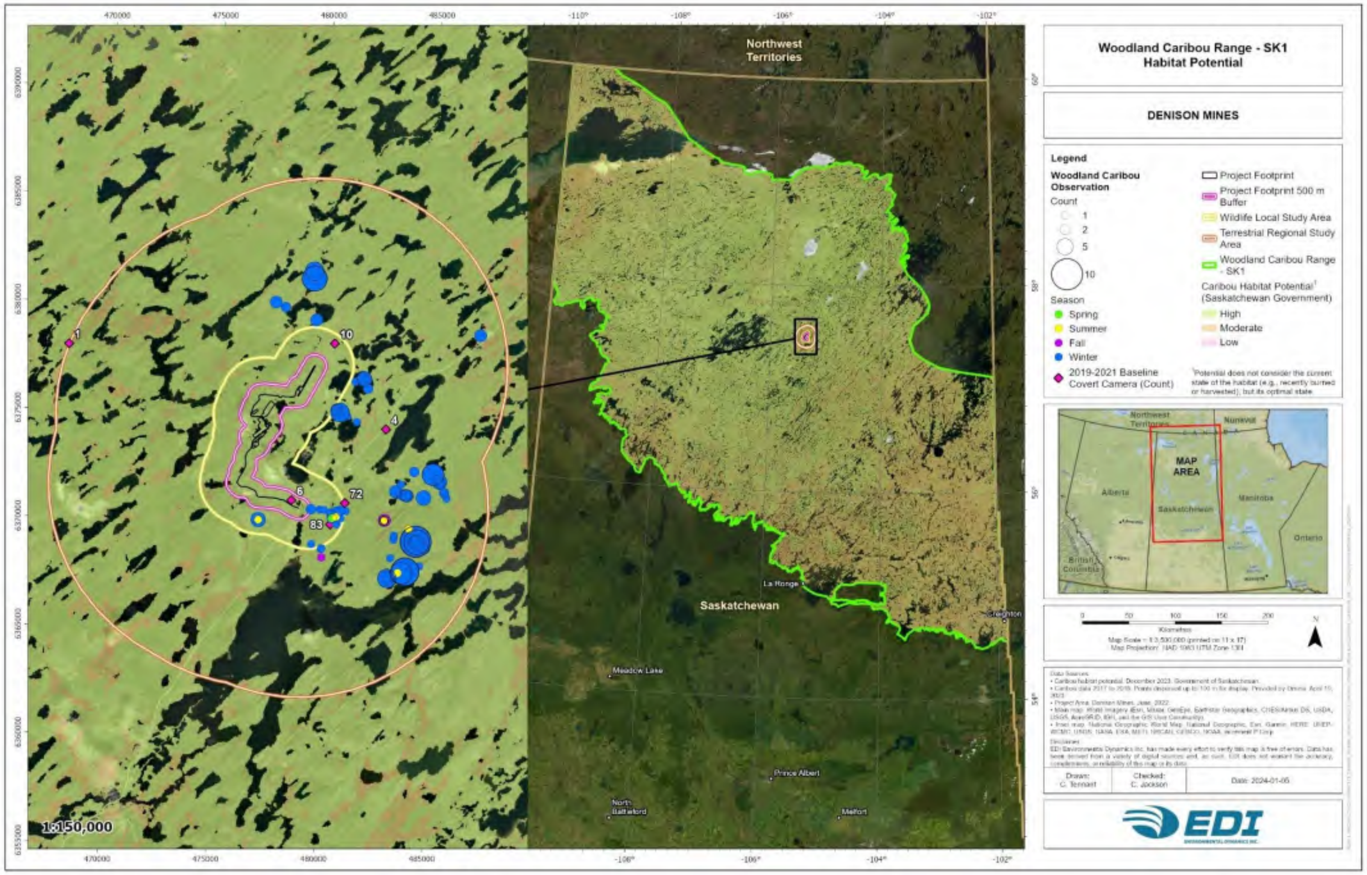


Figure 2-1: Woodland Caribou Range – SK1, Habitat Potential

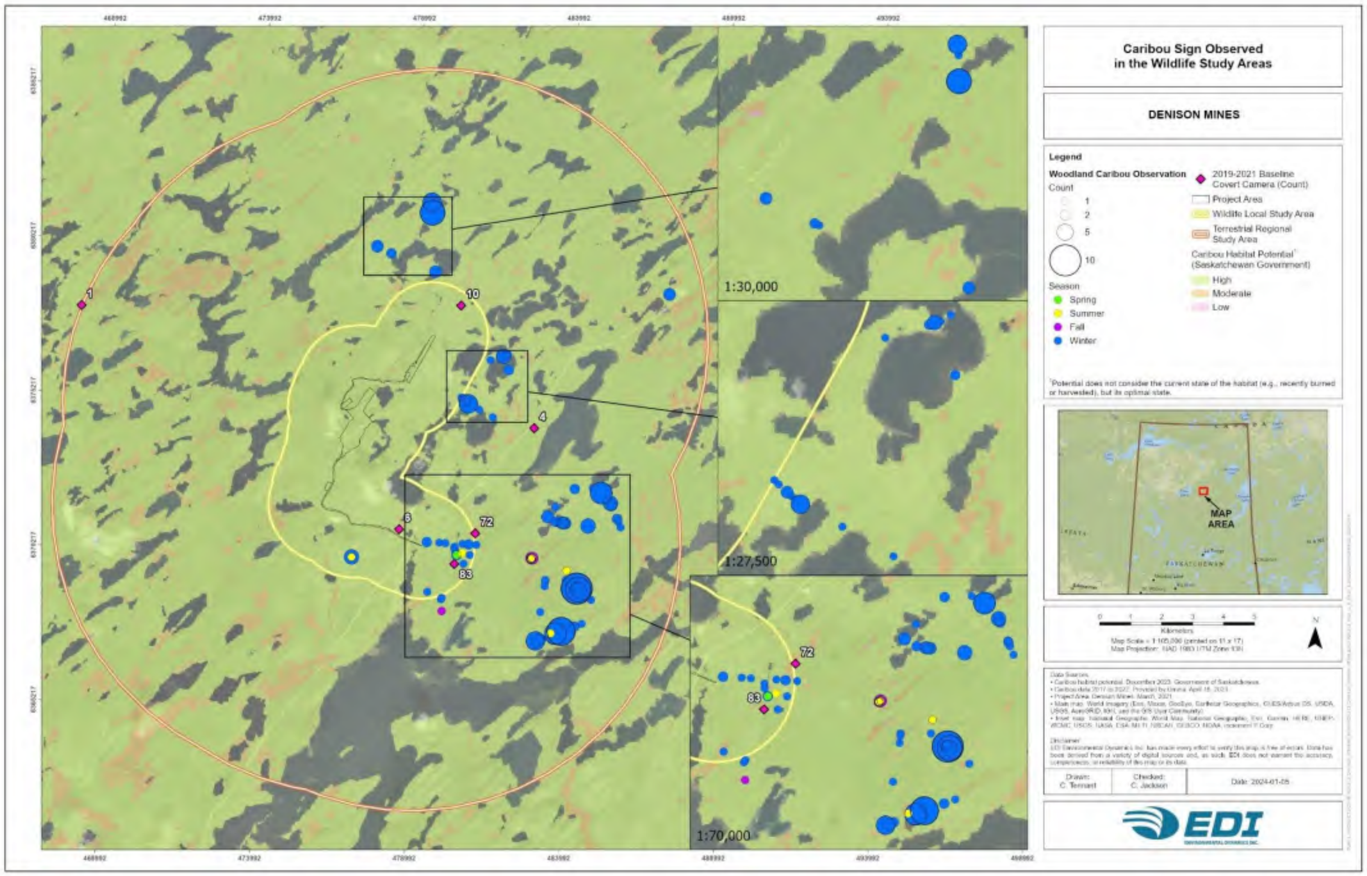


Figure 2-2: Caribou Sign Observed in the Wildlife Study Areas

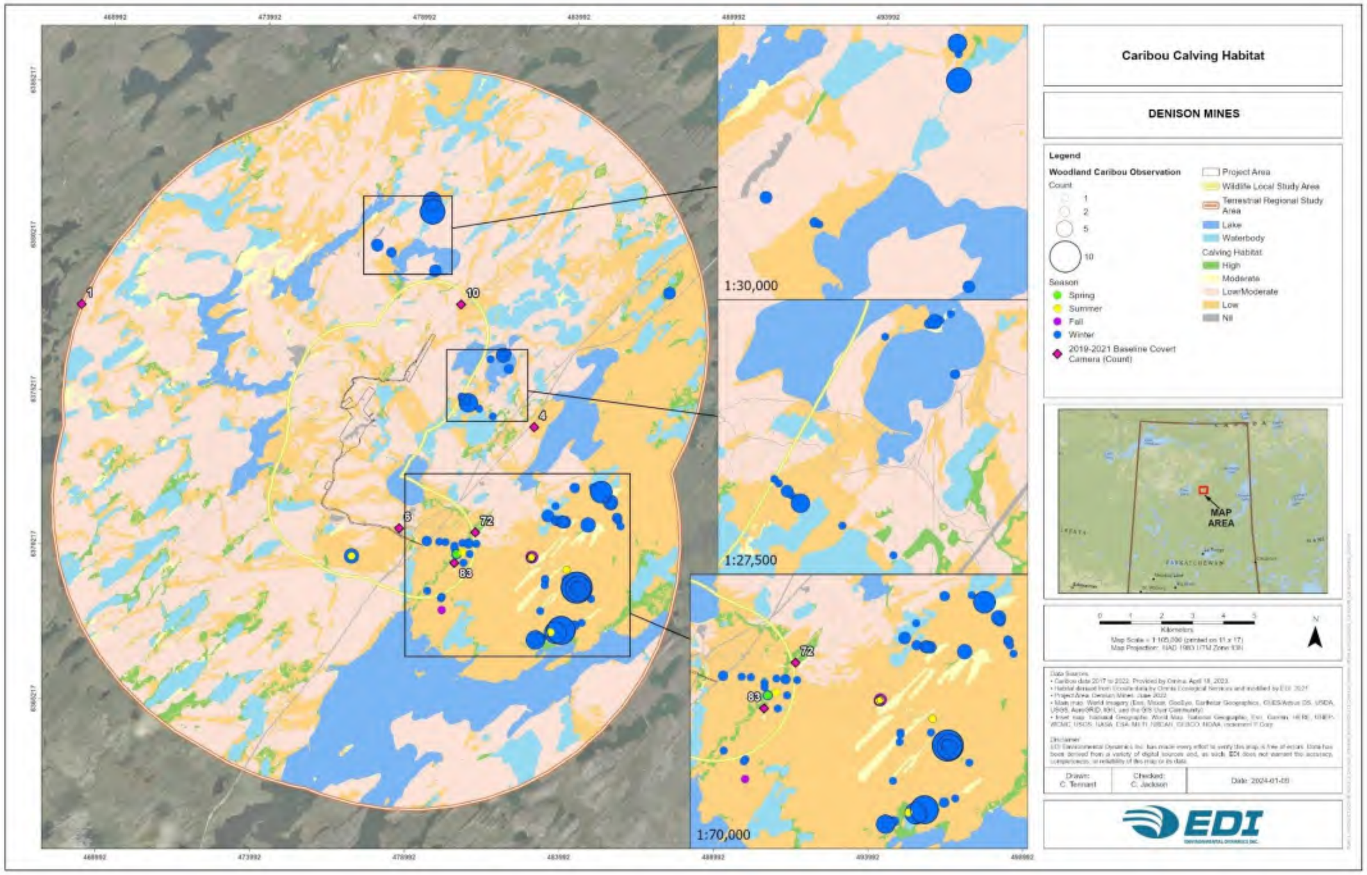


Figure 2-3: Caribou Calving Habitat Potential within the Wildlife Study Areas

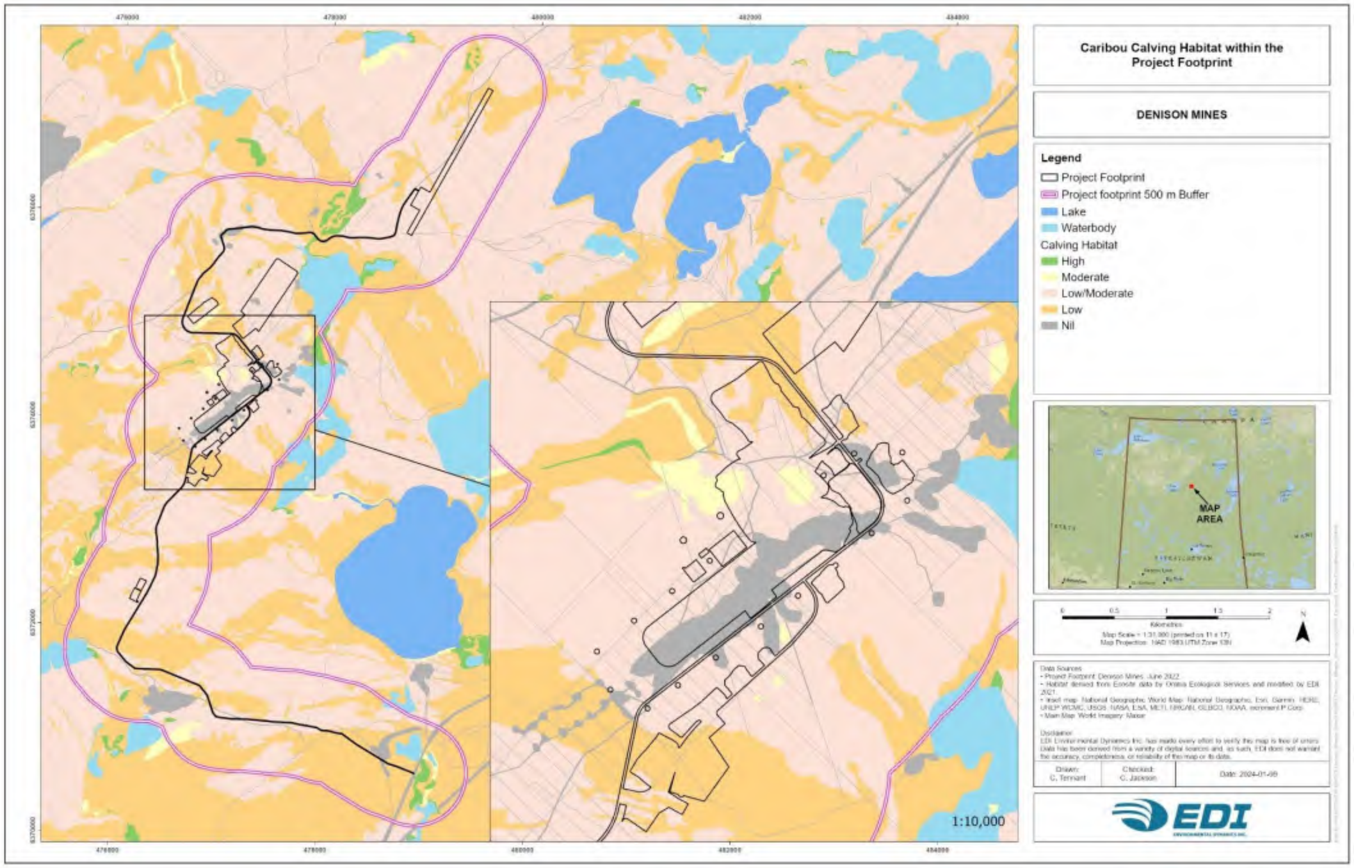


Figure 2-4: Caribou Calving Habitat Potential within the Project Footprint

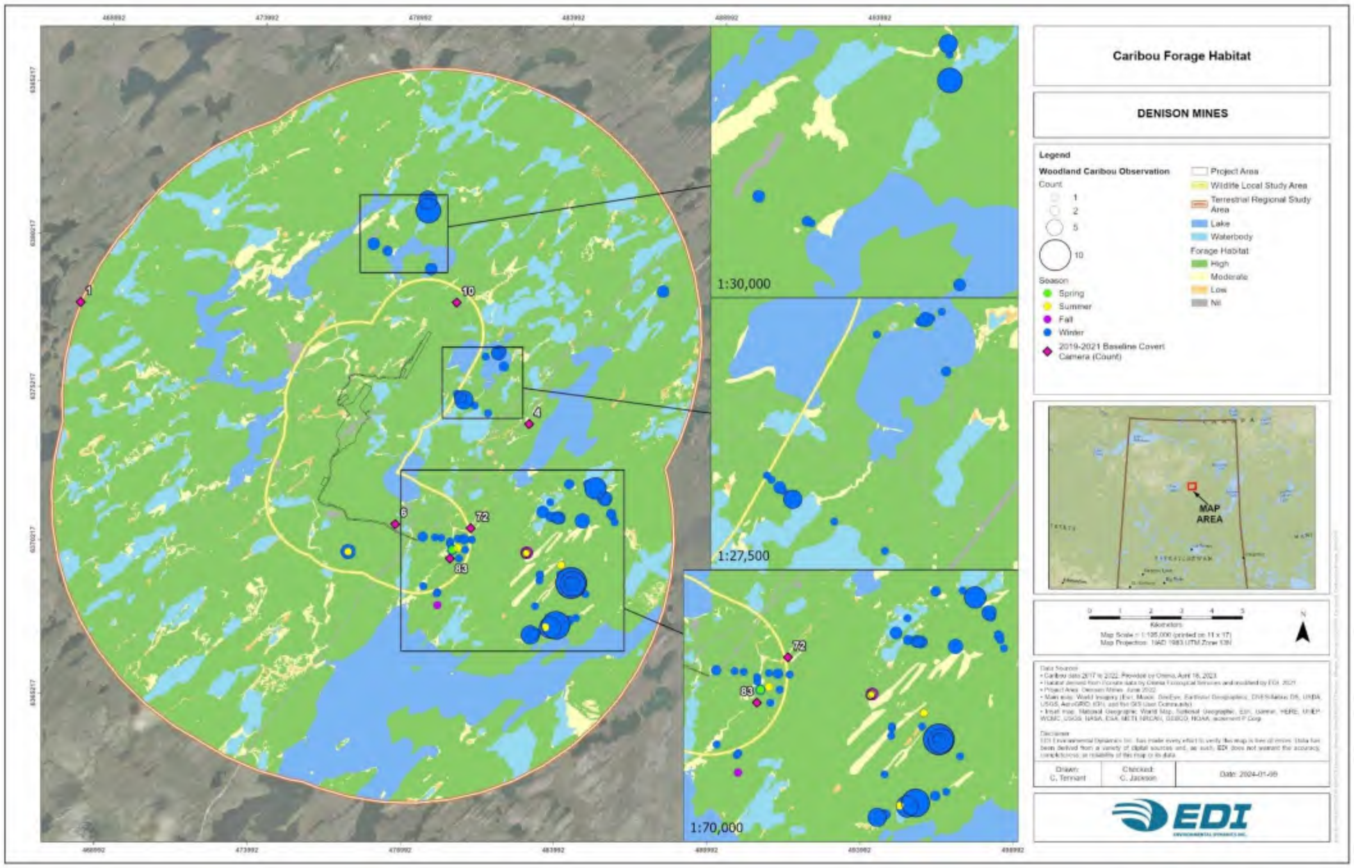


Figure 2-5: Caribou Forage Habitat Potential within the Wildlife Study Areas

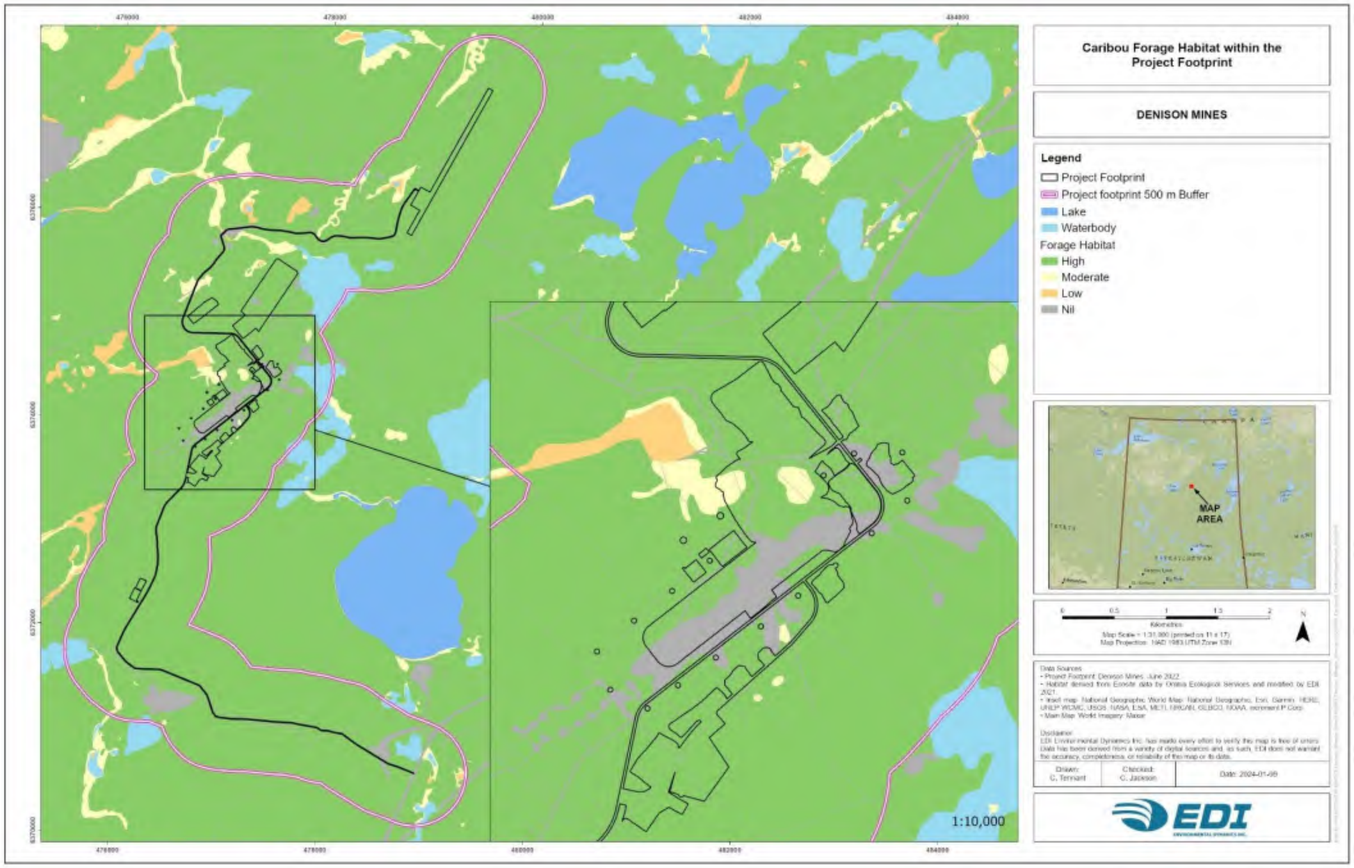


Figure 2-6: Caribou Forage Habitat Potential within the Project Footprint

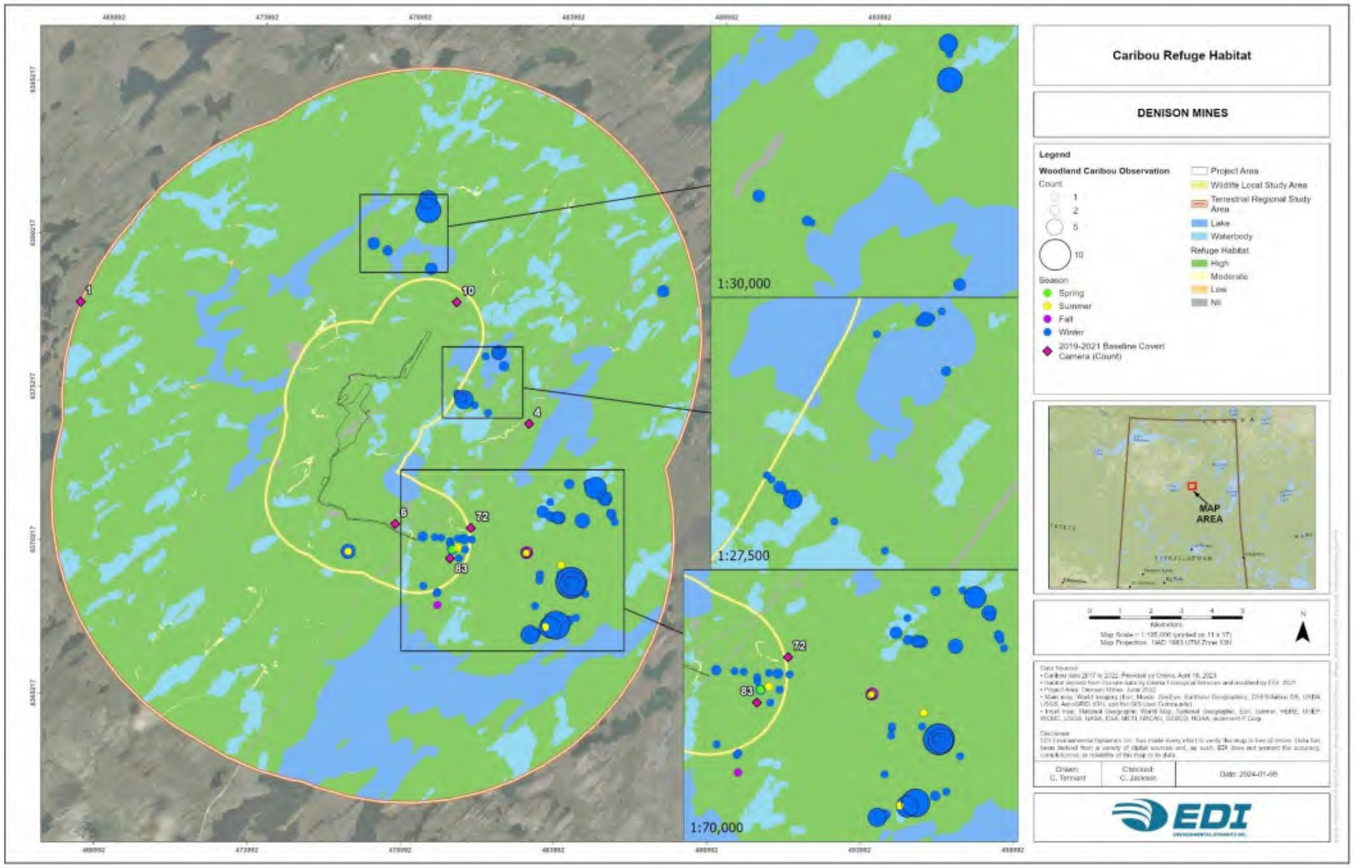


Figure 2-7: Caribou Refuge Habitat Potential within the Wildlife Study Areas

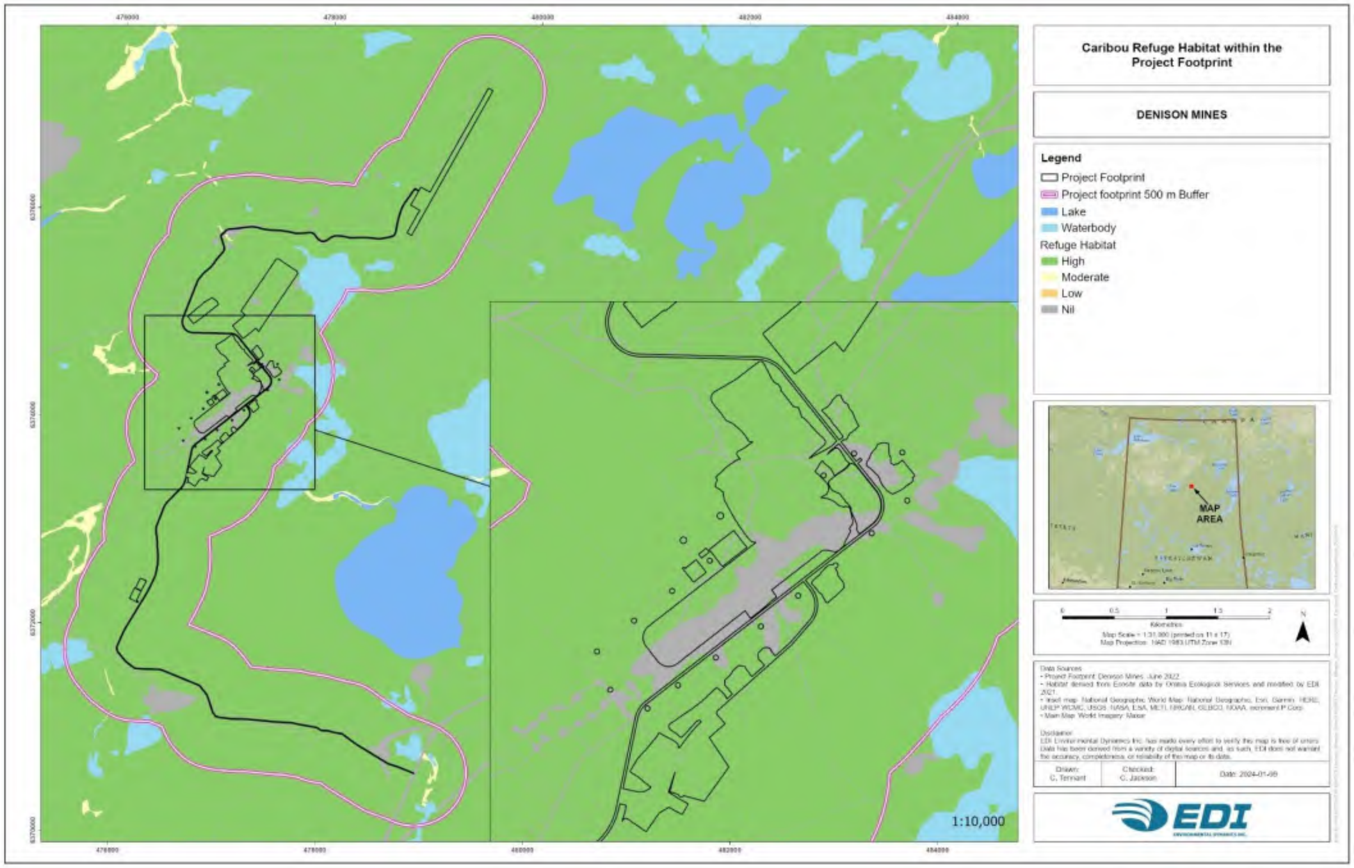


Figure 2-8: Caribou Refuge Habitat Potential within the Project Footprint

2.2 Migratory Birds

The following information is intended to provide additional context to the responses provided in the IR tracking sheet, particularly in regard to the following: IR-159 and IR-162. For IR-160, IR-164, IR-169, and IR-170, the updates were made in Section 9 of the EIS.

Number	IR-159_WRP
Dept.	ECCC
Project effects link	Migratory Birds
Reference to EIS, appendices, or supporting documentation	9.4.3.2.3 Baseline Studies – Migratory Songbirds Appendix 9-B, Section 2.10.2, Results
Context and Rationale	**Context and Rationale:** Information presented in the draft EIS is insufficient to accurately predict Project impacts to breeding birds. The Proponent collected a single year of breeding songbird point counts and aerial waterfowl surveys (including avian species at risk). A single year of surveys in which birds may be unusually scarce or abundant could severely compromise interpretation of post- construction monitoring data. Additionally, data presented in the draft EIS is from 2017 and ECCC advises that more recent data is needed for a comprehensive baseline to verify Project impacts. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal avian Modelling project contain information on avian densities and avian species at risk that could supplement field data. The national standard for major projects recommends a minimum of two years of field surveys to be provided, so that temporal variability can be considered when comparing post-construction against baseline records and other available data. **Updated Rationale:** ECCC recommends that for major projects, a minimum of two years of field surveys should be provided so that temporal variability can be considered when comparing post-construction against baseline records and other available data. More recent data is needed. due to landscape changes that may have occurred since 2017 as well as cumulative effects that have occurred in that time. Additionally, if there was an unusually high population density of birds in 2017 due to extraneous circumstances, Project effects may be attributed to a non-existent decline in the population when the discrepancy can be due to natural variability. A more recent baseline will account for interannual variation and any regional effects and will allow for a more accurate review of mitigation and follow-up measures. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal Avian Modelling project contain information on avian densities and avian species at risk that could supplement field data.
Information Requirement	Supplement breeding bird point count data and aerial waterfowl data collected during 2017 with additional pre-construction field data or existing post-2017 data/modelling to provide a comprehensive baseline that can be used to verify Project impacts during construction and operational phases.

Response:

The EA used an accepted, proven habitat-based EA approach to address the variability of population surveys. Further, the EA used all available, recent/relevant survey data collected in appropriately timed and executed methodologies, including TK. However, supplemental surveys would not be expected to provide any information/data that would affect or alter the findings of the habitat-based EA.

The supplemental avian data received from records from the Saskatchewan Breeding Bird Atlas downloaded through the NatureCounts web portal (Saskatchewan Breeding Bird Atlas 2017), which also includes data received as part of the Saskatchewan Boreal Monitoring Strategy program. These data represent bird observations from 24-point counts conducted on June 7 and June 9, 2019. Nine point-counts are located approximately 6.5 km east of the Project footprint, the majority of which are located in the BS3 ecosite type; 15 point-counts are located approximately 7.7 km south of the Project footprint, the majority of which are located in the BS3/BS7 ecosite type. During this survey effort, 24 migratory songbird species were documented. A summary of the total number of individuals observed for each species across all plots are presented below.

Common Name	Scientific Name	Number of Individuals Observed
American Robin	*Turdus migratorius*	8
Bald Eagle	*Haliaeetus leucocephalus*	1
Canada Goose	*Branta canadensis*	50
Canada Jay	*Perisoreus canadensis*	10
Chipping Sparrow	*Spizella passerina*	19
Common Loon	*Gavia immer*	2
Common Tern	*Sterna hirundo*	1
Dark-eyed Junco	*Junco hyemalis*	10
Greater Yellowlegs	*Tringa melanoleuca*	1
Hermit Thrush	*Catharus guttatus*	11
Lincoln's Sparrow	*Melospiza lincolnii*	8
Orange-crowned Warbler	*Leiothlypis celata*	2
Palm Warbler	*Setophaga palmarum*	10
Red-breasted Merganser	*Mergus serrator*	2
Ruby-crowned Kinglet	*Corthylio calendula*	14
Savannah Sparrow	*Passerculus sandwichensis*	1
Solitary Sandpiper	*Tringa solitaria*	0
Song Sparrow	*Melospiza melodia*	2
Spotted Sandpiper	*Actitis macularius*	1

Common Name	Scientific Name	Number of Individuals Observed
White-crowned Sparrow	*Zonotrichia leucophrys*	6
White-throated Sparrow	*Zonotrichia albicollis*	24
White-winged Crossbill	*Loxia leucoptera*	40
Yellow Warbler	*Setophaga petechia*	3
Yellow-rumped Warbler	*Setophaga coronata*	12

Number	IR-162_WRP
Dept.	ECCC
Project effects link	Migratory birds
Reference to EIS, appendices, or supporting documentation	Section 9.4.3.3, Bird Species at Risk
Context and Rationale	**Context and Rationale:** Not all avian species at risk present in the study area were included as Key Indicators in the avian species at risk (SAR) valued component (VC). Barn swallow and horned grebe were recorded in the study area, but not included as VCs. Additionally, bank swallow may inhabit the Project area. Impacts to Species at Risk Act Schedule 1 listed species need to be identified, avoided, lessened and monitored. In Section 9.4.3.3. the Proponent states: "It is acknowledged that the listed Barn Swallow (Hirundo rustica) and Horned Grebe (Podiceps auratus) could potentially occur in the Terrestrial RSA. Incidental observations occurred during the baseline studies (Appendix 9-B). To focus the effects assessment on a few key species (described in the following) it was decided to use Olive-sided Flycatcher and Common Nighthawk to represent Barn Swallow as well, and to use Yellow Rail and Rusty Blackbird as a substitute for Horned Grebe. Unlike Horned Grebe, Yellow Rail and Rusty Blackbird are also listed provincially." Barn swallow, bank swallow and horned grebe may have different nesting habitat requirements than the representative species discussed in the draft EIS. An explanation of how differing species are representative of one another is required, or if an explanation cannot be provided, the species should be assessed individually. **Updated Rationale:** The management plans for these three species demonstrate the variability in their habitat selection. The Management Plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada (Environment Canada, 2013) states "Yellow Rails inhabit shallow wetlands and other wet areas with grass-like vegetation. They breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes (Bookhout 1995, Alvo and Robert

	1999, COSEWIC 2009), shallow prairie wetlands, and wet montane meadows (Peabody 1922, Sherrington 1994, Popper and Stern 2000). “ The Management Plan for the Rusty blackbird (*Euphagus carolinus*) in Canada (Environment Canada 2015), states: “Rusty Blackbirds tend to select breeding sites with a combination of freshwater bodies with shallow water and emergent vegetation for foraging that are adjacent to wetlands with conifers or tall shrubs with cover for nesting (Matsuoka et al. 2010a, Matsuoka et al. 2010b, Greenberg et al. 2011).” The Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada (ECCC, 2022) states: “The Horned Grebe breeds in small (generally 0.5 to 2 ha, but ranging from 0.24 to 18.2 ha), shallow (at least 20 cm deep, but on average 40 cm), and usually fishless, perennial wetlands, but they can also nest on larger lakes with shallow edges and sufficient emergent vegetation. Breeding sites usually contain at least 40% open water with beds of emergent vegetation, such as sedges (Carex spp.), rushes (Juncus spp.) and cattails (Typha spp.) (Faaborg 1976, Kuczynski et al. 2012, Routhier 2012, Stedman 2018).” Due to differing habitat selection and use, ECCC recommends that each selected VC is given an individual assessment with specific mitigation measures. This will allow for a more accurate review of the chosen mitigation measures.
Information Requirement	Explain how nesting habitat requirements of barn swallow is represented by common nighthawk and olive-sided flycatcher as a VC or assess individually each SAR that overlaps with the Project and is likely to be affected. Explain how nesting habitat requirements of horned grebe are represented by yellow rail and rusty blackbird as a VC, or assess individually each SAR that overlaps with the Project and is likely to be affected. Assess individually each SAR that overlaps with the Project and is likely to be affected. See also related IRs: IR-160 and IR-161.

Response:

As per accepted, proven EA methodology, Denison used a habitat-based methodology to determine the Project’s effects on VCs, using an accepted Key Indicator methodology, and not every species, to focus and inform the EA.

Nesting habitat requirements of the horned grebe are similar at a landscape level to those represented by yellow rail and rusty blackbird in that they are typically found associated with northern waterbodies and watercourses with various forms of emergent vegetation. At a site-specific scale, there are subtle differences in nesting habitat requirements, as summarized previously by ECCC in the Context and Rationale response.

Given the nesting habitat requirements of these species, the available habitat types within the Denison study areas (e.g., Project Area, Wildlife Local Study Area, and the Terrestrial Regional Study Area) for use by these species include the following ecosite types: Labrador tea shrubby bog (BS18), graminoid bog (BS 19), graminoid bog/graminoid fen (BS19/BS24), open bog (BS 20), leatherleaf shrubby poor fen (BS22), willow shrubby rich fen (BS23), graminoid fen (BS24), open fen (BS25), and waterbodies and lakes. The habitat-based methodology of the environmental assessment adequately and appropriately addresses effects on these habitat types and the associated migratory bird species that could potentially use these habitat types. Further assessment of each species would not be expected to affect or alter the findings of the habitat-based environmental assessment.

The characterization of the alteration and/or habitat loss residual effect considers the Project effects on available habitat used by these three migratory breeding birds within the Wildlife LSA and Terrestrial RSA. As outlined in Table 9.3-18, 0.05% of the Project Area, 11.5% of the Wildlife LSA, and 24.2% of the Terrestrial RSA provide habitat types that are potentially available to these three migratory breeding bird species.

Direct habitat loss is calculated as the area of available habitat lost due to site clearing within the Project Area. Direct habitat loss has been mitigated by reducing the size of the Project Area to the extent practicable during Project design; however, available habitat is still predicted to be cleared during Construction. In the Project Area, 0.09 ha or 100% of available habitat is assumed to be removed and will not be available to these species for the duration of the Project (Table 9.3-19). This considers that the Project Area has previously been disturbed (i.e., almost 15% of the Project Area is disturbed by anthropogenic activities) and includes only 0.02 ha (0.01%) of landscape covered by waterbodies. This relates to a removal of 0.02% of available habitat within the Wildlife LSA and 0.001% in the Terrestrial RSA.

An additional 93.9 ha (17.0%) of available habitat in the Wildlife LSA may experience habitat alteration resulting from indirect Project effects, such as sensory disturbance (Table 9.3-19). This area of indirect effect represents 1.0% of available habitat in the Terrestrial RSA that may experience habitat alteration.

2.3 Species At Risk – *Myotis* Species

The following information is intended to provide additional context to the responses provided in the IR responses to for IR-174 associated with both the Round 2 and Round 3 responses.

Acoustic bat surveys were completed between July 22 and 23, 2019 with 61 survey points sampled across five ecosite types (refer to Appendix 9-B). The location of the survey points, species detected, and frequency of detections are included in Figure 2-9.

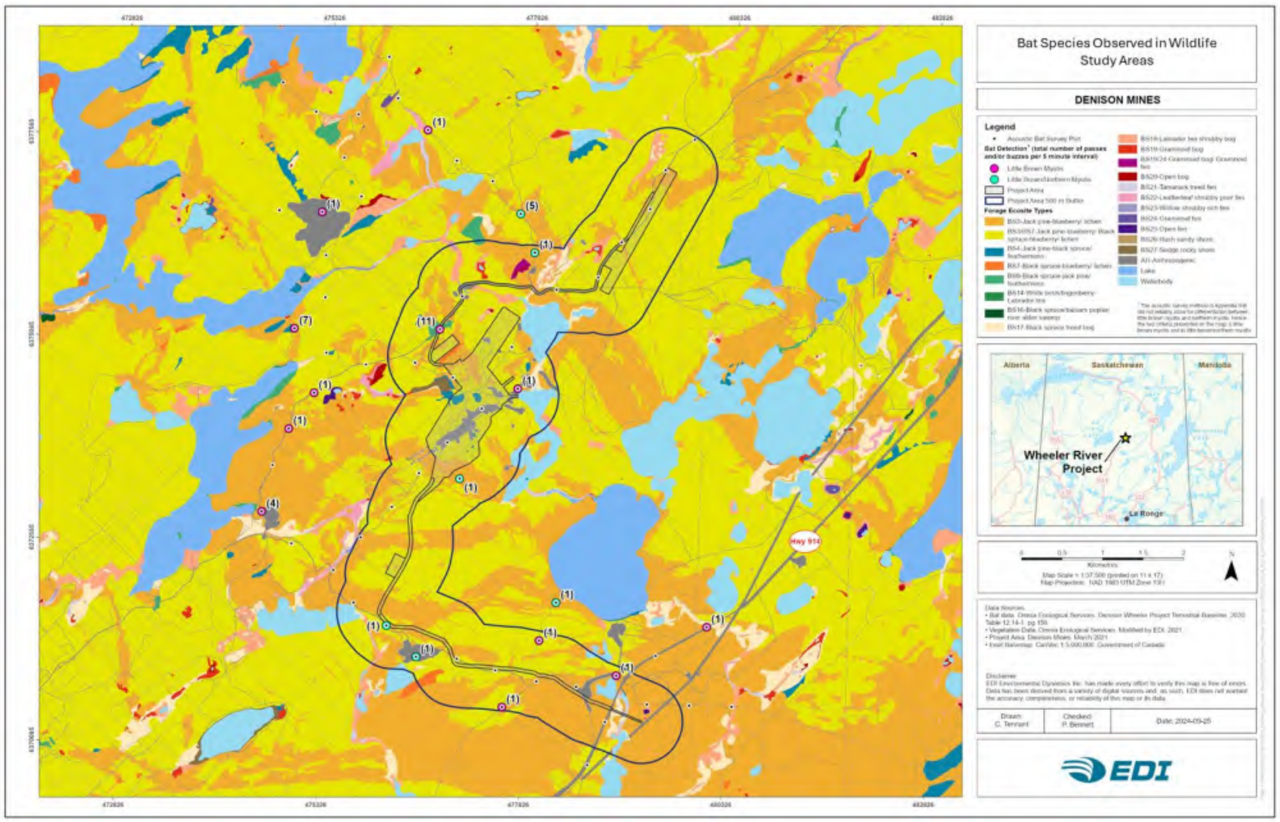
As noted in Appendix 9-D, habitat for the little brown myotis is composed of (1) overwintering hibernacula that are sufficiently cool and humid and (2) summering areas that provide foraging areas and suitable locations for roosting and maternity colonies (COSEWIC 2013). Hibernacula and maternity sites are reported as being the main limiting habitat features for this species (COSEWIC 2013), and this, as described below, is consistent with conditions at the Project site and surrounding area.

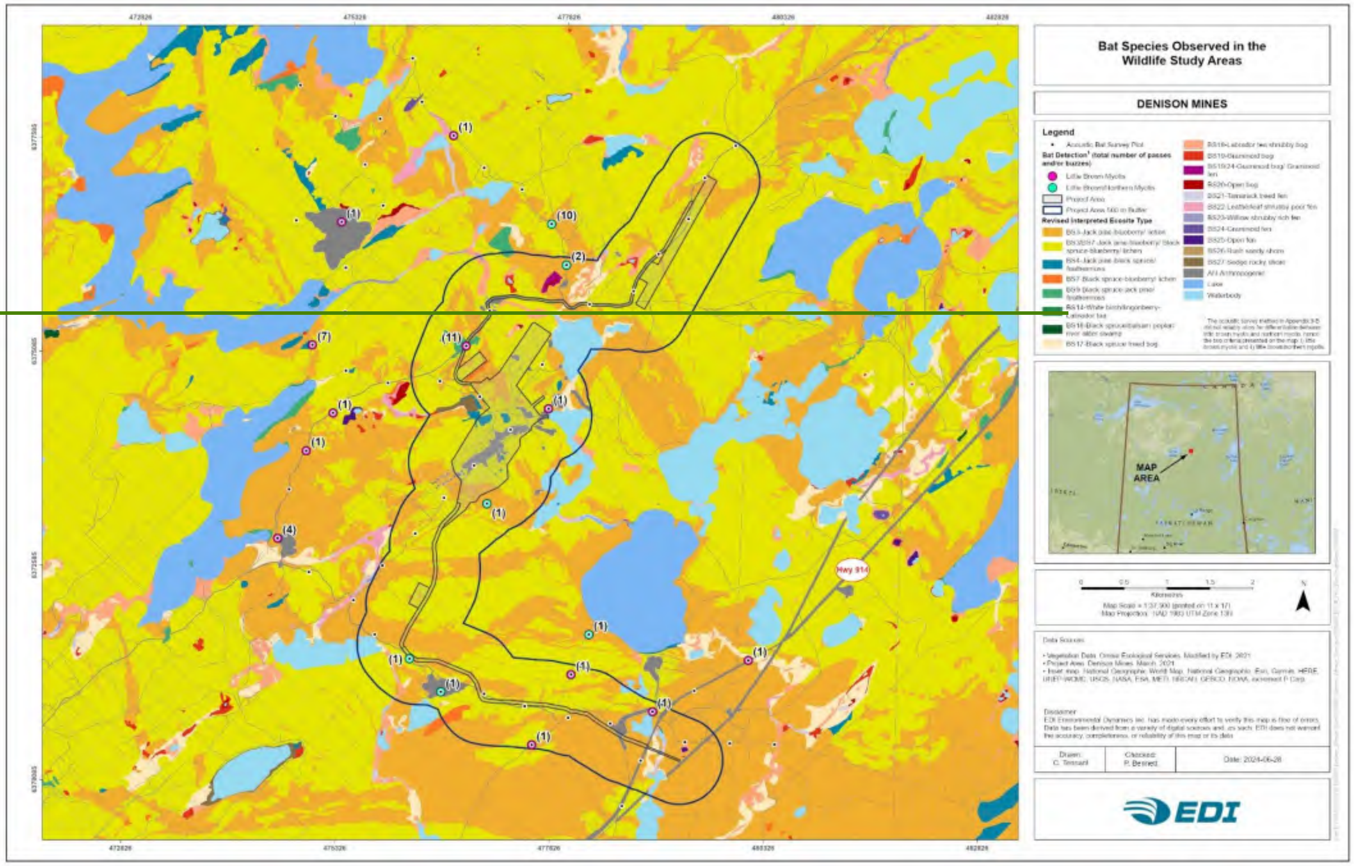
Hibernacula occur in parts of caves, mines (openings to surface for ramps and raises for example), and buildings that have stable and specific temperature (-4 to 13°C) and humidity (>80%) conditions (COSEWIC 2013). Based on existing environment information presented in the EIS including the terrain and vegetation and ecosystem existing environment sections, there are no hibernacula anticipated in the Project Area (i.e., caves, mines, buildings with stable and specific temperatures per COSEWIC 2013). Terrain is low relief due to flat-lying sandstone and almost continuous cover of sandy glacial deposits (i.e., surface is predominately sand textured and there are no rocky outcrops or bedrock at surface for cave habitats); there are no man-made structures (e.g., mine openings or buildings) in the Project Area. As noted in the EIS, the terrain and vegetation communities are fairly uniform throughout the study areas and the habitat considerations in the Project Area are considered representative of the landscape in the wildlife LSA and RSA.

Maternity sites can occur in large-diameter trees, rock crevices, buildings, and bat houses that offer warm and relatively stable microclimate conditions that allow females to avoid going into torpor so they can focus on caring for their young (COSEWIC 2013a, Slough and Jung 2020). As highlighted above, since there are no rock crevices, buildings, or bat houses in the Project Area, a consideration for maternal roost potential was focused on the areas where larger diameter trees may be present.

Existing ecosite information was reviewed and ecosites with higher potential for maternity roosts (i.e., larger diameter trees) were selected. The ecosites with the potential for larger diameter trees are shown in Figure 2-10 below, and include ecosites RF1 (regenerating forest >5m tall; per Appendix 9-B), BS3 jack pine/blueberry/lichen, BS4 jack pine – black spruce/feathermoss, BS7 black spruce/blueberry/lichen, BS9 black spruce – jack pine/feathermoss, BS14 white birch/lingonberry – labrador tea, BS16 black spruce/ balsam poplar/river alder swamp, BS17 black spruce treed bog, and BS21 tamarack treed fen. While these ecosites were selected for the *potential* to have larger diameter trees, it is important to note that the majority of these ecosites have trees with diameter at breast height <10 cm. Refer to Appendix 9-B for representative photos of the selected ecosites.

Based on this conservative mapping exercise, the Project Area contains small areas of suitable potential maternal roost habitat. The total Project Area is around 170 ha and potential bat maternal roost ecosites represent less than 49 ha, when as noted above it is assumed that the ecosites identified above provide trees suitable for maternity roosts across their entirety. As noted in the EIS, the terrain and vegetation communities are fairly uniform throughout the study areas and the habitat considerations in the Project Area are considered representative of the landscape in the wildlife LSA and RSA.


Bat Species Observed in Wildlife Study Areas
DENISON MINES
Legend
Bat Detection[1] (total number of passes and/or buzzes per 5 minute interval)
Forage Ecosite Types
Alberta
Saskatchewan
Manitoba
Wheeler River Project
La Ronge
Hwy 914
Drawn: C. Tennant
Checked: P. Bennett
EDI



Bat Species Observed in the Wildlife Study Areas
DENISON MINES
Legend
Bat Detection[1] (total number of passes and/or buzzes)
Revised Interpreted Ecosite Type
MAP AREA
EDI

Figure 2-9: Bat Species Observed within the Wildlife Study Areas

Commented [A1]: Update the dots

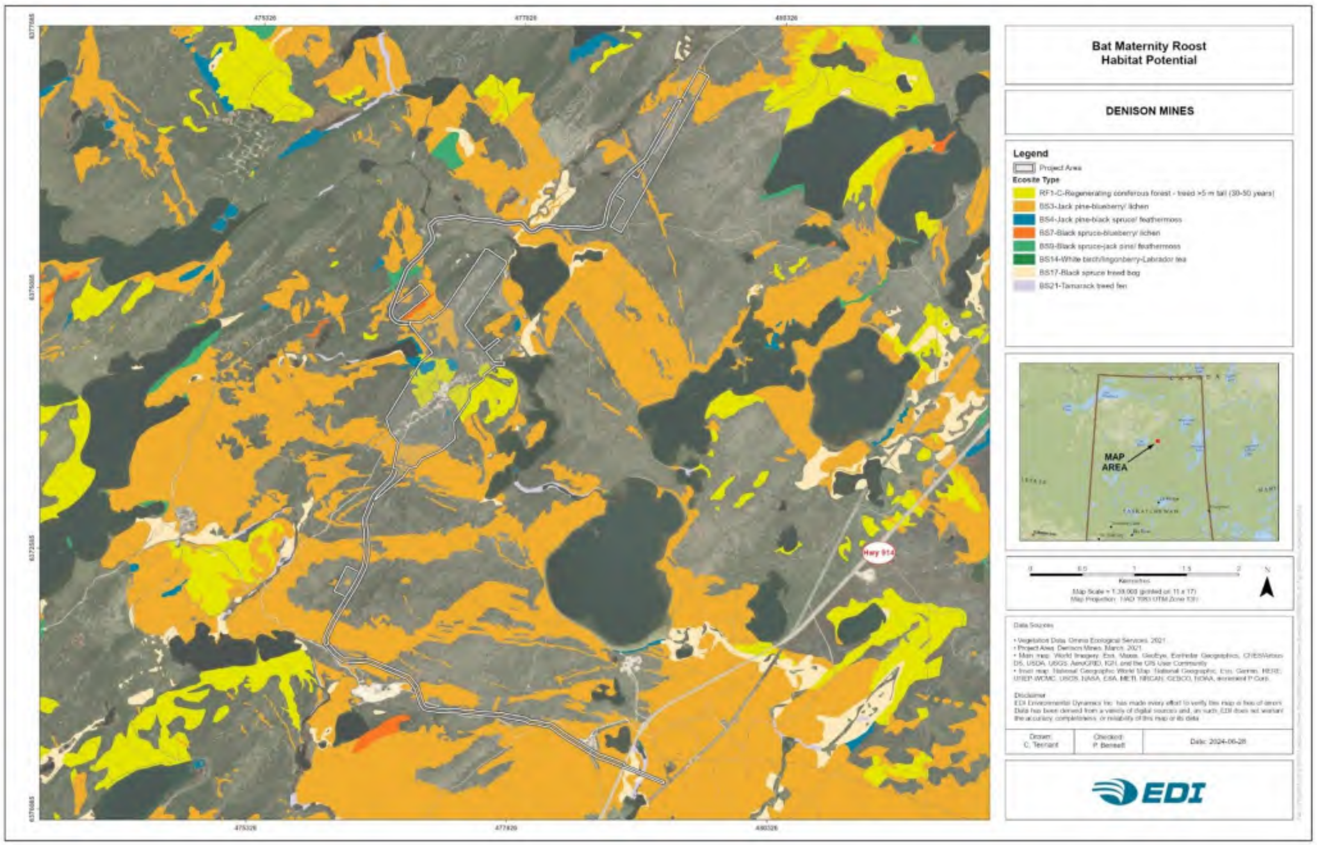


Figure 2-10: Bat Maternity Roost Habitat Potential

3 References

COSEWIC. 2013. COSEWIC assessment and status report on the Little Brown Myotis *Myotis lucifugus*, Northern Myotis *Myotis septentrionalis*, and Tri-colored Bat *Perimyotis subflavus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. xxiv + 93 pp.

Environment and Climate Change Canada (ECCC). 2020*. Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. xiii + 143pp.

Saskatchewan Breeding Bird Atlas. 2017. Data accessed from NatureCounts, a node of the Avian Knowledge Network, Birds Canada. (http://www.naturecounts.ca/). Accessed January 15, 2024.

Saskatchewan Ministry of Environment (SK MOE). 2019c. *Range Plan for Woodland Caribou in Saskatchewan – Boreal Plain Ecozone - SK2 Central Caribou Administration Unit*. July 2019. 90 pp.

Saskatchewan Ministry of Environment (SK MOE). 2023. *SK1 habitat potential raster data for woodland caribou in Saskatchewan*. Email from Lisa Stuart, GIS analyst, Saskatchewan Ministry of Environment. December 8, 2023 email.

Slough, B.G. and Jung, T.S. 2020. Little Brown Bats Utilize Multiple Maternity Roosts Within Foraging Areas: Implications for Identifying Summer Habitat. Journal of Fish and Wildlife Management 11(1):311–320.

Wheeler River Project

Public Notice - Final Results of the Federal Indigenous Team Technical Review of the Wheeler River Project Submission

November 22, 2024: On November 20th, the Canadian Nuclear Safety Commission (CNSC) completed their technical review of Denison Mines Corp.'s (Denison) responses to outstanding Information Requests (IRs) for the Wheeler River environmental impacts statement (EIS) technical review. CNSC has found that the information fully addresses the regulatory requirements for the environmental assessment (EA). All responses to IRs are now deemed as accepted.

The following documents have been posted:

- Cover Letter - CNSC to Denison - Results of the Federal Indigenous Technical Review of the Wheeler River Project Submission (2024-11-20)
- Annex 1 – Results of the Federal Indigenous Technical Review of the Wheeler River Project – Resolved Information Requests for the Wheeler River Project Submission (2024-10-11)
- Wheeler River – October 30th Supplementary Submission for IR-174 from Denison - Memo: Omnia Ecological Services, Denison Wheeler River 2024 Replicate Bat Surveys (2024-10-30)
- Wheeler River – November 13th Supplementary Submission from Denison for IR-114 and IR-174 (2024-11-13)
- Wheeler River – November 19th Supplementary Submission from Denison for IR-114 (2024-11-19)

CNSC staff expect Denison to submit a Final EIS package, including revised responses to the Consolidated Comments from Indigenous Nations and Communities and the Public on the Wheeler River Project. Once received, the submission will undergo a 30-day review by CNSC staff to ensure all documents have been updated accordingly and that all comments from Indigenous Nations and Communities and members of the public have been addressed in an acceptable manner.

Once CNSC staff deems the submission as Final, staff will notify Denison that the EIS has been accepted and will proceed with developing the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) EA Report summarizing the results of the technical review and staff's recommendations to the Commission.

Document reference number: 127

Date modified: 2024-11-22

e-Doc: 7410519

November 20, 2024

Brianne England
Regulatory Manager
Denison Mines Corp.
bengland@denisonmines.com

Subject: Outcome of the Federal-Indigenous Review Team technical review of the October 18, 2024 Responses to Information Requests for the proposed Wheeler River Project

Dear Ms. England,

On October 18, 2024, Denison Mines Corp. (Denison) submitted revised responses to Information Requests (IRs), including Appendix A with supporting information, and Advice to the Proponent comments for the proposed Wheeler River Project [1-2]. On October 30, 2024, CNSC staff found the submission to contain the required information to proceed with the Federal-Indigenous Review Team (FIRT) technical review [3].

Extended Review Period

CNSC staff aimed to complete the FIRT's initial review of Denison's responses to IRs by November 15, 2024. At the request of CNSC, Denison submitted additional information to CNSC staff on October 30th [4], November 13th [5] and again on November 19th [6] to resolve these IRs. For transparency purposes, these submissions will be posted to the Canadian Impact Assessment Registry.

Outcome of the EIS Technical Review

Following the technical review, the FIRT has found that the information provided by Denison addresses the regulatory requirements for the environmental assessment (EA). All responses to IRs are now deemed accepted. A table with the status of the FIRT's review of IRs is provided in Annex 1[7].

Expectations and Next Steps

On November 21, 2024 or shortly thereafter, CNSC staff will post these review results as well as the additional information submitted by Denison on the Canadian Impact Assessment Registry for the proposed Wheeler River Project (Reference number: 80178).

CNSC staff expect Denison to submit a Final EIS package, including updated technical support documents, as well as an updated Commitments Report and an updated Indigenous Engagement Report (IER). Once received, the submission will undergo a 30-day review by CNSC staff to ensure all documents have been updated accordingly.

During this time, CNSC staff will also review the responses to comments from Indigenous Nations and communities and members of the public, to ensure these have been addressed in an acceptable manner. If any of Denison's responses to these comments have changed since the July 2024 submission [8], Denison is expected to submit revised tables that reflect these revisions in track changes, along with the final EIS package. CNSC staff will review the responses provided in the comment tables to ensure they are consistent with the accepted responses to IRs.

If CNSC staff deem Denison's Final EIS submission as acceptable, staff will notify Denison that the EIS has been accepted as Final and that CNSC staff will draft the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) EA Report summarizing the results of the technical review and staff's recommendations to the Commission.

Please note, and as previously mentioned, both the Commitments Report and IER are evergreen documents that should continue to be updated over the remainder of the regulatory review process, and, after the public hearings and Commission decisions, if the project is approved.

Should you have any questions, please do not hesitate to contact me, directly by phone at 343-540-6213 or by email at Jessica.Way@cnsc-ccsn.cg.ca.

Sincerely,

-Original signed by-

Jessica Way
Environmental Review Specialist
Environmental Review Division

c.c.: CNSC: D. Beaton, L. Sigouin, N. Kwamena, P. Burton, A. Levine, K. Gorzkowski, R. Froess, R. Noakes
Denison: K. Himbeault, J. Switzer, C. Inglis-McQuay, R. Nagel

References:

[1] Letter, B. England (Denison) to J. Way (CNSC), *Denison Response to CNSC Comments-Wheeler River EA Submission #5*, October 18, 2024 (e-Doc 7386973)

[2] Email, B. England (Denison) to J. Way (CNSC), *Advice to Proponent Table-Wheeler River EA Submission #5*, October 24, 2024 (e-Doc 7395132)

[3] Letter, J. Way (CNSC) to B. England (Denison), *Outcome of CNSC Staff Completeness Check of the October 18, 2024 Responses to Federal-Indigenous Review Team Information Requests for the Wheeler River Project*, October 30, 2024 (e-Doc 7386982)

[4] Email, B. England (Denison) to J. Way (CNSC), *Memo: Omnia Ecological Services, Denison Wheeler River 2024 Replicate Bat Surveys*, October 30, 2024 (e-Doc 7410703)

[5] Email, J. Switzer (Denison) to N. Kwamena (CNSC), *Wheeler River EIS - clarification for Round 4 - IR 114 and 174*, November 13, 2024 (e-Doc 7410705)

[6] Email, B. England (Denison) to J. Way (CNSC), *IR-114*, November 19, 2024 (e-Doc 7412213)

[7] Annex 6, Federal and Indigenous Review Team, *Wheeler River Project – Information Requests – Submission #4*, November 20, 2024 (e-doc 7389398)

[8] Letter, J. Switzer (Denison) to J. Way (CNSC), *Denison's Completion of Responses to the Consolidated Comments from Indigenous Nations and Communities and the Public Comments*, July 17, 2024 (e-doc 7325554)

Annex 1

Federal Indigenous Review Team (FIRT) Review of Denison Responses to Information Requests (IRs) and Supporting Documents Received October 18, 2024

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-01	-	English River First Nation (ERFN)	Current use of lands and resources for traditional purposes	General	**Context:** Denison has not gone far enough in terms of learning from and incorporating information from ERFN provided in the *Traditional Knowledge Study and Health and Socio-Economic Study Report*. It appears Denison put a disproportionate amount of reliance on the views and interests of one ERFN land user. While we applaud the efforts of Denison to seek feedback from ERFN land users directly and to work closely with such land users, ERFN's rights and interests in the region of the Project (and the potential of the Project to adversely impact such rights and interests) extend well beyond that of just one land user. **Rationale**: It is important for the Proponent and regulators to understand that while the rights and interests of individual ERFN members are important to consider, the Elders and elected leaders of ERFN represent the collective rights and interests of ERFN as a Nation. The results of the scoping study indicated that ERFN holds firmly established rights to the area where the planned project is located. Numerous studies conducted over several decades have examined ERFN's relationship and connection to land use and occupancy of the region where the proposed mine is located from traditional land use, subsistence harvesting, ecological, and sociocultural and economic perspective.	The draft EIS should be revised to reflect the totality of ERFN TK and land use information. Denison and CNSC must continue to work with ERFN to ensure that impacts on ERFN rights are appropriately and fully considered, mitigated, and accommodated.		Accepted
IR-02	-	Canadian Nuclear Safety Commission (CNSC)	Mitigation Measures	General Appendix 16-C	**Context:** Denison's 2019 Wheeler River Terms of Reference states: "The EIA will also discuss the monitoring programs required to demonstrate regulatory compliance and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders." The CNSC's Generic Guidelines for the Preparation of an Environmental Impact Statement (EIS), also state: "The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the Proponent intends to implement them and the environmental outcome the mitigation is designed to address. **Rationale:** The EIS and the Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information. It is not clear which monitoring programs will be employed to demonstrate regulatory compliance, and compliance with the commitments Denison has made to its Indigenous and non-Indigenous Stakeholders.	CNSC staff expect Denison to provide a comprehensive list of commitments along with the next version of the EIS, including any commitments made to Indigenous Nations and communities and other stakeholders (As committed in the Wheeler River Terms of reference, and as noted in the November 28th, 2022 email from CNSC staff to Denison: *Future Submission of a Commitments Table for Wheeler River EIS*).		Accepted
IR-03	-	CNSC	Site preparation	Section 1.3.2 Temporal Boundaries Appendix 10-A (ERA)	**Context:** The EIS and TSD-ERA provide assessment on the Project timeframe, including construction, operation, and decommissioning phases. **Rational**: The site preparation phase is not included in the timeframe (EIS and TSD-ERA). As per REGDOC 2.9.1, the sub-section 4.1.1 Complexity of the environmental risk assessment requirements states that "The applicant or Licensee shall identify facility characteristics and activities that may interact with the environment during the relevant phase of the facility or activity's lifecycle (for example, site preparation, construction, operation, and decommissioning."	Please provide an assessment of those facility characteristics and activities that may interact with the environment during the site preparation phase, along with an assessment of their potential effects, in order to reflect the entire lifecycle or provide a rationale for its exclusion.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-04	-	Environment and Climate Change Canada (ECCC)	Fish and fish habitat	Section 2, Project Description Section: Glossary	**Context:** The Proponent defines 'clean waste rock' as "Waste rock generated as sandstone cuttings and core from drilling activities associated with well and freeze hole development that does not have uranium containing materials". ECCC notes that the use of the term "Clean Waste Rock" could be misunderstood to mean that the waste rock is devoid of any contaminant. Even when the waste rock referred to as "clean waste rock" does not contain uranium materials, it could contain other metals or contaminants that could have adverse environmental effects. It is also not clear whether the "clean waste rock" is characterized for Acid Rock Drainage/Metal Leaching (ARD/ML) given that some portion of the basement rock is to be drilled out to anchor the freeze walls and may have ARD/ML potential. **Rationale:** The current definition of 'clean waste rock' in the draft EIS could lead to inappropriate handling and disposal if it is assumed to be devoid of any metals or other contaminants that might negatively affect the environment.	Provide a clear and more detailed definition of the term 'clean waste rock'.		Accepted
IR-05	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 2.2.1.2	**Context:** Water volumes for mud/diamond drilling is listed as minimal as the mud will be re-used. The mud is identified as a mixture of water, clay, and environmentally friendly polymers that clean out the cuttings and help to keep the drilling bit cool. **Rationale:** Although the mud for drilling will be re-used, there could be environmental impacts should there be an accident while drilling.	Please identify the components of the environmentally friendly polymers for the drilling mud and potential environmental impacts should the mud not be recovered.		Accepted
IR-06	-	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for Proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow", And that "The applicant or Licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems". Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.	including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.		
IR-06	IR-06-R1	CNSC	Geology and groundwater	Section 2.2.1.4, Wellfield for In Situ Recovery Mining	**Context:** This Section of the EIS indicates that a tracer test was completed in 2021 and a feasibility field test was initiated in 2022. No information from these tests is included in the EIS and no reporting timelines are provided. **Rationale:** Guidance from the IAEA (2001) and best practices highlighted by regulatory regimes in other countries such as the United States (IAEA, 2016) and Australia (Geoscience Australia, 2010) indicates that single and multi-well trial (feasibility) testing for mining and remediation techniques should be carried out before a licence for full-scale operations can be granted. This is part of the requirement for Proponents to demonstrate to government authorities that all potential risks have been considered during the life of operation and post-remediation of the mine. Additionally, Section 8.5.2 of the Generic EIS Guidelines states: "Units may be characterized as aquifers or aquitards, and unit descriptions should include their geochemical characteristics, vertical and lateral permeabilities, transport mechanism (diffusion versus advection) and the directions of groundwater flow", And that "The applicant or Licensee should present a conceptual and numerical hydrogeological model that discusses the hydrostratigraphy and groundwater flow systems". Outcomes from the tracer test inform model parameters such as effective porosity (see IR-78), dispersion, and dispersivity (see IR-96). The wellfield leach tests and remediation trails ultimately inform environmental monitoring during site activities, and the source term for the groundwater model. This source term represents the contaminants which flow through the desilicified zone into Whitefish Lake, which represents a source of contamination considered in the ERA. **References**: [1] International Atomic Energy Agency (IAEA). 2001. Manual of Acid in Site Leach Uranium Mining Technology. IAEA-TECDOC-1239. Vienna. 283 p. [2] International Atomic Energy Agency (IAEA). 2016. In Situ Leach Uranium Mining: An	1. Please provide a summary of the results of field tests (i.e., tracer tests, wellfield leach tests, and remediation trials) in the EIS, or provide a technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. 2. Please indicate how outcomes from these field tests inform the design of In Situ Recovery. This information should include: • feasibility of meeting remediation targets. • groundwater flow conditions and validation of flow models. • mobilization of contaminants (e.g., Al, Se or V). • potential for free gas evolution/two-phase flow. • identifying composition of lixiviant and production solutions. • success despite presence of >2% carbonate minerals (siderite, $FeCO_3$) in the ore zone (see Table 4-3 of Appendix 7-A). • site-specific data to parameterize, validate, and refine solute transport models (hydraulic conductivity, effective porosity, dispersivity, diffusion, etc.). 3. Please provide further information of proposed operations including % recovery, uranium concentrations, optimal liquid/solid ratios, anticipated reagent consumption, etc.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Overview of Operations. IAEA Nuclear Energy Series No. NF-T-1.4. Vienna. 76 p. [3] Commonwealth of Australia (Geoscience Australia). 2010. Australia's in situ recovery uranium mining best practice guide. ISBN 978-1-921672-95-8. Canberra. 33 p.			
IR-07	-	ECCC	Fish and fish habitat	Section 2.2.1.4.2, Wellfield Operation Section 2.2.1.4.2.2, Secondary Containment of Mining Solution – Pumping	**Context:** The description in Sections 2.2.1.4.2 and 2.2.1.4.2.2 refer to the differential rates of injection and withdrawal, which implies that more solution will be withdrawn through the recovery well than volume of mining solution injected. According to the description of the site, a freeze wall will create a barrier between the uranium deposit to be mined and outside the isolated area to prevent inflow of groundwater from the sandstone outside the freeze wall. Secondly, it was indicated that the basement rock below the uranium deposit will prevent infusion of groundwater from below. The Proponent stated that inward hydraulic gradient will be created by recovering more solution than is being injected. In general, the wellfield will operate to draw a minimum of 1% more solution out of the wellfield compared to solutions injected in. This will help avoid increased subsurface pressures from injection pressure build up within the deposit. **Rationale:** It is not clear where the extra groundwater will come from that will sustain this differential rate of injection and withdrawals as the freeze wall and bedrock basement will isolate the injection well from groundwater. If it is assumed that there is limited amount of groundwater present in the sandstone layer above the uranium deposit, that amount of groundwater in the sandstone layer is finite and will be exhausted at some point. Therefore, it is not clear where the extra groundwater will come from. If the extra volume of water is not accounted for in the modelling, that would ultimately affect the volume of water that ends up in the receiving environment and likewise the amount of contaminants contained.	Clarify where the extra groundwater will come from to sustain this differential rate of injection and withdrawals during operation and if this extra water has been accounted for in the model and the amount of water that ends up in the receiving environment.		Accepted
IR-08	-	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.1.4.2.2 Project Description	**Context:** This section describes how an inward hydraulic gradient will be created within the mining area as a secondary containment method for control of mining solution. While the process is described, there is no information on contingency measures in place for pump failure or system maintenance solutions. There is also no information on how quickly the hydraulic gradient, and therefore secondary containment, would be compromised if any pumps stopped working. It is also unclear how primary containment (i.e., well design) failure, such as physical/mechanical issues compromising casings, would affect the creation of the hydraulic gradient and secondary containment as well. **Rationale:** It is important to have contingency planning in place in the event that there are any issues with the hydraulic gradient and secondary containment system for control of the acidic mining solution. There is no information in this section on how the hydraulic gradient (i.e., secondary containment) would be maintained if a well or pump (i.e., Primary containment) experienced problems.	Provide further information regarding how the inward hydraulic gradient system functions, with particular focus on how the hydraulic gradient and secondary containment will be maintained if any wells or pumps were compromised.		Accepted

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IR-09	-	CNSC	Geology and Groundwater	Section 2.2.1.4.2.2	**Context:** This section indicates that mining solution within the mining area can primarily be controlled by maintaining an inward hydraulic gradient. The inward hydraulic gradient will be created by recovering more solution than is being injected. **Rationale**: If, for some reason, the recovered solution is much more than that being injected, an excessive drawdown could be created. If, by accident, mining solution is leaking into the upper sandstone aquifer through crack in injection/recovery well casing at the same time, it would be challenging to remediate the upper sandstone aquifer in dry conditions (due to excessive drawdown).	Please clarify if any measure will be implemented to avoid excessive drawdown and develop contingency measures to address such accident.		Accepted
IR-10	-	ECCC	Fish and fish habitat	Section 2.2.1.4.2.3, Tertiary Containment of Mining Solution - Freeze Wall	**Context:** The Proponent stated that as a tertiary means of containment for the mining area, the uranium deposit is proposed to be surrounded by a freeze wall that extends from the surface to the basement rock, isolating the mining area from regional groundwater. Current plans are for the freeze wall to be a minimum of 10 m thick, be installed 25 m away from the uranium deposit, and extend 30 m into the basement rock (Figure 2.2-6). As explained in Section 2.2.1.4.2.2, mining solution will be injected into the ore zone under pressure and will likely react, not just with the uranium in the ore zone, but also the binding or cementing material in the sandstone. This means that some portion of the sandstone above the uranium layer and perhaps some portions of the freeze wall will dissolve, thereby creating more void than just the thickness of the uranium layer or horizon. The void may affect the integrity of the freeze wall as containment. **Rationale:** It is not clear how the Proponent will monitor the freeze wall to verify whether portions of the freeze wall are being dissolved in the mining process and how it plans to verify the integrity of the freeze wall as a containment for the mining solution. In addition, if the dissolution reaction of the uranium ore is exothermic, then the heat generated may also affect the integrity of the freeze wall.	1. Explain how the integrity of the freeze wall will be maintained as a means of containment that prevents migration of the mining solution out of the ore zone into the receiving environment. 2. Demonstrate that the mining solution injected under pressure will not compromise the integrity of the freeze wall as a containment. 3. Demonstrate how both exothermic and chemical reactions of the mining solution used to dissolve the uranium ore will not compromise the integrity of the freeze wall as a containment. **Technical Discussion Required**: Yes. ECCC would like to better understand the chemical constituents that compose the mining solution and the chemical reactions that it will cause.	The Proponent's response is accepted. Please also see AD-50 in the Advice to Proponent table.	Accepted
IR-11	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3 Project Description	**Context:** It is unclear how much contact water may be produced during the drilling of the mine well field during the construction phase of the proposed Project. Figure 2.2-14 indicates that no water will be produced during the drilling process in the construction phase. In Section 2.2.1.2 both mud rotary drilling and diamond drilling are proposed for the creation of wells. Both processes require water, however only mud rotary drilling produces liquid mud that is then reused in the drilling process. **Rationale:** It is unclear if the liquid mud produced during drilling can be reused indefinitely with further water additions, or if this eventually becomes the clean sand grain cutting and how it will be disposed of (i.e., liquid or solid waste). If the mud produced from drilling is classified as liquid waste and disposed of as contact water, it is not clear if this is accounted for in the site water management plan and water balance during the construction phase. Contact water from well drilling during the construction phase has not been quantified or accounted for in Figure 2.2-1, and therefore it is unclear if proposed infrastructure during the construction phase has the capacity to contain this waste stream in addition to the waste streams currently outlined in Figure 2.2-1.	Provide further information on potential wastewater produced during the construction phase from drilling processes, and if proposed infrastructure can contain any water produced.		Accepted

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IR-12	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description	**Context:** There is not enough information provided within the draft EIS and site water infrastructure designs to determine if the infrastructure will sufficiently contain mine site contact and non-contact water runoff. It is unclear how water management will occur during all proposed Project stages at the Project airstrip, which is located away from the main Project site. No information has been provided regarding water that may come into contact with fuels and oils from machinery on the air strip, how and where that contaminated water will be treated, and how surface runoff around the airstrip will be managed. Additionally, it is unclear if contaminants from heavy machinery on roads have been considered during runoff collection plans throughout the mine Project site. Water management at the airstrip and roads can have impacts on surface water quality and sediment quality and contaminants (e.g., Hydrocarbons) from these sources should be considered in overall site water management plans. In Section 2.2.3.1 a site drainage plan for contact and non-contact water has been provided in Figure 2.2-17, and water balances have been provided for the different Project phases in Figures 2.2-14 to 2.2-16. In Section 2.2.3.4 a volume of 30,000m3 for the process water pond is provided, and it is stated that the process water pond has the capacity to contain Probable Maximum Precipitation (PMP) event estimated to be 483.3mm while allowing for 1.0m of freeboard. However, there are no estimates on the total volume of water that may be drained from the overall site infrastructure (i.e., the well field, processing areas, etc.) during a 24-hr PMP event. Additionally, in Figure 2.2.17 culvert locations are provided, however there is no further information on culvert designs, flow ratings and capacity for PMP events. **Rationale:** In order to be able to understand site water management and flood risk potential, more information needs to be provided regarding the site water infrastructure designs and capture volumes during PMP events. This information will aid ECCC in understanding how contact and non-contact water will be conveyed throughout the site. Runoff from roads and the site airstrip will contain contaminants from vehicles, heavy machinery, aircrafts and de-icing practices. Additional information on the runoff collection systems and expected contaminant concentrations for the site airstrip and roads is needed to determine if the receiving environment and aquatic and terrestrial receptors are protected.	1. Provide information on how contact and non-contact water from the site airstrip will be managed. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 2. Provide further information on how potential contaminants in runoff from roads have been considered in the site water management. Include information on potential contaminant characterization and loadings and an assessment of risk to the environment. 3. Provide estimated volumes of water to be drained from overall site infrastructure (such as the mine terrace, airstrip, camp area etc.), during a 24-hr PMP event. 4. Provide additional information on culvert designs and conveyance capacity for PMP events.		Accepted
IR-12	IR-12-R1A	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description Proponent response to IR-12	**Context**: Runoff water from site infrastructure such as the airstrip and roads may be categorized as non-contact water because it does not come into contact with contaminants of potential concern (COPCs) directly from mining operations infrastructure. However, it still has the potential to contain deleterious substances from mine-related activities such as operation of vehicles, including heavy machinery and aircraft, spills, fire management practices, and snow removal practices. The *Metal and Diamond Mining Effluent Regulations* (MDMER) pursuant to the *Fisheries Act* requires all mine effluent and seepage from the mine site that contains deleterious substances be discharged through a final discharge point. This includes deleterious substances in non-contact water from all site infrastructure including the airstrip, roads, and camp area.	1. Update site water management plans to include management of potentially deleterious substances contained in non-contact water from all site infrastructure. 2. Provide updated estimates of water volumes to be drained and managed from overall site infrastructure (including runoff from roads, airstrip, camp area, etc.) during the different Project phases. Include updated information on water treatment flows, capacity and effluent discharge during normal operations, and a 24-hr Probable Maximum Precipitation (PMP) Event.	To be resolved as part of IR-12.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: All mine effluent and seepage that contains deleterious substances must be discharged through a final discharge point. This includes site non-contact water which has the potential to contain deleterious substances such as those released from vehicles, machinery, aircrafts, spills, and de-icing practices. The Proponent has not included how non-contact water runoff from site infrastructure will be captured within site water management planning. To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the capture of non-contact water.			
IR-12	IR-12-R1B	ECCC	Water Quality - Change to an environmental component due to hazardous contaminants	Section 2.2.3, Project Description Proponent response to IR-12	**Context:** The Proponent has clarified that there is no infrastructure in place for management of non-contact water from site infrastructure that may contain COPCs, including but not limited to roads, the airstrip, and the campground. **Rationale:** To understand the potential effects of contaminants from non-contact water on the surrounding environment, site water management planning needs to be updated to include the type of infrastructure and its location for the capture of non-contact water.	Provide a map marking the locations of proposed surface drainage structures for runoff collection including collection ditches, culverts, diversion ditches, perimeter berms, collection ponds and other similar structures.	See also AD-73 in the Advice to Proponent table.	Accepted
IR-13	-	ECCC CNSC	Fish and fish habitat	Section 2.2.4, Waste Management Section 2.2.7.7, Borrow Area Section 2.3.1.3 Site Preparation and Earthworks	**Context:** The Proponent indicates that a borrow area is planned for an area northeast of the processing plant. The borrow material or overburden will be used during construction for roads, airstrip, pads, and in the batch plant for concrete production needs, during Operation for ongoing maintenance of various Project components and during decommissioning for fill and cover material. Suitable construction fill material will be sourced from the proposed borrow area and any suitable clean sandstone generated during freeze wall and well drilling (Section 2.2.7.7). It was also noted in Sections 2.2.1.3 and 2.2.14 that the freeze wall will be established by drilling over 300 vertical holes from surface to the basement rock. The freeze holes will extend 30 m into the basement rock and will produce waste rock from basement rock (Figure 2.2-6). However, there is no information whether the waste rock from basement rock would potentially be acid generating and/or metal leaching. This means that all the extra 30 m of basement rock should also be characterized for potential ARD/ML to determine use or appropriate disposal. **Rationale:** ECCC notes that the Proponent did not indicate whether the borrow material and the drill out part of the sandstone layers and basement rock will be tested for Acid rock drainage/metal leaching (ARD/ML) potential before they will be used during construction, operation and decommissioning. ARD/ML is an environmental hazard that will have an adverse effect on waterbodies frequented by fish. Potential acid generating and metal leaching waste rock could pose negative impacts on the environment if they are not managed adequately.	Please provide: 1. Information on whether the waste rock from the basement rock is potentially acid generating and metal leaching; a. Confirm that any borrow material to be used for construction will be characterized for potential ARD/ML. b. Confirm that the part of waste rock recovered from the basement rock, will also be tested for potential ARD/ML. 2. Criteria for segregating the potential acid generating and metal leaching waste rock, if it exists, from clean waste rock; and, 3. A plan to manage the potential acid generating and metal leaching waste rock, if it exists.	Denison has captured their commitment to develop the waste rock segregation criteria and to develop appropriate mitigations and management for potentially acid generation (PAG) material in version 2 of the Commitments Register (ID 2-33), so this IR has been accepted.	Accepted
IR-14	-	CNSC	Wastes and Decommissioning	Section 2.3.3.1.3 Decontamination, Demolition, and Disposal (p. 2-82)	**Context:** The EIS states "Concrete foundations will be left in place. Any portions of concrete foundations remaining above grade will be levelled and rebar will be cut-off at grade. Large slabs will be perforated on a 2-m grid to permit drainage. Concrete slabs will be covered with 0.5 m of development rock or locally stockpiled till." (p. 2-82)	How has the proposal to leave these foundations in place been received by the Indigenous Nations and communities during engagement sessions? Have engagement activities influenced Denison's planned decommissioning approach? Describe in	Denison has captured their commitment related to addressing concerns from Indigenous Nations and communities on their decommissioning approach within the Preliminary Decommissioning Plans in version 2 of the Commitments Register (ID 4-5), so this IR has been accepted.	Accepted

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				Table 4.3-2: Key Issues and Concerns from English River First Nation (p. 4-33)	Further, Denison notes that "Concern about responsible authority for restoring the environment, including contaminants when mining concludes. How long will it take to have the environment fully restored and, if Denison is no longer the operator, how will this be completed?" (p. 4-33). This comment status is noted as *Complete*. **Rationale:** Permanent structures will remain following decommissioning, according to the excerpt above. It's unclear how engagement activities influenced Denison's planned decommissioning approach, or how the comment above has been addressed or received.	additional detail how the comment from p. 4-33 has been addressed and how this has been received by those who expressed this concern?		
IR-15	-	ECCC	Fish and fish habitat	Section 2.2.3.4 Project Description Section 8.1.3.4.2, Aquatic Environnent	**Context:** In Section 2.2.3.4 it is stated that the estimated PMP event for Project infrastructure planning is 483.3mm. In Section 8.1.3.4.2 it is stated that the PMP is 489.3 mm. **Rationale:** It is unclear which value is the correct PMP value and if Project infrastructure has been planned correctly.	Provide the correct PMP value and verify that Project infrastructure has been designed utilizing the correct value.		Accepted
IR-16	-	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** The EIS and technical supporting documents do not provide sufficient justification for the selection of the proposed wastewater treatment systems for the industrial wastewater treatment plant or the domestic wastewater treatment plant. In addition, it is not clear how the upper bound of the industrial wastewater treatment plant effluent quality was obtained. **Rationale:** Draft REGDOC-2.9.2 formally documents the CNSC's expectations to Licensees for controlling releases to the environment. For proposed new facilities, these expectations include conducting a best available technology and techniques, economically achievable (BATEA) Assessment, and determining key parameters necessary to support the EIS. These include identifying: • environmental release targets to inform the design of wastewater treatment systems to constrain the quantity and concentration of contaminants and physical stressors released into the environment, • the best available technology and techniques through an options analysis; and • the anticipated influent characteristics, overall treatment efficiencies, and maximum predicted design release as the output of the assessment. Consideration of the principle of pollution prevention and BATEA is also a requirement of REGDOC-2.9.1. CNSC staff have met with Denison to discuss the expectations in draft REGDOC-2.9.2.	Please provide a summary of the BATEA assessment to justify the selection of the wastewater treatment plant system. As part of the summary, please identify the anticipated environmental release targets used to inform the design, as well as the maximum predicted design release concentrations and loadings to the receiving environment. The maximum predicted design releases should be used in the ERA to demonstrate protection of people and the environment.		Accepted
IR-17	-	CNSC	Human health with respect to hazardous contaminants	Section 2.2.3.8	**Context:** It is also acknowledged that Denison stated in meetings with CNSC staff that Denison intends to propose final release targets to the CNSC as part of the licence application submission. **Rationale:** It is not clear in the submission whether Denison has considered whether any	Denison should harmonize their proposed Effluent Release Targets with the technology-based performance standards that exist in the Metal and Diamond Mining Effluent Regulations where applicable, or other suitable international regulations.		Accepted

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					applicable technology-based performance standards exist in Canada or internationally, and would be relevant as effluent discharge targets, in order to ensure principles of pollution prevention are applied. Consideration of this would help ensure that the proposed effluent discharge targets harmonize with existing federal, provincial/territorial, and/or municipal requirements. For example, there are release limits for radium-226, TSS, and pH outlined in the federal Metal and Diamond Mining Effluent Regulations, which have been demonstrated to be achievable in the uranium mine and mill industry. In addition, countries like the United States, where in-situ recovery has been conducted in the past, have specific technology-based limits. These are known as New Source Performance Standards and are identified in US Code of Federal Regulations (US CFR) 40, Chapter 1, Subchapter N, Part 440 – Ore Mining and Dressing Point Source Category. It is not clear whether these have been considered in Denison's assessment. These should be considered when identifying suitable achievable technologies.			
IR-18	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.2.3.9, Project Description Appendix 8-E	**Context:** In Table 2.2-1 the upper bound Industrial Wastewater Treatment Plant (IWWTP) effluent quality final discharge targets for Constituents of Potential Concern (COPCs) are provided. General parameters (e.g., temperature, pH, etc.), and several Schedule 4 Substances with maximum authorized concentrations (lead, nickel, suspended solids, and un-ionized ammonia) under the Metal and Diamond Mining Effluent Regulations (MDMER) have not been provided in this table. There are several COPCs (aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese) for effluent characterization under Schedule 5 Section 4 of the MDMER that have not been provided in this table. Additionally, no information on water quality guidelines has been provided in this table. Furthermore, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the Canadian Council of Ministers of the Environment (CCME) water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. **Rationale:** ECCC requests the Proponent include the general water quality parameters that influence water quality thresholds, parameters in Schedule 4 and Schedule 5 Section 4 of the MDMER, and their respective water quality guidelines for consideration and transparency. Discharges from the proposed Project will alter water quality in the immediate receiving area, and this may include some sublethal effects on aquatic biota, which must be minimized. It remains the Proponent's responsibility to adhere to the MDMER to ensure that effluent at the end-of-pipe from all final discharge points be non- acutely lethal and meet requirements for prescribed deleterious substances under Schedule 4 of the regulations.	1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 4 Substances under the MDMER with maximum authorized concentrations: lead, nickel, suspended solids, and un-ionized ammonia. 3. Update Table 2.2-1 and Appendix 8-E to include missing Schedule 5 Section 4 parameters required for effluent characterization under the MDMER: aluminum, mercury, iron, nitrate, thallium, phosphorus and manganese. 4. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. 5. Describe additional mitigation measures that can be considered to minimize impacts to aquatic biota from uranium concentrations in effluent.	In a supplementary submission provided on July 5th, 2024, Denison provided responses to the following outstanding requests: 1. Update Table 2.2-1 and Appendix 8-E to include all general parameters required for environmental effects monitoring: pH, temperature, hardness, alkalinity, and conductivity. 2. Update Table 2.2-1 and Appendix 8-E to include the following missing Schedule 5 Section 4 parameters required for effluent characterization: aluminum, iron, nitrate, thallium, and manganese. Provide further explanation if this information is not available. 3. Include all acute and chronic water quality thresholds for each parameter in Table 2.2-1 and Appendix 8-E. Include information on the concentrations of modifying environmental factors (i.e. pH, hardness, etc.) used to calculate these guidelines as footnotes. 4. Provide a clear commitment to ECCC for continued consultation on developing effluent discharge targets including a review of final predicted effluent discharge targets once available. *This IR is resolved for the purposes of the EA process. The outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a licence.* For item one, the effluent conductivity and TDS presented are not plausible, as explained in the FIRT's May 31st draft comments. As the conclusions of significance for the EA are not influenced by this error, the correct effluent conductivity and TDS will be assessed during the BATEA assessment required for licencing, and predictions will be updated by Denison as needed. It is recommended that conductivity not be used as a surrogate for TDS while monitoring, until the conductivity-TDS relationship is corrected. Follow up for item three is addressed in IR-108 and IR-115.	Accepted

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							To address item four, the Proponent will have to follow the guidance and requirements in REGDOC-2.9.2 to develop effluent discharge targets. The CNSC will engage with ECCC during this process as necessary.	
IR-19	-	ECCC	Change to an environmental component due to radiological contaminants	Section 2.2.4 Project Description	**Context:** In this section, it is proposed that the IWWTP precipitate pond will have a single geosynthetic composite liner system, which is used for ponds/pads that only store non-radioactive materials. However, from Section 2.2.3.9 on industrial wastewater treatment, it is unclear if the precipitates from the stage three neutralization process that are pumped to the IWWTP precipitates pond will have any residual radioactivity. **Rationale:** For the protection of the surrounding environment, it is important that any ponds/pads that are expected to store radiological contaminants be designed to have proper controls (i.e., liners with monitoring systems) in place.	1. Confirm the characterization of the precipitates that are to be stored in the IWWTP precipitate pond. 2. If radiological constituents are expected within those precipitates, update the draft EIS to ensure the proposed geosynthetic liner system for the IWWTP precipitate pond will be adequate to ensure the protection of the surrounding environment.		Accepted
IR-20	-	NRCan	Fish and fish habitat	Section 2.3.3.1.1 Appendix 7-C	**Context**: The Proponent's objective for mining area remediation is to restore the groundwater within the confines of the freeze wall to an acceptable remediation target (EIS, sec. 2.3.3.1.1). The Proponent's acceptable decommissioning objectives for groundwater quality are provided in EIS Table 2.3-3 and in Table 3-5 of Appendix 7-C. These objectives were based on laboratory core flood tests performed by flushing samples of ore with groundwater and groundwater amended with sodium hydroxide or sodium bicarbonate. The composition of the remediated groundwater observed in the core flood tests serves as the source term for the post-decommissioning reactive transport modeling presented in section 4 of Appendix 7-C. **Rationale**: In NRCan's opinion, it is important for reviewers to be able to assess the level of remediation achieved in order to reach the Proponent's decommissioning groundwater quality objectives. Therefore, the Proponent should provide complete water quality data for the pregnant lixiviant that remains in the ore zone after the end of mining and prior to any remediation.	NRCan requests that the Proponent revise Table 3-5 of Appendix 7-C to show the water quality in lixiviant remaining in the ore zone at the end of mining, prior to remediation activities.		Accepted
IR-21	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 2.3.3.1.3, Project Description	**Context:** The decommissioning process for the wellfield and associated infrastructure is discussed, however there is no information provided on the potential risk for subsidence of the ground above the depleted uranium deposit. After the uranium has been dissolved and pumped to the surface, a cavity will be formed in the area where the uranium used to exist. This could destabilize the overlying substrates, causing the ground at the surface to sink in the future. There is currently no information regarding this risk, and how it may alter the overlying environment, surface water features, runoff, or existing nearby waterbodies. **Rationale:** From a surface water and sediment quality perspective, it is important to understand how potential subsidence in the future post-decommissioning may affect the existing environment. It is currently unclear if there is any risk to the aquatic environment if subsidence were to occur and alter existing waterbodies, create new surface water features, or if there will be any risk to the decommissioned onsite industrial landfill and industrial wastewater treatment plant precipitate pond.	Provide further information on the potential risks from subsidence including the probability of occurrence, how it may affect surface water features, and if there exists any risk to the planned decommissioning of waste management infrastructure.		Accepted

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IR-22	-	NRCan	Fish and fish habitat	Section 2.10 Appendix 2-C, section 1.1.1.4	**Context**: With respect to the choice of In-Situ Recovery (ISR) mining solution, two alternatives were assessed: alkaline and acidic lixiviants (Appendix 2-C, sec. 1.1.1.4). In the consideration of technical and economic feasibility of the alternatives (Table 2, Appendix 2-C), the Proponent concludes that: Option 1 (alkaline) is not technically feasible based on the uranium deposit geochemistry. Option 2 (acidic) is technically and economically feasible based on the uranium deposit geochemistry and ability to dissolve uranium. Accordingly, the alkaline alternative was not carried forward into the Environmental Assessment (EIS, Table 2.10-1; Appendix 2-C, Table 3). While acidic ISR solutions are widely used internationally (e.g., Kazakhstan), in the United States, where the environmental regulatory regime is more strict, alkaline solutions have been used exclusively since 1970. **Rationale**: In NRCan's opinion, the Proponent should provide a more thorough technical justification for adopting an acidic ISR lixiviant.	In the Alternative Means Assessment (Appendix 2-C), NRCan requests that the Proponent provides a more thorough technical justification for selecting an acidic ISR lixiviant rather than a less environmentally problematic alkaline leach used exclusively in the USA.		Accepted
IR-23	-	CNSC	Alternative Means	Section 2.10.2 Alternative Means Appendix 2-A PD Engagement Tables Appendix 2-C Alternative Means Assessment (p. 3)	**Context:** There are multiple rows in the Indigenous Tables for Appendix 2-A where comments and concerns raised by Indigenous Nations and communities and other members of the public were taken into consideration in the Alternative Means Assessment. However, it is unclear how these were considered. A few examples: • 16-EN-DesNd-101.1: Interested in any future business opportunities that may be available as Denison advances their Wheeler River Project. • 16-EN-ERFN-100.15: In that territory near the Wheeler River there are a lot of spawning and calving areas for moose, caribou; those creeks are for whitefish spawning. There's lots of heavy muskeg there. A lot of us have been there, and we'd like to know there'll still be access to the area. • 6-EN-ERFN-100.17: Today because of climate change, things are starting to happen that normally didn't happen. Even the permafrost is now further down. In the Wheeler River area, where there's some permafrost, have your environment guys seen a change? Will there be a change? These are some of the questions that need to be answered in order to come out with a positive spin. **Rationale**: Appendix 2-C, Alternative Means assessment, states (p.3): "Engagement with Interested Parties naturally included alternatives means and the engagement input was included in the evaluation of alternative means. Refer to the references list below and *Appendix 2-A Engagement Database Summary – Project Description* for details of engagement information referenced in this alternative means assessment." It is unclear in section 2.10.2 of the EIS, Appendix 2-A or Appendix 2C how the comments documented by Denison have been considered or influenced the alternative means assessment.	Please explain how comments and concerns collected during Denison's engagement sessions were considered or influenced the alternative means assessment. Please include this information in the EIS and/or it's appendices.		Accepted

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IR-24	-	CNSC	Alternative Means	Section 2.10.2 Alternative Means	**Context:** While Appendix 2-C (Alternative Means Assessment) is detailed and includes all aspects of the Alternative means assessment that are required, the summary of the analysis and conclusions in Section 2.10.2 of the EIS lacks the level of detail required to understand the methodology used, and how Denison arrived at these conclusions. **Rationale**: As noted in the Agency's Operational Policy Statement on Addressing "Purpose of" and "Alternative Means" under the CEAA 2012: "If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the Proponent, and be documented in the EIS in sufficient detail to provide context for public and technical comment periods during the project EA, and ultimately to allow the decision maker to understand the choice."	Please summarize the analysis of the alternative means assessment within the body of the EIS, in sufficient detail that a reader of the EIS has adequate information to understand the methodology used, and how Denison arrived at these conclusions. *Note: In addition to the adding text to summarize, Table 6 in Appendix 2-C could be useful to understanding table 2.10.1 in the EIS.		Accepted
IR-25	-	CNSC	Current use of lands and resources for traditional purposes	Section 3, Sections 4, Section 5, Section 11 (and all other applicable once Métis Knowledge Use Study is completed)	**Context:** The EIS states that Denison is currently negotiating an agreement with MN-S and no traditional land use information is included throughout the EIS given no agreement was signed or Traditional land use information was shared at the time the EIS was being drafted. As noted in the EIS Denison has committed that: "As information becomes available from the agreed-upon process between the Métis Nation – Saskatchewan and Denison, it will be incorporated into the final EIS." (p. 11-36) **Rationale:** More information is required to better understand the issues and concerns, valued components, and current use of lands and resources for traditional purposes by MN-S near the Project area. Requirements are detailed in CNSC's Generic EIS Guidelines, section 8.9: Indigenous land and resource use.	Please update the revised Draft EIS to reflect the integration of the Métis Use and Knowledge Study in the Draft EIS where applicable, when this study is completed and provided to Denison. In addition, please include an updated Issues and Concerns table that includes relevant information from the MN-S as a result of engagement activities and relevant MN-S studies in the next version of the EIS, as appropriate. Should this information not be made available to Denison at the time of revising the draft EIS, the next version of the EIS and the response to this IR should provide a status update on discussions and engagement with MN-S and next steps.		Accepted
IR-26	-	CNSC	Precautionary principle and approach	Section 3.4.8 Lands Taken Up from an Indigenous Perspective (p. 3-14)	**Context**: Denison states: "Discrepancies among IK and western scientific information provide an opportunity for Denison to take a precautionary approach. Examples of concrete actions to address uncertainty in cases where IK and LK have differing conclusions on predicted Project effects include addressing uncertainty through monitoring and follow-up programs and communicating results of those monitoring and follow-up programs to demonstrate they have been responsive to the IK shared." (p. 3-14) **Rationale:** CNSC's Generic Guidelines for the Preparation of an EIS state: "In documenting the analyses included in the EIS, the Proponent will demonstrate that all aspects of the Project have been examined and planned in a careful and precautionary manner in order to avoid significant adverse environmental effects. A document by Canada's Privy Council Office, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making*." (Section 2.5)	Please clarify how the precautionary principle, and the Privy Council Office's, *A Framework for the Application of Precaution in Science-based Decision Making About Risk, sets out guiding principles for the application of precaution to science-based decision making* has been considered and incorporated into the EA described in the EIS.		Accepted

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IR-27	-	CNSC	Cumulative Effects Analysis	Section 3.4.8	**Context:** During an outreach and engagement trip by CNSC in October 2022, an abandoned exploration camp adjacent to the proposed Wheeler River site was observed. This site has not been identified within the EIS as part of the cumulative effects assessment. As noted in section 3.4.8, KML has also raised concerns with Denison related to abandoned camps and industrial waste left with no programs for clean-up. **Rationale:** Section 9.4.3 of CNSC's Generic Guidelines for the Preparation of an EIS states that "The applicant shall assess any residual adverse environmental effects of the Project in combination with other past, present or reasonably foreseeable projects and/or activities within the study area."	Please specify why abandoned exploration camps and industrial waste aren't taken into consideration when completing cumulative effects assessment.		Accepted
IR-28	-	CNSC	Current use of lands and resources for traditional purposes	Section 4, IER and engagement appendices, including: Appendix 2-A Appendix 6-B Appendix 7-B Appendix 8-A Appendix 9-A Appendix 10-B Appendix 11-A Appendix 12-A Appendix 13-A Appendix 14-B	**Context:** The summary of issues tables do not appear to include all of the key issues identified by the Indigenous Nations and communities. For example, some Indigenous Nations and communities have shared concerns with respect to accident prevention and overall safety on the Key Lake road (Highway 914) due to increased traffic, impacts on treaty rights and section 35 rights due to cumulative impacts, and decommissioning, that were not captured in the issues and concerns and summary tables in Section 4.3.2 and in the IER. The tables in the engagement appendices include a column titled "Response (From Denison)". The "Response" column does not include responses, but instead points the reader to where this comment or concern was considered. When navigating to the sections referenced, it is often unclear how this information was considered or influenced the assessment. **Rationale:** Additional detail is required in order to ensure the key issues are all identified and to understand the status of validation for each issue raised and the response provided.	1. Update the summary of issues and concerns tables to include all relevant issues and concerns raised by each of the Indigenous Nations and communities to date, including concerns raised in the Indigenous Knowledge studies provided, additional engagement, and Draft EIS comments. 2. Please include a column in the issues and concerns tables to clearly articulate the specific mitigation/monitoring measures that Denison have committed to, or any other measures, in order to address the concerns raised by each Indigenous Nation and community during the engagement process to date. 3. Denison must demonstrate that each Indigenous Nation and community has validated that the summary of issues and concerns table reflects their understanding or agreement, and/or a path forward to complete the validation throughout the EIS and the updated IER. Validation must be complete by the time the technical review is complete, prior to submission of a final EIS. Should Denison not be able to fully address issues, concerns or feedback raised by any Indigenous Nation or community, through mitigation and monitoring measures, this should be documented, and a rationale provided. 4. Update the response column of the Engagement tables to describe how these were considered in the sections referenced. Consider renaming this column to reflect the nature of the content (i.e., how the information was considered).	This response has been accepted. Denison has provided fully updated information as of January 2024. It will be expected that a fully updated IER and issues and concerns tables for each Nation as per the original IR, be provided in future submissions, for CNSC staff awareness of progress on this work. This includes updates on the validation from all Nations and communities, or updated paths forward to validation, if applicable. Note: In the IER Denison provides this information in charts categorized by Nation and in the Appendix 4-B of the EIS, Denison instead includes one large chart with the concerns categorized by key topic. CNSC would recommend using only one method for both the IER and EIS, preferring the format used in the IER by Indigenous Nation and/or community.	Accepted
IR-29	-	CNSC	Current use of lands and resources for	Section 4.3.2 and IER	**Context:** In this section, Denison includes the engagement with BNDN and includes a summary of issues and concerns table for the Nation. Within the history of interactions (Section 4.3.3.2.1).	Please ensure updated information of any additional engagement activities that Denison has completed with BNDN related to understanding their current and traditional land use and potential interests near the proposed project is provided.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			traditional purposes		**Rationale**: Denison states that they have been providing information on the Project to BNDN in 2019, 2021 and again in 2022 and that Denison and BNDN have not responded to date in order to advance further engagement and dialogue.			
IR-30	-	CNSC	Indigenous physical and cultural heritage	Section 4.3.2.1.3, Table 4.3.2	**Context:** Concerns were raised during engagement sessions that "Elders are not being consulted as most of the engagement has been through online means and without a translator". **Rationale:** There's no indication that a translator has been employed to engage with Elders since 2021 in the engagement Table 4.3.2.	How has Denison adapted engagement with Elders from the ERFN since receiving this comment on March 31, 2021?		Accepted
IR-31	-	CNSC	Indigenous Engagement	Section 4.4.2.1.3, Key Engagement Activities (p. 4-88)	**Context and Rationale:** Regarding the following: "An open house for the general public was planned to be hosted in 2022 on preliminary effects and mitigation, but due to concerns identified by MN-S about hosting a public open house in a community with a significant Métis population, this meeting was postponed by Denison. Denison looks forward to rescheduling the meeting in collaboration with the MN-S." (p. 4-88)	Please provide an update on the evolution or progress of this engagement with local communities, following collaboration with MN-S (or otherwise).		Accepted
IR-32	-	CNSC	Current use of lands and resources for traditional purposes	Section 5.3 Section 9.0 Terrestrial Environment	**Context:** Some sections of the EIS (such as Fish and Fish Habitat, Indigenous Lands and resource use) indicate that Indigenous and/or local knowledge was considered when defining the spatial boundaries. However, this is not included in other sections, such as Terrestrial Environment. **Rationale:** Section 5.2.2 of CNSC's Generic EIS Guidelines require that spatial boundaries be defined by considering, but not limited to, the following criteria: Community and Indigenous traditional knowledge, ecological and technical considerations.	Please provide any additional details about how any comments or concerns raised were considered in defining the spatial boundaries with Indigenous Nations and communities with respect to spatial boundaries, for the Terrestrial Section and which specific Indigenous Nations and communities were engaged on these topics and how their input and knowledge was incorporated into the EIS. If already presented in the EIS text body, please indicate where this information can be found or link to Section 4 of the EIS or in the IER.		Accepted
IR-33	-	CNSC	Residual Effect Characterization	Section 5.8.1, Definitions for Residual Effects Characterization and Significance Section 5.8.1.1, Residual Effects Characteristics Section 8, Table 8.3-9: Fish and Fish Habitat - Surface Water Quality	**Context:** Denison uses specific criteria (Residual Effect Characteristics: Direction, magnitude, geographic extent, duration, frequency, reversibility, context and likelihood) and associated ratings (e.g., adverse/positive, low/moderate/high) for the predicted effects assessment. However, it is unclear whether an aggregation method was used in order to determine whether impacts will be significant or not significant, depending on the combination of rating categories (i.e., weightings that were calculated, use of decision rules). For example, medium term and long term are both used to represent the same time category: "Effects are expected to last between 3 to 38 years (i.e., effects expected during Construction through to the end of post-Decommissioning)." (See table 8.4-13 on p. 8-200 compared to table 8.4-12 on p. 8-199 and table 8.5-9 on p. 8-246). **Rationale:** The Generic Guidelines state: "The method used to describe the level of the adverse effect should be transparent and reproducible." In Table 8.3-11, duration was moderate, but again uses same rationale. There is no 'moderate' in Table 8.3-8, and by the same rationale, this should be medium-term to be	If an aggregation method was used and ratings (e.g., High, medium, low) were weighted, what weightings were used, how were these calculated? Please also describe any decision rules that informed the determination of significance. If no aggregation was used, how did Denison ensure that results were consistent, given the varying rankings for each of the key criteria, and varying combination? Regarding inconsistencies in ratings, please use consistent terminology for same rating.		Accepted

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					consistent with definitions provided and summary Table 8.3-12. It was noted that all three tables should be deemed medium-term based on definitions of ratings outlined in Table 8.3-8. Frequency was also showing up as "continuous" and "continuously" in these tables.			
IR-34	-	CNSC	Cumulative Effects Analysis	Section 5.9.2.2 (p. 5-41)	**Context:** Denison identifies the Gryphon deposit as a project that is not reasonably foreseeable. The direct quote from the EIS indicates that the "Development of the Gryphon deposit as an underground mine was evaluated at the prefeasibility level in 2018 but has not advanced to feasibility study or EA. Denison has not announced an intent to proceed with the development of the Gryphon deposit." (p. 5-41) **Rationale:** The guidance Assessing Cumulative Environmental Effects under the CEAA, 2012 defines *Reasonably Foreseeable* as a "physical activity [that] is expected to proceed, e.g. the Proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed." In a press release by Denison Mines (2018: Denison announces decision to advance Wheeler River Project following positive PFS results), Denison publicly disclosed intention to seek the necessary EA for Gryphon to proceed: "After careful consideration of the risks and opportunities associated with permitting and concurrent advancement of project engineering activities, the Company has decided to submit a PD and initiate the EA process in early 2019 for the Phoenix ISR operation, and to bring the Gryphon operation forward, at a later date, as required to achieve the PFS plan of Gryphon first production by 2030." Further, Denison's Wheeler River Webpage references a "start of pre-production activities for the Gryphon operation in 2026"	Please update the cumulative effects assessment in the EIS to include the Gryphon deposit as a Present or Reasonably Foreseeable Project.		Accepted
IR-35	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 6, Chemicals of Potential Concern	**Context:** The use of petroleum products (e.g., propane, gasoline, and diesel) at the Denison Mines Wheeler River site is associated with vehicles and periodic operational testing of emergency generators as well as stationary pumps for emergency power or fire water systems. Thus, the air emissions will contain acrolein. **Rationale:** This chemical of potential concern (COPC) poses potential risks to human health via inhalation, but acrolein appears to have been missed or deemed insignificant. However, its consideration in the assessment will provide information on the significance of the associated risk.	Please consider acrolein in the assessment or provide a rationale for its exclusion.		Accepted
IR-35	IR-35-R1	Health Canada (HC)	Change to an environmental component due to hazardous contaminants IR-35 Response from Denison	Section 6, Chemicals of Potential Concern	**Context**: Potential health risks from long-term exposure to acrolein were not considered in the Proponent's response to IR-35. **Rationale**: No annual predicted concentrations for acrolein were provided in the draft EIS or in the response to IR-35. Concentrations were modelled for short-term exposure (1h and 24h) only in the draft EIS and compared to the 1-hour and 24-hour Ontario Ambient Air Quality Criteria for acrolein. It is Health Canada (HC) guidance to assess both potential short and long-term health effects. The predicted annual concentrations for	Use predicted annual concentrations and available chronic reference concentrations to account for potential health risks from long-term exposure to acrolein to support the decision to screen out acrolein as a COPC from further assessment.	This IR has been accepted. In a June 27th, 2024 supplementary submission, updates were made to Table 3-10 in the Revised DRAFT EIS (January 2024; Appendix 10-A - Environmental Risk Assessment) to include the predicted maximum annual concentration for acrolein at the fence line, as noted in Denison's Response to IR-35.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					acrolein should be compared against chronic reference concentrations (e.g., the USEPA Reference Concentration (RfC)[1] (0.02 µg/m^3) and the Tolerable Concentration (TC) from Environment and Climate Change Canada and Health Canada's Priority Substances List Assessment Report[2] (0.4 µg/m^3)).			
IR-36	-	CNSC	Other	Section 6, Table 6.1-11 Baseline External Gamma Monitoring	**Context:** For one of the exposures in the summary table for baseline external gamma monitoring (Table 6.1-11), the cell states "Destroyed in Field". **Rationale:** No rationale or indication as to why or how it was destroyed is provided.	Please provide any additional info available as to how equipment was destroyed.		Accepted
IR-37	-	CNSC	Air Quality	Section 6.1.1.1, CALPUFF model	**Context:** "The Saskatchewan Ministry of Environment (SK MOE) has developed the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) to assist Proponents in conducting air dispersion modelling assessments in a consistent manner. The guideline defines the recommended approach for dispersion modelling assessments in Saskatchewan, including model selection, emission source characterization, and the determination of compliance criteria to apply." **Rationale:** Saskatchewan air quality guideline requires consultation on use of CALPUFF model, where it states" The ministry acknowledges that there will be situations where specialized air dispersion models such as CALPUFF, CALQ3HCR and others may be applicable. The use of specialized models requires consultation with the ministry" OR "Pre-consultation with the ministry must be undertaken prior to the facility conducting specialized modelling (p. 3)." It is not clear if Denison Mines consulted with Saskatchewan MOE on use of CALPUFF model. Noted that Section 6.1.4.2 is again referring to Saskatchewan MOE guidance for justification, but no indication that they consulted with them (a requirement).	Please confirm and provide a summary of the consultation with the Saskatchewan MOE on the use of CALPUFF model for the Wheeler River EIS as per provincial air quality guidelines.		Accepted
IR-38	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.1, Potential Interactions Between the Project and Valued Component / Key Indicators	**Context:** In this section, the Proponent identifies primary interactions between Project activities and air quality valued components and their associated key indicators. These primary interactions may result in an adverse effect on the valued component. Among the primary interactions are the use of emergency generators in a backup role should there be an interruption of the provincial electrical grid. However, it is not evident what is the anticipated frequency and duration of interruption to grid power. **Rationale:** The Proponent states in the conservative operation scenario that while the site will be powered from the provincial grid at the operations stage, the back-up power generators were assumed to be operating under emergency conditions as a worst-case scenario. ECCC acknowledges the positive impact of extending the electrical grid to the Project site with resultant reduction in generator emissions. The impact of an interruption in grid power would be greatest during the winter months when energy use	Provide an evaluation of a worst-case scenario of grid power interruptions (i.e., average aggregate length of power outages) during the winter months for this section of the electrical power grid.		Accepted

[1] https://iris.epa.gov/static/pdfs/0364_summary.pdf
[2] https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/psl2-lsp2/acrolein/acrolein-eng.pdf

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					would be greatest and surface-based temperature inversions, which vertically trap emissions, would be strongest.			
IR-39	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 6.1.4.2, Potential Project-Related Effects	**Context:** In this section, the Proponent discusses the approach taken for air dispersion numerical modelling. Using their CALMET data set, the Proponent's CALPUFF model runs indicated exceedances for 24- hour total suspended particulates, 24-hour particulate matter (PM10), 1-hour nitrogen dioxide, and 24-hour uranium concentrations. However, there is no mention of possible diurnal and seasonal occurrences of the exceedances. **Rationale:** Adequate assessment of the modelling results requires knowledge of the temporal characteristics for the exceedances. For example, wintertime exceedances may be due to strong temperature inversions, especially during the overnight to morning hours. These strong inversions are challenging for numerical models to capture. Exceedances during warmer months may be due to specific wind directions, which transport emissions directly to downwind receptors.	Provide additional information on any diurnal and seasonal influences of the modelled exceedances.		Accepted
IR-40	-	CNSC	Air Quality	Section 6.1.6.2.1, Air quality significance determination	**Context:** Significance determination was not conducted for air quality due to interconnectedness with other assessment endpoints. **Rationale**: It is not clear where and how these air quality assessment endpoints were factored into the assessment.	Please provide additional information to demonstrate where and how these air quality assessment endpoints were factored in.		Accepted
IR-41	-	CNSC	Air Quality	Section 6.1.6.2.2, Background concentrations	**Context:** The EIS states that "Conservative regional background concentrations from the Saskatchewan Air Quality Modelling Guideline (SK MOE 2012a) and based on the La Loche monitoring station were used for particulate matter, NO2, SO2, and CO. The La Loche monitoring station is located near anthropogenic sources, while the Project is in a remote area removed from anthropogenic sources." **Rationale:** If La Loche monitoring station is located near anthropogenic sources and the Project is not, use of this data is not a conservative or realistic representation of background. For a realistic approach, background data considered should be upper 95th percentile (or max if n<10) from an area representative of project location For a conservative approach, background data from an area located even further from anthropogenic sources (if this exists) should be used, or an upper limit of background less than upper 95th should be applied as the background. Upper limit of background is used to screen out COPCs or often subtracted from total to ascertain relative contribution / impact from source, so using a higher upper limit may result in COPCs screening out or appear to have a lower relative contribution. If background was added to source, then approach used would be conservative. If this is the case, confirmation and reference to where this is discussed in methodology should be provided.	Please provide additional rationale to justify the appropriateness of La Loche monitoring station concentrations as background for project location.		Accepted

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IR-42	-	HC	Physical stressors (noise and vibration)	Section 6.2.4.2.2, (p. 6-66) Section 6, Section 6.2.9, (p. 6-72)	Nighttime noise impacts are not adequately considered for human receptors. **Context:** The EIS states in Section 6.2.9 that, "While the predicted sound levels were less than the guideline values, the increase from baseline was predicted to be noticeable" (p. 6-72). No information is provided on individual noise events occurring during the nighttime period**.** **Rationale:** While the increase from baseline is predicted to be noticeable, it is important to also consider that changes to the characteristics of the sound from baseline (e.g., a change in frequency, changes in sound modulation, increased impulsiveness or tonality, or a shift in noise from the daytime to being more at night) may cause noise to be even more noticeable. Consult ANSI S12.9-2005/Part 4, clause A.1.3 for further information. In particular, consideration should be given to potential impacts on sleep, where adverse impacts are reported to begin when sound levels inside bedrooms exceed 30 dBA for continuous noise sources and 45 dBA LAmax for discrete noise events (WHO, 1999).	1. Provide a description of the project- related nighttime noise sources that may impact human receptors as well as a qualitative discussion of the resulting potential impacts on perception considering not only changes in sound levels but also sound characteristics (e.g., tonality, impulsivity). 2. Confirm whether individual nighttime noise events exceeding 45 dBA LAMax outdoors (or 30 dBA indoors) are expected to occur more than 15 times over the nighttime period at any nearby potentially noise-sensitive human receptor location(s). This may be of particular concern if some construction and/or operations activities occur during sleeping hours.		Accepted
IR-43	-	HC	Physical stressors (noise and vibration)	Section 6.2.5, (p. 6-66) Section 6.2.5, (p. 6-71)	Mitigation measures for project-related noise were not identified for the Construction phase. **Context:** The mitigation measures provided in Section 6.2.5, including a complaint management system is also to be implemented as part of the EMS, are only proposed for the operations phase. However, construction activities are predicted to last more than one year. Construction noise will involve the use of equipment operating at the site, construction of surface facilities, drilling, and partial operation of the freeze plant. It will also include regular truck trips and air traffic for personnel changes. **Rationale:** It is unclear if listed mitigation measures also apply to the construction phase (or only to the operations phase).	1. Clarify whether mitigation measures and the proposed EMS apply to the Construction phase. If not, identify mitigation measures for noise impacts related to Construction phase activities, and consider applying the EMS to the Construction phase and implementing the community complaints and response procedure from the beginning of construction activities. 2. Health Canada suggests that construction noise lasting longer than 1 year be assessed as operational noise, and that noise mitigation measures be applied also to the construction phase. Special consideration should be given to mitigation measures for construction noise that occurs at night, in order to minimize impacts on sleep (i.e., avoiding tonal or impulsive noise sources at night). **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of Appendix H of Health Canada (2017), which identifies additional construction noise mitigation measures that could also be considered to reduce project- related noise.		Accepted
IR-44	-	HC	Physical stressors (noise and vibration)	Section 6.2.8, (p. 6-71)	The noise complaints resolution and response procedure is not sufficiently described in the EIS. **Context:** Section 6.2.8 discusses Monitoring and Follow- up. The Proponent indicates: "The EMS will also include a community complaints and response procedure" (p. 6-71). **Rationale:** Details have not been provided regarding how the complaints would be received, addressed or what the timelines will be for providing a response or resolution.	1. Provide the details of the noise complaints resolution and response procedure as per Health Canada (2017). 2. Consider conducting community consultations and/or implementing an advanced community notification system to pro-actively reduce the probability noise-related impacts and complaints.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					It is important to provide information to potentially affected communities in advance of particularly noisy activities. Community consultation and advanced notification of noisy activities has been shown to reduce complaints (see Health Canada, 2017).			
IR-45	-	HC	Change to an environmental component due to hazardous contaminants	Section 6 Air Quality Technical Supporting Document Section 6.3.1	The carcinogenic risks of diesel exhaust from the Project should be assessed. **Context:** Section 6.3.1 discusses modelled predictions of exceedances for Particulate Matter (PM). TSD p. 22 states: "concentrations of 24-hour PM2.5 are also elevated around the standby generators at the freeze plant, which emit fine particulate matter from combustion of diesel fuel". However, diesel particulate matter is not evaluated for the whole project in the air quality model or the air quality assessment. **Rationale:** Health Canada has determined that diesel exhaust is carcinogenic in humans which is consistent with the conclusion of the International Agency for Research on Cancer (IARC), and that diesel exhaust is associated with significant population health impacts in Canada. To characterize the carcinogenic risk of diesel exhaust from a project, HC has published a report (2022)1 which provides a quantitative assessment of the relationship between ambient PM2.5 exposure and lung cancer risk. Specifically, this report quantifies the increase in risk of lung cancer mortality (over the baseline rate in the Canadian population) due to PM2.5 exposure. This quantitative assessment is considered appropriate to characterize risks from diesel PM given the contribution of diesel exhaust to ambient PM2.5 in Canada, and that the carcinogenicity of diesel exhaust has generally been evaluated based on the respirable PM fraction1,2,3. **References:** [1] HC. 2022. Lung Cancer and Ambient PM2.5 in Canada: A Systematic Review and Meta-analysis. Available at: https://publications.gc.ca/site/eng/9.907038/publication.html [2] HC. 2016. Human Health Risk Assessment for Diesel Exhaust. Available at: http://publications.gc.ca/collections/collection_2016/sc-hc/H129-60-2016-eng.pdf [3] IARC. 2013. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. https://publications.iarc.fr/Book-And-Report Series/Iarc-Monographs-On-The-IdentificationOf-Carcinogenic-Hazards-To-Humans/Outdoor Air-Pollution-2015	1. Evaluate the carcinogenic risk of all potential diesel exhaust from the Project based on the approach proposed by Health Canada (2022). Additional guidance (Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation") is provided as an appendix to this comment table.[i]		Accepted
IR-46	-	HC	Physical stressors (noise and vibration)	Appendix 6-A Table A-1	Low-frequency noise and associated potential human health effects were not assessed. **Context:** Some equipment that may emit low-frequency noise (LFN) have been listed in Table A-1: Assessment Scenarios and Sound Level Data (Section 6 Appendix A); however, no information describing potential impacts of this type of sound on nearby human receptors are presented.	1. Clarify whether any project-related activities (construction, operation and/or decommissioning) may produce LFN that could impact off-site human receptors. Evaluate LFN in the noise assessment, if and where applicable. See Appendix C of Health Canada (2017) for a discussion of LFN.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: Low frequency noise can be associated with the introduction of noticeable vibrations and rattles in nearby structures. Research indicates that annoyance related to noise is greater when low-frequency noise is present (ISO 1996-1:2003). As sound environments are usually characterized using A-weighted decibel levels (dBA) that reflect the frequencies most audible to the human ear, the impacts of low- frequency noise may need to be assessed separately.			
IR-47	-	ECCC	Air Quality	Appendix 6-A, A.1	**Context and Rationale:** Verification of the following calculation is required for assessing predicted emissions of dust from general construction. It appears the result of 0.70 ton/acre/month is incorrect and should instead be 0.314 ton/acre/month. Appendix 6-A, Appendix A, A.1 (p. A4) TSP Emission Factor for General Construction: $EF\,(TSP) = 0.11\frac{\frac{ton}{acre}}{month} \times 1.2\frac{\frac{ton}{acre}}{month} \div 0.42\frac{\frac{ton}{acre}}{month} = 0.70\frac{\frac{ton}{acre}}{month}$	Explain how the emission factor total suspended particulates (EF (TSP)) result was obtained or rectify if it is incorrect and update the draft EIS to reflect the correction.		Accepted
IR-48	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, Figure 6.2.3, p. 6-57	Noise-sensitive receptors are not included on noise contour maps. **Context:** Noise-sensitive receptors are identified in the acoustic model report in Section 6 Appendix 6-E but not presented on any maps in the atmospheric and acoustic sections of the main report (Figure 6.2-3). **Rationale:** The noise assessment typically includes a map illustrating modelled noise levels from the Project at receptor locations in the study area. Certainty regarding the presence of human receptors in the regional study area is also recommended in order to assess cumulative impacts.	1. For more clarity, identify noise-sensitive receptors on Figure 6.2-3: Noise Assessment Study Area as well as on contour maps showing the baseline and predicted noise levels.		Accepted
IR-49	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The Noise Source Characterization is incomplete. **Context:** Section 3.0 of the Draft EIS Section 6 Appendix 6- E discusses Source Characterization. There is no detail regarding potential tonal or impulsive noise sources in Section 3.0. **Rationale:** The draft EIS should include a description of sound source characteristics (e.g., tonal, impulsive, highly impulsive) in order to properly inform the quantitative noise assessment and which assumptions/adjustments need to be applied and to properly evaluate impacts of project noise on health of affected receptors.	1. Identify any tonal, regularly impulsive, highly impulsive, or high-energy impulsive noises likely to be produced during project activities that could be audible at noise sensitive receptors. Furthermore, describe the timing (e.g., hours of night-time activities), frequency and duration of noise events, and their sound characteristics, including frequency spectrum. See Health Canada (2017) for details.		Accepted
IR-50	-	HC	Physical stressors (noise and vibration)	Appendix 6-E, 4.0 Table A.1	The description of noise modelling does not document or justify the use of sound level adjustments**.** **Context:** ISO Standard 9613-2 has been used for the sound level modelling; however, it is unclear if all applicable adjustments have been considered as per ISO 1996-1:2016 (Table A.1).	1. Clarify whether ISO-1996-1:2016 has been considered in the modelling to account for any applicable sound level adjustments. Adjustments should be considered when calculating Ln (night- time sound level) and Ldn (day-night sound level). In addition, if applicable, adjustments can be applied depending on the noise characteristic (impulsive,		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: When modelling techniques are used to estimate present (baseline) or future (construction and operational) sound levels, these techniques and any accompanying assumptions, including the use of sound level adjustments, it is important to provide appropriate documentation and justification. Note that in situations where more than one source characteristic adjustment is applicable (e.g., impulsive or tonal), only the higher of the adjustments is used. However, all time-of-day adjustments and the quiet rural area adjustment are to be added to the highest of the applicable source adjustments.	highly impulsive, etc.), and because the Project location is considered to be in a quiet rural area. See: ISO 1996-1:2016 and Health Canada (2017) for details.		
IR-51	-	CNSC	Geology and Groundwater	Section 7, Figure 7.8-1 Appendix 7-C	**Context:** Figure 7.8-1 (p. 7-107, main EIS report) shows monitoring well cluster outside of the freeze wall. **Rationale**: It is not clear what the targeted hydro-stratigraphic units of each monitoring well cluster are. In addition, it is not clear how the establishment of the freeze wall and any leakage from the brine solution will be monitored. If there is any "window" within the freeze wall (i.e., the freeze wall is not continuous), is there any way to identify that?	Please clarify the targeted hydro-stratigraphic units of each monitoring well cluster in Figure 7.8-1 (p. 7-107, main EIS report). Please clarify how the establishment of a continuous freeze wall will be monitored.		Accepted
IR-52	-	ECCC	Fish and fish habitat	Section 7, Geology and Groundwater Appendix 7	**Context:** According to the Proponent, ''an acidic or low pH mining solution will be used to leach uranium ores from the ground. Mining solution may be a mixture of sulphuric acid, hydrogen peroxide, ferric sulphate, and freshwater (from shallow groundwater well or surface waterbody) or recycled water. Wellfield will consist of a combination of injection and recovery wells, in the general the arrangement of one recovery well in the center surrounded by four injection wells (5-spot pattern) with about 5 to 10 m between wells. The final wellfield is expected to include approximately 300 wells over an area measuring 90 m wide x 750 m long''. As the components/contaminants mentioned in the description of the hydrogeologic contaminant transport processes above may be transported to Whitesfish Lake through groundwater, the injection and recovery wells should be included in the model. **Rationale:** The hydrogeologic contaminant transport processes described above are an important part of the proposed Project and it is not clear why numerical modelling results and a sensitivity analysis for the above processes was not presented.	1. Explain why 3D hydrogeology and contaminant transport numerical modelling of the injection and extraction wells was not presented. 2. Alternatively, provide simulation results and a sensitivity analysis for the injection and extraction of the acidic solution in the mining area.		Accepted
IR-53	-	CNSC	Geology and Groundwater	Section 7.3, Table 7.3.-2 Appendix 7-C	**Context:** The field-based hydraulic conductivity values (referred to as K values hereafter) in Table 7.3-2 (p. 7-32, main EIS report) indicate that the K value ranges of upper and lower sandstone aquifers have a significant overlap with those of the intermediate sandstone aquitard. However, the calibrated K value in Table 2-2 (p. 2.7, Appendix 7-C)) for the intermediate sandstone aquitard is close to the lower end of the field-based K value range, while the calibrated K values for the upper and lower sandstone aquifers are close to the upper end of the field-based K value range. **Rationale:** It is not clear how representative the calibrated K values are of the field-	Please provide additional information to support the representativeness of the calibrated K values (for example, use graph to present the measured K values and the calibrated K values).	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Please include figure(s) (y axis representing depth below ground, x axis representing K, different length of vertical line segment representing different packer testing intervals, etc.) showing the field measured K values, as well as the calibrated K value for the upper sandstone aquifer, intermediate aquitard, and lower sandstone aquifer. This would help demonstrate the distribution of field measured K values and representativeness of calibrated K values.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					based K values for each hydro-stratigraphic unit, and if the significant difference between the K values for the upper and lower sandstone aquifers and those for the intermediate sandstone aquitard is supported by the geological properties of the corresponding stratigraphy units. It is stated in the report (p. 7-36, main EIS report) that "Vertical fracture or fault zones that hydraulically connect the Local (upper) and Semi-Regional (lower) groundwater flow regimes are present throughout the Athabasca Basin". But fractures and fault zones are not explicitly considered in the model. There is possibility that these features could increase the hydraulic connection between the upper and lower sandstone aquifer.			
IR-54	-	CNSC	Geology and Groundwater	Section 7.3.1	**Context:** EIS states: "The most important associated topographic features in the region are the northwest to southeast trending drumlins and eskers…." This is not the trend shown on the provided maps, nor described elsewhere in the report, e.g., Section 7.3.2.1 **Rationale:** Inaccurate information in the EIS	Please update the EIS where required to accurately describe the topographical features.		Accepted
IR-55	-	NRCan	Fish and fish habitat	Section 7.3.3.1; Appendix 7-A, sections 3.4, 3.5, 3.8, 4.2; Appendix 7-C, section 2.8	**Context**: According to the Proponent's conceptual hydrogeological model (EIS, sec 7.3.3, Figure 7.3-7, Table 7.3-2; Appendix 7-A, sec. 3.4, Table 3-4), the horizontal hydraulic conductivity of the Intermediate Sandstone (Iss) aquitard is 8.4 E-09 m/s based on field measurements. The Proponent further assumes a 10:1 anisotropy ratio for the unit (Appendix 7-A, sec. 3.5.1) such that its estimated vertical conductivity is 8.4 E- 10 m/s. Based on this information, structural geology and groundwater quality data, the Proponent concludes that the connectivity between the Upper sandstone aquifer and the Intermediate Sandstone aquifer (sic) is limited (EIS sec. 7.3.3.3; Appendix 7-A, sec. 4.4). While acknowledging the paucity of conductivity data and the Proponent's attempt to mitigate this by leveraging collateral information on fracture frequency and clay content (Appendix 7-A, sec. 3.3.1), NRCan considers that the hydraulic conductivity assigned to the Iss aquitard is unrealistically low and inconsistent with the following lines of evidence: a) The conductivity value for the Iss is based on the geometric mean of 18 field measurements, 12 of which are from the same borehole (WR-695) located in the Gryphon zone, beyond the domain of the numerical model (Appendix 7-A, Appendix C, Table C-1). If the conductivity data were weighted equally, with one value per borehole, the geometric mean would be approximately 1.5 E-07 m/s, or two orders of magnitude higher; b) The Proponent notes that vertical fracture or fault zones that hydraulically connect Upper and Lower aquifer systems are present throughout the Athabasca Basin including in the Phoenix area (EIS, sec. 7.3.3.2.2; Appendix 7-A, sec.3.8.1); c) The Proponent notes that groundwater chemistry data (major ions) corroborate the presence of structurally controlled vertical hydraulic connections between the Upper and Lower aquifer systems (EIS, sec. 7.3.3.2.2, sec. 7.3.3.3; Appendix 7-A, 4.3.3); d) Groundwater chemistry data (Appendix 7-A, sec. 4.2, Table 4-1) also indicate the presence of detectable levels of "bomb" tritium (indicating recharge waters < 50 years old) in the Lower Sandstone Aquifer (GWR-025, GWR-008, GWR-033) and in the Iss (GWR-009, GWR-034), outside the area of U mineralization. This is also evidence of vertical hydraulic connection through the Iss. In summary, whereas the Proponent conceptualizes the Iss as a very low-permeability unit with localized vertical hydraulic connection (WS Shear), NRCan interprets the Iss as a "leaky" aquitard with pervasive fracture-controlled and much higher vertical hydraulic conductivity.	In the "Parameter Uncertainty Assessment" for the numerical groundwater flow model (Appendix 7-C, sec. 2.8), NRCan requests that the Proponent develop a calibrated numerical model with an alternate conceptualization of the Intermediate sandstone as a "leaky" aquitard with a horizontal hydraulic conductivity on the order of 1 E-07 m/s and a much lower anisotropy ratio. This should involve modifying the model lateral boundary conditions to allow for groundwater inflow/outflow across the entire thickness of the Athabasca Sandstone Group rather than just the Lower Sandstone aquifer.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: The significance of NRCan's alternative interpretation of the Iss hydrostratigraphic unit is that deep groundwaters, including mining-impacted waters, may represent a greater proportion of baseflow discharge to Whitefish Lake than the 1% currently estimated in the Proponent's groundwater flow model (EIS, sec. 7.4.2.1, p.7-51; Appendix 7-C, sec. 2.6.3).			
IR-56	-	CNSC	Geology and Groundwater	Section 7.3.3.2	**Context:** It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." **Rationale:** It is not clear why the exploration boreholes have not been decommissioned.	Please clarify why the exploration boreholes have not been decommissioned and the timeline to decommission the boreholes according to appropriate guidelines/procedures. If it is not decommissioned before the ISR operation, what is the potential impact of the unplugged boreholes on the mining solution migration?		Accepted
IR-57	-	NRCan	Fish and fish habitat	Section 7.3.3.2 Appendix 7-A, sections 3.1.2 and 3.7 Appendix 7-C, section 2.5.2	**Context**: The Proponent's conceptual model of groundwater flow in the Local Study Area (EIS, sec 7.3.3, Figure 7.3-7) involves an unconfined Upper system hosted by overburden and the Upper sandstone aquifer, and a Lower confined system hosted by the Lower Sandstone Aquifer. The Intermediate Sandstone aquitard acts as a confining unit. Vertical heads gradients are directed downwards west of the Phoenix deposit and upwards beneath surface water receptors including Whitefish Lake (EIS, sec. 7.3.3.2). Using head data from nested monitoring wells (Appendix 7-A, sec. 3.1.2, Table 3-1) the Proponent calculates upward gradients in cluster WR-607, between the Lower Sandstone aquifer and the Upper Sandstone aquifer. In cluster LA-5, an upward gradient is calculated between the Upper Sandstone and the overburden unit (Appendix 7-A, Table 3-5). In areas west and south-west of the Phoenix deposit, groundwater is estimated to flow downward under a vertical gradient of approximately 0.015 m/m (Appendix 7-A, p.3-15). **Rationale**: In NRCan's opinion, the Proponent's interpretation of vertical head gradients in the LSA is not fully accurate. For the "Up-Gradient" monitoring well cluster, the tabulated head data (Appendix 7-A, Table 3-1) and data logger hydrographs (Appendix 7-A, Appendix B) indicate a downward gradient (0.014 m/m) from the overburden unit to the Intermediate Sandstone and an upward gradient (0.056 m/m) from the Lower Sandstone to the Intermediate Sandstone. Head data from the "NW" monitoring well cluster indicate a similar pattern of downward (0.016 m/m) and upward (0.014 m/m) gradients converging in the Intermediate Sandstone. In the "Downgradient" and "SE" monitoring well clusters, head observations and data logger hydrographs indicate downward gradients from the shallow aquifer system but essentially equal heads in the Intermediate and Lower Sandstones. This more complex picture of groundwater flow systems in the LSA does not appear to have been captured in the Proponent's conceptual model. Given the importance of the baseline hydrogeological regime for predicting the transport and fate of COPCs in the post-decommissioning period, the	In section 2.5.2 of Appendix 7-C (Calibration Results), the Proponent should demonstrate that the numerical groundwater flow model reproduces quantitatively or at least qualitatively the vertical head gradients calculated from observations in the nested monitoring well clusters (Appendix 7-A, Table 3-1).		Accepted

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					Proponent needs to demonstrate that the numerical groundwater flow model accounts for observed vertical head gradients.			
IR-58	-	ECCC	Fish and fish habitat	Section 7.3.2.4, Ore Deposit	**Context:** The Proponent states that the Phoenix ore bodies are long and narrow (approximately 25 to 50 m wide) and are located within or near a graphitic pelite unit. Hydrothermal alteration associated with the ore zone is a discontinuous envelope of clay alteration and a sulphide-cemented rock zone that extends into the overlying sandstone and the underlying basement (Figure 7.3-3). This black, clay-rich zone is approximately 3 m thick on average and locally hydraulically isolates the ore zone from the overlying sandstones and underlying weathered basement rock. **Rationale:** As indicated by the Proponent, a 3 m black clay rich zone isolates the ore zone from the overlying sandstones and underlying weathered basement rock. It is, however, unclear whether this discontinuous clay layer will prevent downward migration of uranium-bearing solution into the Paleo-weathered basement rock or horizontal flow along the unconformity surface to escape into the environment. Escape of uranium-bearing solution into the environment will have a negative effect on the receiving environment.	1. Verify that there will be no downward migration of mining solution into the paleo- weathered basement rock or that there is no flow along the unconformity surface. 2. If downward migration of the mining solution occurs, explain how it will be mitigated.		Accepted
IR-59	-	CNSC	Fish and fish habitat	Section 7.4 Assessment of Project-related Effects, Figure 7.4-2 (p. 7-56)	**Context:** Figure 7.4-2: Simulated Change in Groundwater Discharge and Flow through Whitefish Lake Over the Life of the Project appears to be missing information. **Rationale:** Legend is included below the image, but the Legend box is blank. The green dotted line is not represented by anything in the legend.	Please update this Figure to ensure it is complete, and that features are properly indicated in the legend.		Accepted
IR-60	-	NRCan	Fish and fish habitat	Section 7.4.2.1 Appendix 7-C, section 5.2.1, Appendix B	**Context:** In the discussion of the limitations of the numerical groundwater flow model (Appendix 7-C, sec. 5.2.1), the Proponent invokes the well known modeling principles of "Occam's razor" and "Parsimony" which guided the parametrization of hydraulic conductivity in model layers. The Proponent states that hydrogeologic property values were applied uniformly for, among other units, the Lower Sandstone aquifer beyond the immediate area of desilicified materials. However, in the layer parametrization for the Lower Sandstone aquifer (Appendix 7-C, Appendix B, Figure B-5), NRCan notes a large zone of enhanced conductivity (1 E-05 m/s) extending south from Kratchkowsky Lake, which contrasts with the value (2 E-07 m/s) assigned elsewhere outside the desilicified zone. NRCan also notes the extremely detailed parametrization of hydraulic conductivity in the clay cap overlying the ore zone where borehole control is dense (Appendix 7-C, Appendix B, Figure B-6). **Rationale**: In NRCan's opinion, these model features appear to violate the principle of "Parsimony" and require greater justification supported by field observations.	NRCan requests that the Proponent provide justification based on field evidence for the multiple hydraulic conductivity zones assigned to the Lower Sandstone aquifer and the clay cap above the ore zone.		Accepted
IR-61	-	CNSC	Geology and Groundwater	Section 7.4.2	**Context:** There is no discussion of potential induced seismicity from mining processes. **Rationale:** Induced seismicity may lead to a loss of process as identified for natural seismicity.	Please provide information on the potential mining-induced seismicity.		Accepted

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IR-62	-	ECCC	Fish and fish habitat	Section 7.4.2, Potential Project-related Effects	**Context:** The Proponent indicates that the mining area includes: • the 'active mining area', which is the target ore zone; • a zone extending between 11 and 13 m above the active mining area that represents the maximum vertical height over which the injected mining fluids will migrate upwards from the ore zone during active mining; and • a zone extending 50 m vertically upwards from the active mining area (that incorporates the active mining area and the 11 to 13 m zone defined in the previous bullet) that was selected to account for potential upset conditions. **Rationale:** It is not clear to ECCC how the Proponent would be able to limit the mining solution migration within 11 & 13 m above active mining as the maximum vertical height over which the injected mining fluid will migrate. As the mining fluid will be injected under pressure into zones with possible presence of fractures, the pressure may also cause additional fractures and given that the solution is warm/hot will possibly dissolve the other cementing material in the sandstone above, making it difficult to accurately predict where the solution will migrate to.	1. Explain plans to limit the upward migration of mining solution into the overlying layer to 11 and 13m above the ore zone. 2. Explain what impacts will occur if the mining solution migrates beyond the predicted height.		Accepted
IR-63	-	CNSC	Geology and groundwater	Section 7.4.2.1, Potential Effect #1: Groundwater Quantity – Construction to Decommissioning Appendix 7-C, Section 2.7, Groundwater Conditions During Mine Operations	**Context:** The numerical groundwater model described was calibrated to observed water level and stream baseflow data. Table 7.4-3 in the EIS indicates that Denison recognizes the potential for freeze wall operation to impact groundwater quantity. To simulate this impact, the model was adapted to reduce recharge (to 50%) within the freeze wall area, reduce hydraulic conductivity associated with the vertical freeze walls, and simulate pumping within the freeze wall area. Recovery from pumping and effects on discharge to groundwater discharge to Whitefish Lake are discussed in the potential effects section. **Rationale:** Although this assessment considered drawdown of the water table and discharge to Whitefish Lake, the discussion did not address the potential effects of operating the freeze wall on the local and semi-regional groundwater regimes. What would the pathway be for groundwater to pass around the freeze wall? What is the basis for the parameters selected, e.g., 50% recharge and lower hydraulic conductivity for freeze well? These factors need to be considered when evaluating the potential impacts of freeze well operations on groundwater flow conditions and corresponding receptors.	Please provide a more fulsome discussion on the impact of freeze wall operations on local and semi-regional groundwater regimes and potential receptors. Please provide the rationale for assumptions made for key model parameters (e.g., selection of 50% recharge, hydraulic conductivity value used to represent freeze wall). In addition, please discuss the potential pathways for groundwater flow around the freeze wall, complete with figures demonstrating these pathways.		Accepted
IR-64	-	ECCC CNSC	Fish and fish habitat	Section: 7.4.2.2, Potential Effect #2: Terrain Morphology and Stability – Operation Appendix 7-A, Appendix K (p. 12)	**Context:** The Proponent stated that the geological assessment predicted maximum vertical displacement in altered sandstone immediately above the mining area (17.5 cm). A very minor change in elevation at ground surface (of less than 7.5 cm) was predicted within a discrete and localized area overlying the ore body. The modelling work is considered to provide a worst-case bounding scenario. If subsidence were to occur over the lifetime of the Project, or in the years following mining, the extent of vertical displacement is not expected to exceed that predicted in the modelling, which is based on an assumed volume extraction. **Rationale:** ECCC notes that the thickness of the ore zone has an average thickness of 5 m with a range of 2 to 17 m, and is 25-50 m wide and that the overburden rock above the ore zone measures about 400 m. Therefore, it is not clear how the Proponent determined that the surface expression of a subsidence on the surface if it occurs will be limited to 7.5 cm and localized. A subsidence greater than 7.5 cm, implies that the void	Explain: • Will this be revisited with updated data based on extraction feasibility results? • How will the surface expression of a subsidence will be limited to 7.5 cm and localized? **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent consider implementing remediation measures immediately after mining to prevent subsidence from occurring in the first place.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					in the ore zone will be narrower, and will affect the amount of water migrating through the zone. It was the recommendation of the consultant who conducted the work in Appendix K that more accurate material properties should be used for future modelling.			
IR-65	-	CNSC	Geology and Groundwater	Section 7.4.2.2	**Context:** It is stated the maximum subsidence is 7.5cm based on modeling with an assumed volume extraction. Has subsidence from dewatering/pumping and from lack of inflow of groundwater due to freeze wall been considered? **Rationale:** Surface facilities and wells may be impacted if there is unaccounted for subsidence.	Please provide additional details for any dewatering/pumping induced subsidence.		Accepted
IR-66	-	CNSC	Geology and Groundwater	Section 7, Table 7.5-1, Row 1, Column 6	**Context:** Column 6 in Table 7.5-1 indicates the mitigation measures for a valued component. For Row 1, Geology, there is no description of mitigation measures but only that contingency plans will be developed if based on monitoring. **Rationale:** Subsidence may impact wells and surface infrastructure.	Please provide additional details on monitoring and contingency plans related to the geological environment (e.g., subsidence), including triggers for implementing such plans.		Accepted
IR-67	-	CNSC	Geology and groundwater	Section 7.6.2.1 (Remediation Objectives)	**Context:** Metallurgical testing, including batch reaction, coreflood testing and column tests are mentioned frequently throughout Sections 2 and 7 of the EIS. Outside of the composition of restored solutions from coreflood tests #2B and 3C, results from these various tests are not reported in the EIS or any associated Appendices. **Rationale:** The results from metallurgical testing are important to a number of items discussed in the EIS, including (but not limited to): evolution of hydrochemistry during remediation, source of salts in Lower Sandstone Aquifer porewaters, process plans, industrial wastewater treatment, estimating composition and volume of process precipitates, and composition of mining fluids and leachate. In particular, the EIS posits that mining area decommissioning objectives are achievable based on metallurgical testing and provides these objectives in Table 2.3-3. CNSC staff need to understand the specifics of this metallurgical testing, given its importance for the development and justification for mining and remediation activities. Denison must also provide information demonstrating that the proposed restoration actions and remediation targets are As Low As Reasonably Achievable (ALARA).	1. Please provide a summary of the results and the analysis of results of the metallurgical tests within the EIS, or provide the technical supporting document with this information, and ensure the documentation is appropriately referenced in the EIS. This should include sample information for cores (e.g., mineralogy, location, U content, depth), test conditions (e.g., duration, # of iterations, column length, flow rate, temperature, pressure, sample frequency, influent/effluent composition), as well as results and how they are pertinent to the development of ISR activities. 2. Please provide further clarification/justification on how results from two singular coreflood tests (i.e., Coreflood #2B and Coreflood #3C) can justify large-scale remediation activities and targets following solution mining. 3. Please provide material demonstrating that the proposed restoration actions and remediation targets are ALARA.		Accepted
IR-68	-	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.3, 4.1, 4.4.4 and 4.7	**Context**: Sources terms for the COPCs considered in 3D reactive transport modeling are given by the composition of "Restoration Solution #1", which the Proponent believes is representative of groundwater quality in the ore zone after remediation at decommissioning (Appendix 7-C, sec. 3.3, Table 3-5; sec 4.0). The Proponent considers COPC source terms as "initial conditions" for groundwater quality in the ore zone at the start of the model simulation period. During the simulation, no additional mass of COPCs is transferred to groundwater in the ore zone. **Rationale**: In NRCan's opinion, this representation of COPC sources is not conservative as it fails to account for various long-term slow mass release processes. These processes	NRCan requests that the Proponent's reactive transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) consider extended source release periods for additional COPCs.		Accepted

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					could include redissolution of secondary phases formed during ISR mining (e.g., radium-bearing gypsum or barite, jarosite, alunite) and migration of unrecovered lixiviant or restored solution from low-permeability regions or stagnant zones that were not fully swept during mining or remediation. NRCan notes that scenario #2 in the Proponent's transport prediction uncertainty analysis (Appendix 7-C, sec. 4.7) does consider an extended source release period for protons (desorption from chlorite). However, in NRCan's opinion, additional modeling scenarios should consider extended-release periods for other COPCs as well.			
IR-69	-	NRCan	Fish and fish habitat	Section 7.6.2.2.3 Appendix 7-C, sections 3.1 and 3.2	**Context**: For hydrogeological and geochemical assessments in support of ISR projects, the Proponent identifies two aspects of primary importance (Appendix 7-C, sec. 3.1). These are a) groundwater remediation (Appendix 7-C, sec. 3.1.1); and b) the assimilative capacity of host rocks downgradient from the ore zone (Appendix 7-C, sec. 3.1.2). According to the Proponent, the objective of groundwater remediation at decommissioning is to achieve water quality in the mined zone that does not pose a risk to receptors at the point of exposure. Assimilative capacity refers to the ability of groundwater-rock reactions to naturally sequester or attenuate COPCs migrating from the ore zone during the post-decommissioning period. **Rationale:** However, in NRCan's opinion, the Proponent has neglected to mention the most fundamental aspect for hydrogeological and geochemical assessments in support of ISR projects. That aspect is the choice of ISR lixiviant and its effects on the mineralogy and hydrogeochemistry of the ore zone during mining operations. The Proponent provides information on the pre-mining mineralogy (Appendix 7-C, sec. 3.2.1) and hydrogeochemistry (Appendix 7-C, sec. 3.2.2) but no information on their expected changes as a result of ISR mining. This Information is important when considering source terms in reactive transport modeling.	NRCan requests that the Proponent provide a detailed description of the expected mineralogical and hydrogeochemical changes occurring within the ore and barrier zones as a result of the injection of acidic lixiviant.		Accepted
IR-70	-	CNSC ECCC	Fish and fish habitat Geology and groundwater	Section 7.6.2.2.3, Evaluation of Geochemical Reactive Transport Appendix 7-C, Section 4.4.2, Sub-Domain Model Hydrogeologic Parameters	**Context:** The EIS indicates that "changes to hydrogeological conditions within the mining area were considered during development of the 3D sub-domain model. Dissolution of ore within the active mining area is expected to enhance … hydraulic conductivity". In Section 4.7 (Prediction Uncertainty Analysis), predictive uncertainty scenarios are provided. For scenario 7, the hydraulic conductivity (K) of the ore zone was increased even further than initial model assumptions. The value used is not indicated in the text. **Rationale:** A hydraulic conductivity (K) value of 5x10-6 m/s, which is a factor of five (5) greater than the value assumed for the ore zone, was applied in the base case numerical model to account for this impact. It is unclear from the information provided in Section 7 of the EIS or associated Appendices what the basis of this five-fold increase in K value for the ore zone, and how this was judged to be conservative, or to adequately represent anticipated conditions. This parameter is important as it impacts the rate at which contaminants flow from the ore zone following mining activities. Due to of the dissolution of uranium, larger voids will likely be created, and the hydraulic conductivity may increase by more than a factor of 5 compared to pre-project material. Therefore, a variation of at least one or two orders of magnitude for hydraulic conductivity should be used in the sensitivity analysis. Having a representative, conservative value for hydraulic	Please provide a more fulsome discussion on the anticipated impacts of mining on permeability of the ore zone due to mining activities in the EIS or in an Appendix. The value used for scenario 7 of the prediction uncertainty analysis should be provided. The scientific rationale for the use of a K value only a factor of five greater than the value assumed for the ore zone in the 3D regional model should be provided, alternatively, provide simulation results for a more conservative scenario. Specifically, this discussion should address the potential effects of mechanical permeability enhancement with tools, dissolution of ore, gas plugging, chemical plugging, plugging due to ion exchange, and mechanical plugging.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					conductivity is essential for understanding groundwater as a pathway of contaminant transport to Whitefish Lake and potential impacts to aquatic life. The K value used in the predictive uncertainty analysis should be reported.			
IR-71	-	CNSC	Geology and groundwater	Section 7.7.1, Climate Change Considerations	**Context:** The report states that in a scenario of increased precipitation and decreased/constant evaporation, climate change may result in greater flows in the Wheeler River drainage system and increased recharge to groundwater, which would correspond to increased groundwater discharge to Whitefish Lake. Additionally, it is also stated that climate change was evaluated qualitatively. **Rationale:** It is not clear why the impacts of increased evapotranspiration associated with higher average temperatures were not considered, even though these are likely outcomes of temperature increases due to climate change in areas such as the Prairies (Climate trends and projections - Canada.ca). It is also not clear why climate change considerations were not assessed quantitatively.	Please provide a discussion on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area. Provide justification for performing qualitative assessment of impacts of climate change rather than a quantitative one.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The effect of climate change on groundwater recharge in Prairies or Canada is generally uncertain due to the large degree of uncertainty in the modelling of future recharge although future changes in temperature and precipitation are expected to alter groundwater recharge (through changes to runoff, evapotranspiration, and snow accumulation). While CNSC staff accepts the response on potential effects of increased evapotranspiration, as well as decreased groundwater recharge for the study area, no justification has been provided on why quantitative analysis was not completed to address the effect of climate change on groundwater recharge.	Accepted
IR-72	-	CNSC	Geology and groundwater	Section 7.8.2, Groundwater Monitoring	**Context:** Monitoring seems to consider COPCs from surface facilities, and excursion of pumped mine fluid in the Lower Sandstone Aquifer. There does not appear any discussion on how the proposed monitoring program considers potential excursions of brine from freeze wells. **Rationale:** It is unclear how potential excursions of brine from freeze wells will be monitored. Would this be through the fiber optic cables installed within the freeze well network? Or would it be achieved in the monitoring well clusters? If this is the case, how would an excursion of brine from a freeze well be differentiated from an excursion of mining solution?	Please provide further information regarding how potential excursions of brine from freeze wells will be monitored as part of the proposed groundwater monitoring program.		Accepted
IR-73	-	CNSC	Geology and groundwater	Section 7.8.2.2, In Situ Recovery Mining Area Appendix 7-A, Appendix C	**Context:** The EIS recommends that a follow-up study be carried out to supplement available data on hydraulic conductivity in the Desilicified Zone (DSZ). **Rationale:** Appendix C (Summary of Hydraulic Testing Data and Conductivity Values) of Appendix 7A indicates that only n = 6 hydraulic conductivity values are available for the DSZ, one of which appears unreliable due to a problem with packer sealing. This is relatively few values compared to the Intermediate and Lower Sandstones. Additionally, limited hydraulic head data from boreholes screened in the DSZ is available (GWR-037, GWR-012 and GWR-014; See Figures 16/17 in Appendix 7-A) – most information appears to originate from open core holes. The information presented in its current form is insufficient considering the importance of this zone as a preferential pathway for contaminants following remediation activities, and the heterogeneity of the unit due to intense hydrothermal alteration and fracturing. Further information regarding hydrogeological properties and groundwater flow would aid greatly in validating and refining the numerical groundwater model.	As per the EIS recommendations, please provide additional information to supplement available data on hydraulic conductivity in the DSZ. Please provide the following information as part of the follow-up study: 1. identification of the vertical conductivity (KV) as there is an upward flow component (isotropy was assumed in DSZ for numerical model, this assumption must be verified) 2. quantification of the horizontal and vertical flow gradients in the DSZ; and 3. identification and mapping of any structures with the potential to influence groundwater flow in the DSZ, such as fracture/fault zones.		Accepted
IR-74	-	CNSC	Geology and Groundwater	Section 7.8.2.3	**Context:** It is stated in Section 7.8.2.3 (p. 7-113, main EIS report) that, at the Post-Decommissioning Stage, “Excursion are signaled by a change in water quality that is outside of that bounded by modelling predictions”, and “The model predictions	Please clarify in which locations the water quality data is used to compare with the model predictions to determine if excursion occurs.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					spatiotemporally bound COPC concentrations in the subsurface that do not pose a risk to the receiving environment. Water quality that is outside of this bounding is defined as representing a material increase over a meaningful period compared to the predicted values either in rate of change or magnitude of change of COPC concentrations." **Rationale**: It is not clear in which locations (e.g., is it in the mining area, or downstream of the mining area, or anywhere else?) the water quality is used to compare with the model predictions to determine if excursion occurs.			
IR-75	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K	**Context:** The geomechanical study showed that the stability of the remnant ore zone and surrounding rock mass is highly sensitive to the magnitude of the material properties. To quantify this risk, the Proponent conducted a sensitivity analysis to assess the influence that material properties have on the stability of key stratigraphic layers. The results of the sensitivity analyses suggest that small variations in the cohesion magnitude and angle of internal friction may significantly influence the stability of the altered sandstone, ore zone, and upper and lower clays. **Rationale:** By considering the potential uncertainties and risks in association with the geomechanical study and the empirically derived rock mass strength parameters and the non-site specific physical parameters of different rock formations used for the modeling, the Proponent's consultant suggests to define a laboratory testing program to address data gaps in the current geotechnical data and increase confidence in the material properties, and use more accurate material properties to model the phased extraction of uranium-enriched rock and assess the associated risks for cavity collapse and failure in the steel casing. CNSC staff concurs with these suggestions.	Please provide a plan to implement recommendations for further detailed geomechanical studies to reduce the uncertainties and risks in association with the stability and deformation analyses of ore zone rock matrix and its overlying rock mass formations and assess their impacts on the mine operation.		Accepted
IR-76	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K (p. 12)	**Context:** Based on the consultant's report, the modeled vertical strain is approaching or exceeding the tensile and compressive yield limits for steel casing. **Rationale:** Failure of steel casing may result in process loss or alter groundwater flow and quality.	Please provide additional details on how casing integrity will be monitored and potential effects mitigated.		Accepted
IR-77	-	CNSC	Geology and Groundwater	Appendix 7-A, Appendix K Results of a Geomechanical Study Investigating the Influence of Uranium Extraction on Mining-Cavity Stability for the Wheeler River Uranium Project (Revision 1)	**Context:** It is reported in the appendix K report, within Appendix 7-A, that both phase I scoping analysis and phase II detailed strip model were investigated by numerical modelling. The analysis discussed influence on host rock stability as a result of incremental increase in volumetric extraction and graded conservative treatment of material properties. **Rationale:** As critical components of a numerical geomechanical simulation, initial and boundary conditions are crucially important to the confidence and reliability of the modelling results. However, this information is absent from the current report. In-situ principal stresses largely affects the stability of the excavated host rock, and the vertical strain and surface subsidence. This information is also absent in current form.	Please provide details on the boundary and initial conditions applied on stress loading and strain for the numerical analysis. In particular, the in-situ principal stresses, which are critical to correct understanding of the excavation disturbance to the host rock, should be provided and justified as appropriate.		Accepted
IR-78	-	CNSC ECCC	Fish and fish habitat	Appendix 7-A, Section 3.5.2, Porosity	**Context:** This section of the report outlines the estimated/assumed effective porosity values. The only reference provided is for permeameter testing on rock core samples (Scibek, 2019).	1. Please provide the reference for the data substantiating the assumed effective porosity values reported in Appendix 7-A and used in the numerical model in Appendix 7-C.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.*	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			Geology and groundwater	Appendix 7-C, Section 2.3.2.1, Porosity Values	Additionally, the report states that "As tracer test results to estimate effective porosity were unavailable at the time of modelling, effective porosity values for the sandstone bedrock and basement units were sourced from literature values", where literature values are effective porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to justify this value. Additionally,, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". **Rationale:** The source of reported effective porosity values is unclear from Section 3.5.2 in Appendix A (e.g. literature review, field work, laboratory work). In Section 2.3.2.1 of Appendix 7-C, there is a lack of clarity regarding the effective porosity data used in the numerical model. It appears that no site-specific data derived from tracer tests or pumping tests is used in the numerical model. Given that effective porosity directly correlates to seepage velocity and by extension transport time and distribution of COPCs in groundwater, it is an important parameter. Given its relative importance for contaminant fate and transport, effective porosity should be based on field measurements, or at the very least accounted for in the sensitivity analysis.	2. Please provide information on how the site-specific effective porosity values from tracer tests or pumping tests, were considered in the numerical models. Section 2.2.1.4 of the EIS asserts that tracer tests were carried out in 2021 – this information should thus be available for improving/updating models. Alternatively, provide a sensitivity analysis for the effective porosity in the Desilicified Zone, or contaminant transport simulation results with more conservative effective porosity values.	Effective porosity is an important parameter to understanding groundwater flow and contaminant transport. The Proponent states that "As tracer test results to estimate effective porosity were unavailable at the time of modelling, effective porosity values for the sandstone bedrock and basement units were sourced from literature values", including porosities from the Cigar Lake study (AECL, 1994), situated approximately 40 km NE of Wheeler River. No on-site Wheeler River field data was used to explain this value. Additionally, in the Cigar Lake study, the authors reported that, because results from tracer tests and pumping tests were unavailable, "a practical approach was adopted, i.e., to use the porosity values obtained from laboratory measurements made on core samples, and to assume that those numbers were close to the average field kinematic (effective) porosity values". In response to the IR, the Proponent explained and supported their methodology for selecting a value for effective porosity. This method included consideration of literature values and a regional analogue at Cigar Lake. ECCC notes that a tracer test was conducted, the results of which were not considered in the selection of the effective porosity parameter. If field test data is available that is potentially relevant to determining effective porosity, it should be included in the EIS when discussing effective porosity. The field test data should also be made available for review by the FIRT, to confirm the conclusions reached by the Proponent. Other sources of information can be useful when explaining the most appropriate value for effective porosity such as literature values and regional analogues, as per the Proponent's IR response. However, field test results should be presented in the EIS and considered as a part of such an explanation. If the Proponent feels that not utilizing field test data is the most accurate approach when selecting an effective porosity value, then this conclusion should be reached with consideration of the field test data as a part of the evaluation. Provide a discussion of how the effective porosity values are selected, including a discussion of how field test results were considered. This information is necessary to confirm that the selected effective porosity values are valid. This also relates to IR-52.	
IR-79	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4, Groundwater Chemistry	**Context:** Table 4-1 in Section 4 of Appendix 7-A provides groundwater monitoring results from sampling activities carried out at 26 monitoring wells in 2019, 2020, and 2021. The majority of these wells were only sampled once (n = 8) or twice (n = 17). In some cases (Lower Sandstone Aquifer/Intermediate Sandstone Aquitard), the variability of results between sampling events is quite high. Data for the Paleoweathered Zone is sparse. **Rationale:** Insufficient information is presented in the EIS and associated Appendices to concretely define baseline groundwater chemistry for the different hydrostratigraphic units. As defined in the CNSC's Generic Guidelines for the Preparation of an EIS: "Based on the scope of the project, the EIS will present sufficiently detailed baseline information to determine the effects the project could have on the VCs and analyze those effects". This is particularly important given certain features of the study area (i.e., presence of zones of thermal alteration/desilicification, as well as hydraulically active	Please provide the statistical basis (number of samples and variability) by which "baseline" is defined and the justification that the current information is sufficient to adequately characterize groundwater quality. In order to ensure sufficient baseline information is collected, further iterations of sample collection for groundwater monitoring wells in all defined hydrostratigraphic units may be required. In addition, groundwater quality downgradient from the proposed mining area should be further characterized to assess spatial influence of alteration and hydraulically active features,		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					fractures/faults), and the need to adequately characterize baseline conditions in the Desilicified Zone downgradient from the proposed mining area. As an example, the US Nuclear Regulatory Commission (NRC) typically requires a minimum of four (4) quarterly samples from (i) surficial aquifers, (ii) production aquifers, (iii) overlying aquifers, and (iv) underlying aquifers to characterize preoperational groundwater quality (E. Striz, pers. comm.).			
IR-80	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** This section provides data for groundwater samples collected during the Cigar Lake analogue study and Millennium Project for further regional context. The previous studies are heavily referenced to support interpretations made for the conceptual site model. **Rationale:** The Piper Plots in Figure 26 are difficult to interpret (many overlapping circles with variegated colors), and Cigar Lake samples plot predominantly as Na/K-Cl/SO4 groundwater facies. Conversely, samples collected as part of the Phoenix Project (current), plot either as Ca-HCO3 or Ca-SO4/Cl groundwater facies. No explanation is provided for the observed hydrogeochemical differences between groundwater from the Phoenix project and the Cigar Lake analogue study/Millenium Project.	Please provide additional clarity to and interpretation of Figure 26 in Appendix 7-A, including a revision to the Figure to allow for easier interpretation. This could include clear identification of end members, as well as arrows indicating proposed evolution of groundwater chemistry. Further discussion should be provided describing observed differences between groundwater chemistry at the Phoenix project compared to Millenium/Cigar Lake.		Accepted
IR-81	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit	**Context:** The report states in the description of hydrochemistry of the Lower Sandstone Aquifer that, "On the basis of groundwater chemistry and tritium values in that groundwater, the authors (of the Cigar Lake analogue study in 1994) concluded that the groundwater reflected a younger water component that had penetrated to depth along hydraulically active fractures/faults. The same conclusion is made here (in the Wheeler River EIS) for the Phoenix study area – meaning that fracture/fault conditions are such that some areas of the MFa are characterized by younger/recharge groundwaters". **Rationale:** Tritium results for most wells in the Lower Sandstone Aquifer (MFa) reported in Table 4-1 of Appendix 7-A exhibit tritium concentrations <15 Bq/L for the 2020 sample, and 0.1 or <0.1 Bq/L for the 2021 sample. Tritium in modern precipitation typically varies from 1 – 3 Bq/L. Conclusions made in the text are not supported by data, especially given that tritium values are not reported in the EIS for local precipitation or surface water. This is important in reinforcing the assumption from the conceptual model that modern meteoric water circulates at depth in the Lower Sandstone Aquifer.	Provide a further discussion on the interpretation of tritium in groundwater, rather than echoing conclusions from the Cigar Lake analogue study. Consideration should be given to the assertion that modern meteoric water circulates at depth in the Lower Sandstone Aquifer. Collection and analysis of stable isotope (e.g., δ2H, δ18O) samples is a cost-effective solution which would greatly improve understanding of groundwater hydrology and support the development of a conceptual model.		Accepted
IR-82	-	CNSC	Geology and groundwater	Appendix 7-A, Section 4.3.3, Hydrochemistry by Hydrostratigraphic Unit Appendix 7-C, Section 3.5	**Context:** A. In-field measurements of Oxidation-Reduction Potential (ORP) for three (3) out of twenty-six (26) groundwater samples are presented in Table 4-1 of Appendix 7-A. Although sparse, these values are also used to characterize redox conditions for representative groundwaters in Table 3-5 of Appendix 7-C. B. In Section 3.5.5 of Appendix 7-C it is stated that groundwaters in the PHREEQC model were allowed to equilibrate with atmospheric concentrations of oxygen, resulting in oxidizing subsurface conditions. In Section 3.7 of Appendix 7-C it states that input files for 3D reactive transport were generated based on outcomes for PHREEQC modelling. However, in reading Section 4 of Appendix 7-C, it is unclear whether this assumption (equilibration with atmospheric oxygen) was carried forward for the 3D model.	1. Provide further discussions and information (i.e., ORP measurements or analytical data for redox couples) on redox conditions at the Phoenix site. Particular focus should be given to the spatial heterogeneity of redox processes. Tools such as the reference provided [2] below provide an example of simplified framework for characterizing redox conditions in aquifers. 2. Clarify assumptions regarding initial redox conditions for the 3D solute transport model. 3. Provide the % reactive pyrite by weight assumed for models	Please see AD-65 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					C. As per p. 3.49 of Appendix 7-C, "A small amount of reactive pyrite was assumed for the first 500 m of transport away from the ore zone in the model, primarily in the desilicified sediments of the Lower Sandstone Aquifer, and deeper portion of the Intermediate Sandstone Aquitard". **Rationale:** A. Given the importance of redox conditions for U mobilization and precipitation/dissolution of minerals (e.g., pyrite/metal oxyhydroxides) and the corresponding influence on contaminant transport from both a modelling and monitoring perspective, these should be further characterized. It should also be noted that the measurement of Oxidative-Reductive Potential (ORP) in natural waters can be complex and difficult due to the variability and disequilibrium of natural systems and issues inherent to electrode calibration (e.g., Schuring et al., 2000). Measurements of redox couples (e.g., As(III)/As(V); Fe(II)/Fe(III); S(-II)/S(VI)) are typically recommended to accurately characterize redox conditions in natural waters (Schuring et al., 2000). B. The assumptions regarding redox conditions for the 3D solute transport model should be clarified. C. The amount of pyrite (e.g., % by weight) assumed for the purposes of modelling should be clarified, given the potential role of pyrite as a reducing agent in limiting the transport of COPCs. **Reference**: [1] Schuring J.; Schulz, H. D.; Fischer, W.R.; Bottcher, J.; and Duijnisveld, M.H.W. 2000. Redox: Fundamentals, Processes and Applications. Springer: Berlin.	in the text. Justification for proportions used, such as analytical data, should also be provided. **Reference**: [2] Jurgens, B.C., McMahon, P.B., Chapelle, F.H., and Eberts, S.M., 2009, An Excel workbook for identifying redox processes in ground water: U.S. Geological Survey Open-File Report 2009–1004 8 p.		
IR-83	-	CNSC	Geology and Groundwater	Appendix 7-A, Section 7.4.2.2 and Appendix K	**Context:** Leaching of uranium from the ore zone will generate voids within the ore zone, which could fail and collapse. Failure of the voids would cause displacement in overlying rocks, which will lead to the eventual ground subsidence. Based on the developed geological model, a geomechanical study was conducted to assess potential maximum vertical displacement in the overlying rock formations and predict the ground subsidence. While a layer of altered sandstone is modeled above the ore zone, the desilicified zone, a zone that is comprised of completely to partially unconsolidated sands and has very low rock quality, high fracture intensity, and high friability, and low strength in the area overlying and east of the Phoenix deposit, appears not to have been included in the model for geomechanical modeling. The evaluated displacement/deformation in the overlying rock formation and the resulted ground subsidence would not be conservative without including the desilicified zone. **Rationale:** Stability of the ore zone rock matrix and the potential displacement/deformation in the overlying rock formations when voids in the extracted ore zone collapse are critical for protecting the overlying aquifers, preventing substantial ground subsidence, safeguarding casing integrity, and mitigating plug-off of the remaining ore as well as efficiently mining extraction. The deformed zone in the overlying rock formations will change in hydraulic conductivity that will impact on the assessment of potential effects on groundwater flow and contaminant transport in the zone. Therefore, the rock mass behavior including and above the ore zone should be	Please provide details whether and how the desilicified zone is considered in the geomechanical modeling of the detailed strip model. Such details should include figures and the linkage between the geomechanical model including the determination of strength parameters of the desilicified zone and the geological model including information on the core delineation of the desilicified zone.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					adequately understood and the potential displacement/deformation should be assessed and quantified with adequately defined geological model.			
IR-84	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.5.2.4 (p. 2.35, Appendix 7-C) that "In addition to calibrating to water level elevations targets, the model was calibrated to estimates of groundwater discharge to Whitefish Lake. A match between simulated and observed flows helps to support that groundwater recharge rates are reasonable, and to provide validation for water budget assessments. Baseflow calibration targets were developed using point streamflow measurements collected upstream and downstream of Whitefish Lake. Figure 2-10 (p. 2.26, Appendix 7-C) shows the locations of the baseflow calibration targets, and Table 2-7 (p. 2.35, Appendix 7-C) illustrates the model-simulated groundwater discharge rates in relation to the estimated range of baseflow from stream measurements. The simulated baseflow to Whitefish Lake is in good agreement with the estimated representative baseflow". **Rationale:** It is not clear in Figure 2-10 (p. 2.26, Appendix 7-C) where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. Additionally, it is not clear how the groundwater discharge to Whitefish Lake is simulated, since the model domain does not cover the whole Whitefish Lake.	1. Please clarify in Figure 2-10 where the point streamflow measurements were conducted upstream and downstream of Whitefish Lake. 2. Please clarify how the groundwater discharge to Whitefish Lake is simulated considering that the model domain does not cover the whole Whitefish Lake.		Accepted
IR-85	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** Section 2.7.3 (Appendix 7-C) mentions Wells A, B and C, and Figure 2-17 (p. 2.43, Appendix 7-C) illustrates the predicted drawdown ranges at Well B and Well C. **Rationale:** It is not clear where Well A, Well B and Well C are located.	Please provide the locations of Well A, Well B and Well C illustrated in a Figure.		Accepted
IR-86	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** It is stated in Section 2.7.3 (p. 2.41, Appendix 7-C) that "Both the pumping demand and the recharge changes were incorporated into a transient simulation performed using the calibrated groundwater flow model. The model simulation was started at the beginning of mine construction, with initial conditions taken from the calibrated model. The simulation period was extended for 40 years to include the entire period of construction, operation, and decommissioning, and extending through 17 years post decommissioning". **Rationale:** It is not clear what is the difference between the calibrated model and transient model in terms of parameters (such as the K values for the mining zone), boundary conditions, etc.	Please clarify the parameters, boundary conditions and any other aspects as used in the transient model that are different from the calibrated model.		Accepted
IR-87	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** In Section 2.8 (p. 2.45, Appendix 7-C) Parameter uncertainty assessment, only parameters for certain zones (part of each specific hydro-stratigraphic unit as shown in Figure 2-19, p. 2.46, Appendix 7-C) related to the pathway from the ore zone toward Whitefish Lake were allowed to vary in order to find combinations of parameter values that met statistical calibration criteria. If each hydro-stratigraphic units within the whole model domain were treated as parameter zones that can have varied hydraulic conductivity values, a different combination of parameter values could be obtained that meet statistical calibration criteria too.	It is recommended that the parameter zones in the Parameter uncertainty assessment include hydro-stratigraphic units in the whole model domain to investigate the possible combination of parameter values that could make the groundwater in the mined-out zone more active hydraulically.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: The parameter values for parameter zones between the mining area and Whitefish Lake is important in determining the hydraulic connection between the mining area and Whitefish Lake. Parameter values in other parameter zones could also be important. For example, if the K values for the intermediate sandstone aquitard are significantly larger than in the current calibration results, the interaction between the upper sandstone aquifer and the lower sandstone aquifer could be more active, and the mined-out zone could be more active hydraulically and groundwater in the minded-out zone could have a shorter residence time than in the current calibrated model. Additionally, it is noted that Figure 2.19 (p. 2.46, Appendix 7-C) illustrates the parameter zone for the intermediate sandstone aquitard. However, Figure 2.20 (p. 2.49, Appendix 7-C) did not include the intermediate sandstone aquitard in the results.			
IR-88	-	CNSC	Geology and Groundwater	Appendix 7-C	**Context:** The conceptual hydrogeological model includes upper sandstone aquifer, intermediate sandstone aquitard, and lower sandstone aquifer. The desilicified zone above the ore zone have enhanced hydraulic conductivity. The boundary condition for the lower sandstone aquifer on the west (upstream) side was assigned to have specified head, which provide source of water for the lower sandstone aquifer. As a result of the conceptual model setup, the upper sandstone aquifer is hydraulically active and the groundwater residence time within the upper sandstone aquifer is relative short. In contrast, the lower sandstone aquifer (and the ore zone) is hydraulically inactive, and the groundwater residence time in the lower sandstone aquifer is relatively long (as shown in the particle tracking results in Figure 7.6-2 (p. 7-71, main EIS report), and the simulated plume for chloride in Figure 7.6-7(p. 7-86, main EIS report)). It is stated in Section 2.6.4 (Appendix 7-C) that "As noted above in section 2.6.3, it is estimated that 99% of the groundwater discharge to Whitefish Lake is derived from groundwater that has only flowed through shallow deposits (i.e., Overburden and Upper Sandstone Aquifers). Contribution of deep groundwater flow through the Desilicified Zone within the Intermediate Sandstone Aquitard is estimated to be < 1% of the groundwater discharging to Whitefish Lake". This simulation result is reflective of the conceptual model. Section 7.3.3.3 (p. 7-42) states that "The Lower Sandstone Aquifer is characterized spatially by two types of groundwater. The first groundwater type is most like that observed in the Local Flow System. This reflects hydraulically active fractures and fault systems that allow fresh recharge water to penetrate and mix with deeper waters in the aquifer. The second type of groundwater is within the zone of thermal alteration around the ore zone ……". The hydraulic connectivity of the ore zone with the upper sandstone aquifer has important implication on the groundwater restoration. The ore zone is not hydraulically active locally because it is enclosed by a clay zone before the mining operation. But if it is located within a hydraulically active area, or on a groundwater flow pathway that is hydraulically active, the mined-out zone (with much larger porosity and hydraulic	It is recommended to conduct the following work to demonstrate if the mined-out zone is hydraulically active: 1. Determine the groundwater residence time in the lower sandstone aquifer and compare it with the simulated residence time in the numerical model. 2. Conduct additional particle tracking to demonstrate where groundwater originating from the mined-out zone flow towards (forward tracking) and where groundwater flowing towards the mined-out zone originates from. This would help determine why groundwater in the mined-out zone is not hydraulically active. 3. Conduct sensitivity analysis to investigate the effect of higher K values for the intermediate sandstone aquitard and the K and porosity values of the mined-out zone on the plume migration.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					conductivity) could become active hydraulically after mining operation is finished. Figure 7.6-7 (p. 7-86, main EIS report) shows that the chloride plume is most persistent within the mined-out mining area. This seems to indicate the mined-out zone is hydraulically inactive after the mining operation is finished. It is stated in Section 7.3.3.2 (p. 7-37, main EIS report) that "Exploration boreholes drilled in the Phoenix area, where left unplugged, have the potential to provide preferential flow paths between the Overburden and Upper and Lower Sandstone Aquifers. Exploration holes were reportedly grouted approximately 10 to 20 m above and below the ore zone, resulting in open holes remaining throughout the overlying materials. These portions of the open holes may act as open conduits for groundwater flow through the 400 m of Athabasca Group Sandstone." So, there is possibility that the unplugged borehole could increase the hydraulic connection between the upper and lower sandstone aquifer. **Rationale:** It is important to understand if the larger area containing ore zone is hydraulically active. Additional confidence would be gained if there is any other evidence that support that the area containing the ore zone is not hydraulically active, and groundwater residence time in the lower sandstone aquifer surrounding the ore zone is comparable with the simulated results. Table 2-4 (p. 2.16, Appendix 7-C) shows the effective porosity (0.01-0.05) of the ore body. Figure B7 (p. B.8, Appendix 7-C) shows that the calibrated K values for the mined-out zone is 1x10-6 m/s. Section 3.5.2 (p. 3.24, Appendix 7-C) states that "The same average linear velocity was assumed for the mining area (source zone), following from the discussion in Section 4.4.2, where the hydraulic conductivity value in this zone following mining was set to 5x10-6 m/s, and a porosity of 0.2 is assumed for the ore zone (Table 4-2)". It is not clear what the justification is for the selection of the porosity and K values for the mined-out area, and whether they are conservative. It is also not clear, what the potential impact on the groundwater flow and COPCs transport would be If the mined-out zones collapse.			
IR-89	-	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone	**Context:** The Proponent states that a hydraulic conductivity value of 5x10-6 m/s was uniformly assigned to the model layers representing the Desilicified Zone. They additionally state that this value is consistent with packer and pumping tests screened in this unit that have interpreted hydraulic conductivity values ranging from 1x10-6 to 3x10-5 m/s (Appendix C), with a geomean of 6.0x10-6 m/s. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on fish and fish habitat. **Rationale:** The Desilicified Zone is a critical layer in the hydrogeological model as it represents a key potential pathway of contaminants to Whitefish Lake. The base case hydraulic conductivity value (5x10-6 m/s) is even lower than the geometric mean, not to	1. Provide an in-depth rationale for choosing a value of 5x10-6 m/s as the base case for the hydraulic conductivity, in both the PH REdox EQuilibrium (PHREEQC) and Finite-Element Ground Water Flow (FEFLOW) models. 2. Provide a rationale for keeping the sensitivity analysis within one order of magnitude considering the lack of physical data on the Desilicified Zone. Alternatively, provide contaminant transport simulation results with more conservative hydraulic conductivity (e.g., more than 3x10-5 m/s) values in the Desilicified Zone. See also related: IR-96.	The Desilicified Zone is a critical layer in the hydrogeological model because it represents a key potential pathway of contaminants to Whitefish Lake. There is a limited amount of field data for the Desilicified zone. A sensitivity analysis should allow the model to test slightly outside of the observed field data values. Following a supplementary submission provided by Denison on July 2nd, this IR is accepted for the purposes of the EA review, subject to the addition of a commitment to: • revisiting and updating the groundwater models as necessary, as more data becomes available through the EA follow-up monitoring program to improve confidence on the hydraulic values of the desilicified zone. This commitment must be provided in the updated commitment report, as part of the final EIS submission package. Denison should also take this commitment into account when developing the EA follow-up monitoring program.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					mention the highest value found. When simulating geochemical processes and contaminant transport within this important pathway a more conservative approach should be employed. Modifying this parameter will affect travel times and distribution of COPC in the subsurface.			
IR-89	IR-89-R1	ECCC	Fish and fish habitat	Appendix 7-C, Numerical Modelling: Post-Decommissioning Evaluation, Section 2.3.1.4, Desilicified Zone IR-89 Response from Denison	**Context:** The Proponent states that the range of hydraulic conductivities considered in sensitivity analysis was limited to values that fit within a calibration constrained uncertainty analysis of the model. Considering that the Desilicified Zone is of particular interest because it is the main pathway for the COPC to reach Whitefish lake, and that hydraulic conductivities are not entirely understood, ECCC recommends that a larger range of hydraulic conductivities be simulated to understand potential effects on the aquatic environment. The Proponent clarified the details of the calibration-constrained uncertainty analysis that was used for parameter bounding within the model, with hydraulic conductivity sensitivity bounds determined based on model calibration values that were supported by the available physical data. **Rationale:** ECCC agrees that calibration constrained uncertainty analysis using hydraulic head field data is useful to determine probable upper limits of K values. However, there is always some degree of uncertainty in groundwater data and models. Sources of such uncertainty may include errors, lack of complete and representative field data to determine key parameters, or any number of heterogeneities associated with groundwater systems over large scales. Such uncertainties will always exist and can be accounted for by conducting a sensitivity analysis that accounts for the lack of physical data in the Desilicified Zone by running modelling scenarios using parameters that are outside of the calibration constrained values.	Expand the sensitivity analysis of hydraulic conductivity outside of calibration constrained parameters to account for the lack of physical data in the Desilicified Zone.	See IR-89 (above).	Accepted
IR-90	-	ECCC	Fish and fish habitat	Appendix 7-C, Section 2.4 and 2.6	**Context:** Hydraulic conductivities and hydraulic gradients play an important role in groundwater flow, geochemical modeling, and contaminant transport for the PHREEQC and FEFLOW models. Although there is an important vertical component to the contaminant transport, there is no distinction made between lateral and vertical hydraulic conductivities of hydraulic gradients. **Rationale:** According to the conceptual model, there is an important vertical aspect to the groundwater flow thus incorporating any vertical hydraulic gradient or hydraulic conductivity information into the calibration would increase confidence in the results. Providing a distinct value for vertical hydraulic conductivity will improve the accuracy of the model in regards to the transport of contaminants to Whitefish Lake through the Desilicified zone, which is important to understand potential impacts to aquatic life.	1. Explain if the vertical and lateral hydraulic gradients and hydraulic conductivities are assumed to be equivalent. 2. Provide a rationale for not distinguishing between vertical and lateral hydraulic gradients. 3. Alternatively, provide both lateral and vertical hydraulic gradient estimates and the implications on contaminant transport.		Accepted
IR-91	-	NRCan	Fish and fish habitat	Appendix 7-C, section 2.5.2	**Context**: The numerical model calibration quality plot (Appendix 7-C, sec. 2.5.2.1, Figure 2-13) contains a small error. The vertical (simulated heads) and horizontal (observed heads) axes do not have the same scales (499 to 521 masl versus 499 to 522 masl). Therefore, the line of ideal fit is offset.	The Proponent should correct the scales on the axes of Figure 2-13 in Appendix 7-C. The Proponent should also comment on the effect on calibration of the clustering of most observation wells in the ore zone.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: As a result, NRCan notes that observed heads in the 510-512 masl range are underpredicted by the model. NRCan also notes that the calibration statistics (Appendix 7-C, sec.2.5.2.3) are highly leveraged by two data points from open boreholes south of Kratchkowsky Lake where simulated values are largely controlled by the nearby constant-head boundary in the Lower Sandstone aquifer (520 masl).			
IR-92	-	CNSC	Geology and groundwater	Appendix 7-C, Section 3.2.1, Mineralogical Composition	**Context:** Table 3-2 summarizes the clay content of the Athabasca Group sandstones and the Paleoweathered Zone. Although minimum, maximum and median values are provided, the number of samples and variability of the dataset are not. Rationale for incorporating illite into reactive transport modelling and excluding kaolinite/dichlorite is provided in the text. From p. 3.29 in Appendix 7-C: "The illite content was based on the normative clay composition determined from site-specific corehole elemental analysis (median illite by mass is 7.68%; Table 3-2) and using portable infra-red mineral analysis indicating median illite content by mass is 13.1% (data not shown)" From p. 3.30 in Appendix 7-C: "Using the minor amount of illite compared to the more dominant chlorite is conservative in that not all sorptive capacity of the clays is accounted for in the simulated paleoweathered zone". This conservative assumption appears contrary to assumptions for the desilicified zone (DSZ) and Athabasca Group sandstones "Illite was used to represent the total clay content, which varies from 1.74% to 5.85% by mass in the hydrostratigraphic units within the Athabasca Group sandstones and Desilicified Zone". **Rationale:** Information is missing in the EIS regarding the clay composition of hydrostratigraphic units. Results from infrared mineral analysis are not reported. The assumption for the solute transport model is that all clays in the downgradient DSZ are illite. However, clay content in the Read Formation (Lower Sandstone Aquifer) downgradient of the ore zone is low in illite (0.42%) compared to kaolinite (0.52%) and dichlorite (1.18%). A value of 3.9% illite clay by weight is used for the DSZ, but Table 3-2 indicates median content is 2.42% illite. It is not clear why illite was used to represent total clay content for the DSZ, as opposed to the conservative assumptions used for the Paleoweathered Zone, nor has any basis or justification been given.	1. Please provide in Table 3- the number of samples and variability of the datasets used to estimate the clay content of hydrostratigraphic units for the model. Include results from infrared mineral analysis in the text if the information is used to support assumptions for modelling. 2. Please provide further information/discussion within the EIS relating to the assumptions of clay content in hydrostratigraphic units for modelling. Provide further justification and rationale as to why total clay content in the Athabasca Group sandstones and Desilicified Zone is assumed to be illite, and how this assumption is conservative. This discussion could include a comparison of the properties (cation exchange capacity, surface area) of illite vs. kaolinite vs. dichlorite for the anticipated range of subsurface conditions (pH, redox, U concentrations, etc.).		Accepted
IR-93	-	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-10: Properties of Adsorbing Mineral Phases	**Context:** In Appendix 7-C, section 3.5.6.2.2 Ion Exchange and Surface Complexation, the consideration of ion exchange and surface complexation and the corresponding parameters and chemical reaction are discussed. **Rationale:** The site density of sorbent Geothite was reported in Table 3-10 to be 1.6E3 mol/kg. Taking into account the specific surface area of 60 m2/g, this equals to 1600/6E4 mol/m2, or 0.0266 mol/m2, 1.6e4 sites/nm2. This value largely overestimates the site density of goethite, which is reported to be in the range of 2~6 sites/nm2. The reference used in the EIS report indicates the similar	Please provide additional evidence to justify the model parameter of site density for goethite, applied to the numerical model. If necessary, the reactive transport modelling should be re-run to update the contents presented in the EIS report.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					range of variation for this specific parameter. There are plenty of similar studies on SCM of iron oxides in literature. It is suggested to consult with more than one single study to enhance the reliability of model parameters. The overestimation of sorption site density will directly result in underestimation of the affected COPCs' concentrations in pore fluid. This will result in underestimation of COPC transport plume in the affected underground space, and potentially the dissolved concentrations in the hydrogeological sink.			
IR-94	-	CNSC	Geology and Groundwater	Appendix 7-C, Numerical modelling: post-decommissioning evaluation, Section 3.5.5, Subsurface Conditions Incorporated	**Context:** It is reported in this section the assumed subsurface conditions that were applied in the geochemical site conceptual models. Critical phenomenon of pH tail was mentioned. Inclusion and exclusion of corresponding geochemical reactions were discussed briefly. **Rationale:** It was reported that the residual reduced minerals of uraninite and pyrite were not included in the modelling of the remediated mining area. The argument was based on consideration of the upstream groundwater, passing through the mined zone, will not be oxidizing and groundwater conditions are expected to be similar to pre-mine conditions. However, this ignores the pH tail effect that releases proton H+ sorbed to solid surface during ISR flooding. By ignoring this process, there is a potential risk of underestimating the source terms for some key COPCs. Exclusion of uraninite and pyrite in remediated mining area modelling is contradictory to pH-tail effect. The justification is not sufficient in the current form.	Please provide additional evidence to justify the approach for excluding uraninite and pyrite from the analysis of remediated mining area. This may require the results from additional modelling.		Accepted
IR-95	-	CNSC	Geology and Groundwater	Appendix 7-C, Table 3-11	**Context:** The Table 3-11 reported the Solid-Phase Concentrations and Partitioning Constants for COPCs. Data were both measured and simulated. **Rationale:** It is unclear how the partition coefficients of various COPCs upon desilicified and paleoweathered rocks were obtained. It was not reported at what pH were these K_d analyzed. Sorption of chemicals on solid phase is known to be pH dependent. It is unclear whether pH influence was considered in the measurement and analysis of apparent partition coefficients. In addition, uptake of metals on clay is highly nonlinear, and always has a maximum capacity. Even with a very strong affinity towards specific metal ions, the sorption will be saturated at elevated concentrations. Therefore, assuming a linear correlation needs to be cautious of the concentration range of target COPC species, and the applicable sorption capacity of the clay mineral. In the current model, only the linear form of sorption is considered, although with discussion of K_d value selection. Additional rationale is needed to justify if the applied methodology is sufficient for assessment.	Please justify the choice of applying a linear form partition coefficient for the modelling and assessment, and whether it provides a conservative approach to the assessment results. Clarity around the experimental conditions during the measurement of partitioning coefficient of various COPCs on the target rocks may help support this assumption.		Accepted
IR-96	-	CNSC	Geology and groundwater	Appendix 7-C, Section 4.4.4, Sub-	**Context:** From the text, "Transport parameters were specified for diffusion (1x10-9 m2/s), longitudinal dispersivity (10 m along the plume trajectory), and transverse	1. Please provide the source of the numerical value used for diffusion and longitudinal and transverse dispersivity, and	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews,*	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Domain Model Transport Boundary Conditions	dispersivity (5 m)". The source of this information is not provided in Appendix 7-C. It is unclear if the values used are defaults in the modelling software, from literature, from small-scale laboratory tests, or are site-specific values determined through tracer tests. **Rationale:** The use of a calibrated flow model does not imply that the solute transport model is calibrated. The transport parameters (such as effective porosity, dispersivity and reactive transport parameters) can only be calibrated by matching simulated and observed spatial and/or temporal distributions of a solute. Sensitivity analysis indicates that decreasing longitudinal and transverse dispersivities by a factor of two resulted in exceedances of groundwater criteria for both selenium (Se) and cobalt (Co). Given the clear influence of these values on contaminant transport, it is important that transfer parameter values are justified in the solute transport model. In addition, the influence of large-scale heterogeneity on dispersion and solute transport predictions should be discussed, to identify any uncertainty in the model predictions, and provide confidence that the applied model is adequately representing groundwater flow and solute transport. Further guidance on solute transport modelling can be found in BC MOE (2012) [1]. **Reference**: [1] British Columbia Ministry of the Environment (BC MOE). 2012. Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Resource Development Activities. Report no. 194001, 385 p.	provide justification if default values by the model code were used. 2. Please provide a discussion on the influence of large-scale heterogeneity on dispersion and solute transport predictions in the modelling report. See also related: IR-89.	*prior to the granting of a Licence.* CNSC staff appreciate the comprehensive information provided relating to longitudinal dispersivity and variation based on scale. However, it should be noted that guidance from Gelhar et al. (1992) and the BC MOE (2012) indicate that horizontal transverse dispersivity values should be approximately 1 order of magnitude lower than longitudinal dispersivity values, and vertical transverse dispersivity values should be approximately 2 orders of magnitude lower than longitudinal dispersivity. For the model presented in the EIS, transverse dispersivity is represented by a singular value of 5 meters, with the supporting rationale that the Gelhar et al. (1992) identified 5 meters as a representative value. It is important to note that the Gelhar et al. (1992) paper considered 5 meters to be representative for horizontal transverse dispersivity and identified that vertical transverse dispersivity is smaller than horizontal transverse dispersivity. Additionally, it is important to note that Petrotek (2021) used a transverse dispersivity of 1 m in their numerical models of the ore zone aquifer. CNSC staff thus request that Denison provide further information relating to why horizontal and vertical transverse dispersivity are represented using a singular value, and how this value is considered appropriate to represent both dimensions. **Reference:** Petrotek 2021. Groundwater Model Report Phase 1, Phoenix Deposit Wheeler River Project. Prepared for Denison Mines. December 2021.	
IR-97	-	ECCC	Fish and fish habitat	Appendix 7-C, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b	**Context:** Appendix 7, Figures 4-6, 4-7a, 4-7b, 4-8a, 4-8b, 4-9a, 4-9b present contaminant transport simulations of chloride, selenium, cadmium, and uranium. All simulations use initial condition concentrations at t=0 (or end of mining operations. In the 3D FEFLOW contaminant transport model it is not clear why initial condition concentrations were chosen rather than a constant concentration boundary. It is also unclear if mining activities will cause mobilization of the contaminants beyond the end of operations. **Rationale:** The choice of boundary conditions may impact the predicted transport of contaminants that reach Whitefish Lake through groundwater, which may have impacts to aquatic life.	1. Explain and clarify if mining operations will mobilize contaminants beyond operations? 2. Clarify if the source of contamination, (e.g., uranium, selenium) will cease after operations? 3. For the 3D model please provide the rationale for using initial concentrations rather than constant concentration boundary conditions for contaminant concentrations.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, if required.* It should be noted that the fate and transport simulations of the COCs are dependent on groundwater flow. Therefore, the Proponent's conclusions on the transport of COCs, may need to be revisited depending on how IR-89 is resolved.	Accepted
IR-98	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 8, Aquatic Environment	**Context:** It states in EIS in Section 8.3.7.1 (p. 8-151) that "Cameco's Key Lake Operation will overlap spatially and temporally with the Project". **Rationale:** It is not clear whether there is the possibility that planned Denison discharges would eventually flow into and influence a background reference lake used by Key Lake operation.	Please provide supporting information to demonstrate whether discharges from the proposed operation will not eventually flow into a reference lake used by another existing operation.		Accepted
IR-99	-	CNSC	Aquatic environment	Section 8, Water Quality, Table 8.2-13	**Context:** Table 8.2-13 shows the maximum concentration of hazardous and radiological COPC's in surface water throughout the local study area. However, the concentration for all constituents is stated as mg/L.	Please use Bq/L when displaying concentration of radiological COPC's. If this was a typographical error in the table, please indicate as such and revise the table to indicate values are		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: It is unusual for radiological COPC's to be displayed in mg/L, radiological constituents are typically displayed in Bq/L	indeed in Bq/L. Please also review other tables displaying concentrations of radiological constituents to ensure this error is not repeated in other tables.		
IR-100	-	HC	Indigenous Peoples' health / Socio- economic conditions	Section 8, (p. 8-195) Section 8.5.3, Table 8.5-2, (p. 8-226)	Mercury is excluded as a COPC in the assessment. Inadequate consideration of mercury and methylmercury in fish and other country foods, and use of incorrect Hg-related health guideline values can underestimate the risks to human health among country food consumers. **Context:** Section 8 states "Mercury has not been identified as a COPC for the Project as it is currently not present in the receiving environment (i.e., background condition) at detectable concentrations and will not be produced as part of the mine process; therefore, it will not be discharged to the aquatic environment. However, it is understood that potential nutrient enrichment-related effects are possible and can be linked to increases in mercury in the environment" (p. 8-195). Table 8.5-2 shows that there is mercury present in the tissues of Northern Pike and White Sucker sampled in the waterbodies within the local study area and in Russell Lake. These fish are regularly consumed by nearby communities according to the ERFN 2017 dietary survey. In Section 8.5.3, fish tissue concentrations are compared to Health Canada's human health risk- based maximum permissible mercury concentration (0.5 µg/g wet weight), which is applicable to most species of commercially sold fish rather than country foods. **Rationale:** It is recommended that mercury be listed as a COPC considering it is in fact present in fish tissue under existing conditions, the significant consumption of fish by the local Indigenous communities, and its toxicological significance to human health. Further, the Health Canada provisional tolerable daily intake (pTDI) value of 0.2 µg/kg/bw/day (Health Canada, 2007) is a more appropriate reference level when evaluating consumption of mercury in fish by Indigenous people, as it allows for the consideration of food consumption patterns in the risk assessment that differ from the general population and is protective of the most sensitive sub-group (i.e., developing foetus). It is important to note that methylmercury, rather than inorganic mercury, is generally the predominant mercury species present in fish and is also the most toxicologically significant form. The assumption of 100% of mercury in fish and other country food items being present as methylmercury ensures that the potential health risks are not underestimated. It is unclear, however, if the mercury data presented throughout the EIS represent total mercury, inorganic mercury or methylmercury.	1. Include mercury (including methylmercury) as a COPC in the assessment given the baseline presence of mercury in sampled fish, the potential increase of methylmercury in receiving waters due to nutrient enrichment resulting from the Project, the significant fish consumption by the local population and that country foods, particularly fish, are an important source of dietary exposure to mercury. 2. Assess health risks from fish consumption by calculating hazard quotients for baseline and predicted methylmercury levels in country foods using Health Canada's pTDI for methylmercury (Health Canada, 2007). 3. Clarify whether mercury data represented throughout the EIS represents total mercury, inorganic mercury or methylmercury. **Suggestions for mitigation and follow-up measures:** Health Canada recommends including methylmercury in the list of COPCs to be monitored in fish throughout all project phases. See also related Advice to the Proponent: AD-31.	The July 2nd, 2024 supplementary submission for IR-100 and version 2 of the Commitment Register (July 17th) included a commitment to assess health risks from fish consumption by comparing fish tissue data collected during operation from the monitoring program against Health Canada's mercury guideline of 0.5 ug/g wet weight, as applicable (ID 8-44). Reviewers note an apparent contradiction between use of the provisional tolerable daily intake (pTDI) and the commercial guideline for mercury in fish. The Proponent states that the health risks from fish consumption will be assessed by comparing mercury concentrations from monitoring activities to the Health Canada maximum level for mercury in retail fish. As noted in HC's review of the Round 2 Response, the mercury guideline for commercial fish (0.5 ppm) may not be protective of human health because fish consumption patterns of local Indigenous populations may differ from that of the general Canadian population who generally obtain fish from retail sources. The health risks of mercury exposure should be assessed using local fish consumption rates and the provisional tolerable daily intake (pTDI) value of 0.2 µg/kg bw per day. Denison are expected to remove reference to the use of commercial guideline for mercury in fish to remove apparent contradiction with provisional tolerable daily intake in the final EIS submission package, and this IR can be resolved for the purposes of the EA process. *The following outstanding issue will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: • Local fish consumption rates should be discussed and refined as needed during planned engagement with Indigenous Nations and communities.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-101	-	ECCC CNSC	Fish and fish habitat	Section 8.1.1.3, Section 8.2.1.3 Aquatic Environment	**Context:** In Section 8.1.1.3 Spatial and Temporal Boundaries the Project Area, Local Study Area (LSA) and Regional Study Area (RSA) are established as they pertain to surface water quantity. The same is done in Section 8.2.1.3 for surface water quality. In Section 8.1.1.3 Figure 8.1-4, the locations of the Project Area, LSA, RSA and surface water features and monitoring stations are provided. However, the locations of wetlands located near the Project area and within the LSA and RSA have not been provided. The location of wetlands within or near the Project footprint, as well as the other wetlands existing within the LSA can be confirmed from Part II_S9 Terrestrial Environment, Section 9.2.3.3 Figure 9.2.-8, including the wetland classifications. There appears to be at least one shallow open water wetland and several bogs located within the Project Area. There is no consideration of wetlands or potential effects to wetland hydrology, surface water or sediment quality throughout the aquatic environment assessments. There is no baseline information regarding wetlands and their status as fish habitat and ecological function, or assessment of potential effects to flow rates, water levels, water quality, sediment quality, or biota. **Rationale:** There is currently not enough information provided for ECCC to provide advice on the potential risks of the proposed Project to wetland hydrology, surface water and sediment quality within the LSA. This pathway of effects is important to assess in terms of potential effects to wetland habitat availability and quality due to changes in flow rates, water levels, water quality, sediment transport, sediment quality and potential effects to terrestrial and aquatic receptors. It is necessary to evaluate if changes in groundwater and surface water runoff flows and routing will affect water levels and habitat availability within wetlands. Potential effects from COPCs and radionuclides to surface water and sediment, or potential effects to ecological receptors within wetlands have not been evaluated.	1. Provide baseline information regarding wetland characterization within the Project Area and LSA, including: locations, wetland type, size, water surface elevation, depth, water flow pathways, and the presence of wildlife receptors including presence of fish/fish habitat within the Aquatic Environment section of the draft EIS. If this information is available in annexes or baseline studies, summarize it within the main body of the Aquatic Environment section of the draft EIS with references to respective documents for review. 2. Provide baseline information on wetland surface water and sediment quality characterization for wetlands within the Project footprint. 3. Provide an assessment of potential effects to wetlands within the LSA and potential effects to ecological receptors during all phases of the proposed Project. 4. Provide further information on mitigation measures and monitoring that would be applied for the protection of wetlands.	In a supplementary submission provided on October 15th, 2024, Denison provided additional wetland characterization information and reference material for derived sediment partitioning co-efficients (Kd values) used in the Environmental Risk Assessment (ERA). Generally, Denison has provided the information and updates requested to satisfy all parts of the Round 4 request, however EA conditions are required. Additional context on CNSC staff's review follows: 1. Denison has provided additional information regarding the references for derived Kd values, which are based on regional data rather than site specific data, as there is currently not enough site-specific data to derive Kd values. Kd values can be highly variable and can be dependent upon many factors, such as the physico-chemical properties and/or activity of a COPC, concentration of suspended sediments, the hydro-sedimentary conditions (ex. Particle size and porosity), and sampling/measurement methods. While the additional information is enough to satisfy the Round 4 information request, the following activities will be required: a. Conduct a sensitivity analysis to provide further insight into how increased or decreased Kd values (ex. Increasing/decreasing by a degree of magnitude) influence the predictive surface water and sediment quality modelling results and conclusions of risk to receptors as part of licensing after the BATEA has been finalized. b. Continued validation of measured water and sediment quality data against regional values, including calculation of site-specific Kd values once enough monitoring data has been collected. Site-specific Kd values should continue to be periodically updated with more monitoring data as it is collected as part of licensing ERA updates. 2. Denison has committed to conducting a power analysis and additional statistical analyses during licensing which will incorporate additional baseline and pre-operations sediment data (as per EA commitment #8-46). In their commitment Denison states that these analyses and results will be included in the ERA for Denison's licence to operate. Disturbance of baseline sediment conditions will occur during site preparation and construction phases due to works in water to construct the effluent discharge. Due to the potential for construction activities to impact the aquatic environment and biota through sediment disturbance and resuspension of contaminants into surface water, Denison will be expected to provide, for CNSC review and acceptance, an updated ERA with the additional baseline data and the results of these statistical analyses prior to commencement of any project-related activities that require in-water work. Based on the aforementioned conclusions, this IR can be accepted, and outstanding issues and concerns will be addressed through the use of EA conditions. CNSC staff will expect that Denison: 1. Conduct a sensitivity analysis on Kd values (ex. Increasing/decreasing by a degree of magnitude) as part of licensing for LTPS/C after the BATEA has been completed. 2. Continue to validate measured water and sediment quality data against regional Kd values, and once sufficient monitoring data is available calculate site-specific	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							Kd values and include periodic updates of site-specific Kd values as part of required ERA updates for licensing (specific to both ERA updates for LTPS/C and LTO). 3. Conduct a power analyses and additional statistical analyses during licensing (LTPS/LTC), which will incorporate additional pre-construction baseline sediment data, and include these analyses and results in an updated ERA to be submitted for CNSC review and acceptance prior to any project-related activities requiring work in water. EA condition language along with any detailed expectations (if required) will be shared at a later date. *Note: there is a linkage between this IR and IR 114.*	
IR-102	-	ECCC CNSC	Fish and fish habitat	Section 8.1.3.1 Appendix 8-C, including Appendix II, Table 1 (p. 2)	**Context:** Only one measured-results dataset for baseline stream flow exists that is relevant to the Project data from the Water Survey of Canada (WSC) station for Wheeler River (06DA005), and the Proponent used constructed records. The Proponent states that data from 06DA005 was used to extend local hydrometric station records and calculate baseline water quantity metrics. However, this was done through a complex combination of daily data correlation or monthly unit area runoff relationship, with or without offset, where some stations were based off constructed records instead of the real long-term dataset at 06DA005 (see Section 8.1.3.1 and Appendix II of Appendix 8-C, Table 1, p.2 (PDF p. 569)). Appendix 8-C references previous reports in its own appendices, but no equations are shown and there is no description of the accuracy of the fit, or explanation for not referring back to the one dataset (WSC station). Subsequent statistics calculated from these constructed records (e.g., 7Q10 needed for SK water Licenses) would be affected by this uncertainty. **Rationale:** Fish habitat can be altered by changes to depositional and erosional patterns in streams. Confidence in the Proponent's estimate of baseline water quantity, and by extension Project effects to fish habitat, cannot be established without a complete description of the method applied, as well as a discussion of its accuracy.	1. Provide more information on the extension of Project hydrometric station data using WSC station 06DA005. 2. Discuss the accuracy of any correlations/relationships and justify any deviations from simple unit area runoff relationships in the estimation of baseline water quantity values for the Project hydrometric stations. Constructing records from records that are themselves constructed is not recommended. 3. If baseline water quantity metrics need to be revised, discuss (if any) resulting changes to the effects assessment.		Accepted
IR-103	-	ECCC CNSC	Fish and fish habitat	Section 8.1.3.4 Climate Change Influenced Extreme Events	**Context:** The Proponent notes that Intensity duration frequency (IDF) curves are used to estimate the size of water management structures around a site and that the IDF curves are often specific to climate monitoring stations. The Proponent used the IDF_CC Tool 5.0 developed by the Institute for Catastrophic Loss Reduction (2021) which generates Intensity Duration Frequency (IDF) curves at ungauged locations in order to estimate future IDF curve values under influences of climate change. This tool generates sub-daily values at ungauged locations by interpolation and distance weighing from gauged locations. **Rationale:** IDF trends exhibit random behavior at some locations and correlated behavior at other locations. The choice of gauged locations will infer the statistics for the ungauged locations, including the IDF trends. Without identification of the gauged locations, it is not possible to assess if the modelled data is realistic or not. If the	Provide the gauged stations used to generate the sub daily duration values found in Table 8.1-6: Baseline of Intensity Duration Frequency data.	As Denison has added a commitment related to updating the IDF (1 in 100 year 24-hour rainfall) and demonstrate climate change resilience of the project (conduct climate risk and resilience assessment) in version 2 the Commitments Register (ID 8-50), this IR has been accepted for the purposes of the current EA process. *The following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.* If future projections of IDF are going to be used in design, then the Proponent is advised to consult the CSA (2019) guidance and provide revised estimates of their potential changes over the project's duration. The Proponent should perform a statistical analysis of precipitation using historical data at the location of interest including, confidence intervals to consider uncertainty using	Accepted

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					modelled data is not accurate the design of water management structures on the site may not be sufficient resulting in the potential for impacts to the Project from flooding or extreme weather events.		the approach outlined in CSA (2019). Additionally, ECCC calculated that the IDF value for a 24h 100-year event is 91.2 mm at 95% confidence interval (using 10 years (2011-2021) of historical precipitation data at Key Lake). However, the same IDF value for a 24h 100-year event was presented as an average value of 67.2 mm with no confidence interval in the IR-103 Attachment. The Proponent value is neither representative nor conservative and the proponent should update the current value based on a new statistical analysis that considers uncertainty and longer record of historical precipitation. See also AD-72 in the Advice to Proponent table.	
IR-104	-	ECCC	Fish and fish habitat	Section 8.1.3.4.2 Probable Maximum Precipitation (PMP) Events Appendix 8C	**Context and Rationale:** The Proponent notes: "The probable maximum precipitation (PMP) event is a design standard value for an extreme rainfall event. The PMP event does not have an estimated return period but is instead based on the theoretical maximum amount of water that a storm could produce based on the maximum persisting dew point." The Proponent provides a PMP value of 489.3 mm, which is based on data and methodologies available in 1999, taken from the Atmospheric Environment Branch Report (1999), Report Number AHSD-R99-01. The Proponent references Appendix 8C for details. Appendix 8C contains no supplementary information other than what is already provided in Section 8.1.3.4.2. The assumptions and methodologies presented in the report are the results of time series analyses available in 1999. As time series evolve so do the derived statistics. In order to assess potential flood risks and impacts to the Project from flooding, data that is current and representative of the changing climate is needed. The Proponent should explain why they've used data from 1999 rather than using up to date data, describe what alternative methods for determining PMP they have considered, and describe how they will support their use of 489.3 mm as a PMP, or describe how they will generate a refreshed PMP. The main factor that influences the statistical data output is the length of the time series hence the reason to keep the statistical data. The PMP values can be substantially (>10%) different if two decades of data is used in the statistical analysis.	1.Provide a revised PMP value (using up to date data) or justify the use of a PMP that is based on data and methodologies from 1999 as opposed to a more recent time series analysis. 2. Describe the alternative methods for determining PMP values that were considered. Include descriptions of both "statistical" outcomes and "rational" outcomes as applicable. **Technical Discussion Required**: Yes	Response to IR-104 is accepted by CNSC staff based solely on the Denison's response (E-DOC#-7220826, p.47/112) that states: "Despite Denison's reiteration that the PMP is adequate for the EA level design basis, Denison is committed to revisiting the estimates per CNSC's recommendations, as applicable, for the licensing phase of the Project." *This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* There are an additional 24 years of meteorological datasets since the 1999 study thus all historical rainfall extremes including those since 1999 study should be considered to estimate up to date PMP at the Project site The proponent's justification on whether the 1999 or 1994 PMP estimates are current and conservative should be substantiated based on meteorological data analysis. An estimation of updated PMP is achievable by the proponent as meteorological data is freely available and accessible from ECCC and the proponent should provide a revised PMP. The Proponent should also clarify how recent the data used to calculate the PMP or the time series is and explain the use of an older data set that will not produce as accurate of a PMP value as a more recent data set would produce, even when estimates are conservative. Specifically, a. Explain the rationale for the use of the data set which was used to derive the PMP. B. Clarify if the PMP and/or the time series was calculated using more recent data. This will allow for an accurate evaluation of the validity of results derived from the data sets selected by the Proponent.	Accepted
IR-105	-	Directorate of Fisheries and Oceans (DFO)	Fish and fish habitat	Section 8.1.4.1, Potential interactions between project and valued component/key	**Context:** Table 8.1-8 and Table 8.3-6 in the EIS indicates a potential for freeze wall operation to influence groundwater interactions and surface water quantity and as a result, impact fish and fish habitat. Section 8.1.4.2.2 references Section 7 Geology and Groundwater for details on potential impacts. In addition, IR-63 notes the groundwater model does not describe the pathway in which groundwater would pass around the freeze wall during operation and any resulting potential effects on groundwater discharge to Whitefish Lake.	1. Provide a more fulsome analysis of the potential impact of freeze wall operations on local and semi-regional groundwater regimes, and subsequently to fish and fish habitat within Whitefish Lake. The analysis should provide a rationale of how the scope of the groundwater model is relevant to and able to detect changes at the scale of fish and fish habitat.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				indicators Surface Water Quantity Section 8.1.4.2.2, Surface Water Taking 8.3.4.1, Potential interactions between project and valued component/key indicators	**Rationale:** As per IR-63, the groundwater model analysis is insufficient to make conclusions on the potential effects of the freeze wall on groundwater discharge into Whitefish Lake. DFO requires this information to fully understand if altered groundwater regimes will result in changes to Whitefish Lake water levels and any potential impacts to fish and fish habitat as a result of changing water levels.	2. If impacts to fish and fish habitat in Whitefish Lake are predicted to occur due to changes in the groundwater regime, describe any mitigation measures that could be used to avoid these impacts. 3. If impacts are predicted that cannot be avoided, characterize residual effects on fish and fish habitat.		
IR-106	-	CNSC	Change to an environmental component due to hazardous contaminants	Section 8.1.4.2.3, Surface Water Discharge	**Context:** It is stated in this section under construction that all site contact water will be held in the Clean Waste Rock Pond. **Rationale:** It is unclear from this section what will happen to the contact water held in the Clean Waste Rock Pond, and whether it will be removed from site or released at a later time. What is the contingency plan if more contact water is produced during construction than the Clean Waste Rock Pond has capacity for.	Please indicate what will happen to the contact water stored in the Clean Waste Rock Pond during construction activities, will it be released after the wastewater treatment plant is installed? Further, please describe the contingency plan if contact water produced exceeds estimates and will exceed the volume of the clean waste rock pond?		Accepted
IR-107	-	CNSC ECCC	Aquatic environment	Section 8.2.3.3, Existing Surface Water Quality	**Context:** Under the methodology and metrics section (8.2.3.1) it is stated baseline water quality was sampled in 2016, 2018, and 2019. Looking at the data in Appendix A of Appendix 8D it seems that some waterbodies have little data available for baseline characterization. For example, Whitefish Lake only has 3 and 5 samples taken between its two sample stations, with sampling frequency seeming intermittent. **Rationale:** The amount of data available for baseline water quality characterization does not seem sufficient to adequately characterize the baseline and the variation it would experience. An effective baseline characterization is vital to ensure water quality is indeed not being affected by the Project. In addition, it is not clear if data quality objectives were applied to determine baseline information was adequate. To meet CEAA 2012 requirements, and CNSC expectations outlined in REGDOC 2.9.1, Environmental Principles Assessments and Protection Measures, the applicant is required to complete a characterization of the baseline environment. As described in REGDOC 2.9.1 Appendix B.2, Characterization of the Baseline Environment for Environmental Assessment Under CEAA 2012, the “baseline information should be sufficient to support the use of an aquatic dispersion model to conduct the site-specific ERA and to support an assessment of the effects of the environment on the facility or activity” In addition, the “applicant or Licensee should include an assessment of any limitations or gaps in the quality and extent of baseline data and methods, as well as the method(s) by which they have been addressed.”	Please clarify which data quality objectives were used for the baseline characterization data. Please provide justification whether the number of datapoints collected with inconsistent frequency in baseline surface water characterization is sufficient to meet data quality objectives and to adequately characterize the baseline, and whether Denison is confident that the data collected is enough for a robust water quality baseline characterization. **Suggestions for mitigation and follow-up measures:** CNSC recommends that additional water samples are collected and analyzed at a consistent frequency to ensure a robust baseline	In a supplementary submission provided on October 15th, 2024, Denison provided additional baseline water quality characterization data collected from June to September 2024 to supplement existing baseline data. Additional context on CNSC staff’s review follows: 1. Denison has committed to collecting addition pre-construction and pre-operational baseline water quality data and has provided supplementation information on the sampling locations, frequency and parameters to be monitored in their Round 4 response. In the information request for Round 4, a statistical power analysis was requested to confirm there is enough baseline data to detect effects. The same request was made for IR-101 where Denison has committed to conducting a power analysis for sediment data once more baseline data has been collected. Denison must provide the same commitment to complete this analysis for water quality data once more baseline data has been collected. 2. Denison has committed to collecting additional baseline and pre-operations water quality data (as per EA commitment #8-48). In their commitment and Round 4 response Denison states that this additional data and updated effluent quality data will be incorporated in the ERA for Denison’s licence to operate. Due to the potential for construction activities to impact the aquatic environment and biota through sediment disturbance and resuspension of contaminants into surface water, Denison must commit to providing for CNSC review and acceptance an updated ERA with the additional pre-construction baseline data and the results of statistical analyses prior to commencement of any project-related activities that require in-water work.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							Based on the aforementioned conclusions, this IR can be accepted, and outstanding issues and concerns will be addressed through the use of EA conditions. CNSC staff will expect that Denison: 1. Complete a power analysis for water quality data once more pre-construction baseline data has been collected. 2. Incorporate additional pre-construction baseline water quality data and power analysis results into an updated ERA to be submitted for CNSC review and acceptance prior to any project-related activities requiring work in water. EA condition language along with any detailed expectations (if required) will be shared at a later date.	
IR-108	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.3.3 Aquatic Environment	**Context:** Tables 8.2-2 and 8.2-3 provide summaries of the baseline surface water quality in the LSA. No justifications for the selection of water quality guidelines have been provided. COPCs that require calculations based on other parameters such as hardness, pH, or temperature to derive guidelines (i.e., ammonia, cobalt, zinc, etc.) should be indicated within the table, with a note specifying the parameter values used in the calculations, so that thresholds may be confirmed. No baseline data for un-ionized ammonia has been provided, which is a Schedule 4 substance requiring monitoring under the MDMER. For cobalt, manganese, and vanadium, Federal Environmental Quality Guidelines (FEQGs) and/or CCME Canadian Water Quality Guidelines (CWQGs) for the Protection of Aquatic Life have not been included. A guideline of 26 mg/L has been provided for molybdenum as a Saskatchewan Environmental Quality Guidelines (SEQG), however the actual SEQG is 31 mg/L and the CCME CWQG is 0.073 mg/L. **Rationale:** In order to assess potential changes to surface water quality from Project related activities, ECCC requires that data on all parameters that require MDMER effluent and receiving environment monitoring be provided for assessment, including accurate water quality guidelines where available.	1. Update Tables 8.2-2 and 8.2-3 to include all COPCs that require effluent characterization and receiving environment monitoring under the MDMER. 2. Update Tables 8.2-2 and 8.2-3 to include missing or corrected water quality guidance thresholds, and information on values used to derive thresholds for COPCs that are dependent on general parameters.	A number of additional corrections were provided in the supplementary information provided by Denison on July 2nd, 2024. However, the following remains outstanding: • In Table 8.2-3, the long-term benchmark for ammonia as N is 5.74 mg/L for all stations except SA-4, SA-5 and SA-6, where it is 6.98 mg/L. Additionally, the TDS long-term benchmark of 500 mg/L based on SEQG, found in Table 8.2-8 is not included in Tables 8.2-2 or 8.2-3. This IR is accepted for the purposes of the EA review, and the following must be corrected in the final EIS submission package: 1. In Table 8.2-3, confirm if the long-term benchmark of 6.98 mg/L for ammonia as N for stations SA-4, SA-5 and SA-6 is correct and provide justification as to why the benchmark differs at these stations. 2. In Table 8.2-2 and 8.2-3, confirm the correct long-term benchmark for unionized ammonia as it currently differs between various stations. 3. For consistency, update Tables 8.2-2 and 8.2-3 to include the Total Dissolved Solids (TDS) benchmark utilized in Table 8.2-8.	Accepted
IR-108	IR-108-R1	ECCC	Change to an environmental component due to	Section 8.2.3.3 Aquatic Environment IR-108 Response from Denison	**Context:** Incorrect benchmark environmental quality guidelines and guidelines that cannot be verified remain within the updated Tables 8.2-2 and 8.2-3 provided in the Proponent's response. The Proponent provided an Aluminum Saskatchewan Environmental Quality Guidelines (SEQG) value of 0.005 mg/L in both tables. This is incorrect and appears to be the guideline for irrigation, not the guideline for protection of aquatic biota. The Proponent provided a Molybdenum SEQG of 26 mg/L in both tables. This value is incorrect. The correct SEQG for Molybdenum is 31 mg/L and the Canadian Water Quality Guideline (CWQG) is 0.073 mg/L. The Proponent provided a Nitrate SEQG of 13.29 mg/L in both tables. This value is incorrect. The correct SEQG for Nitrate is 3 mg/L and the CWQG is 13 mg/L. **Rationale:** In order to verify the benchmark environmental quality guidelines that are calculated based on environmental modifying factors such as pH, hardness and dissolved organic carbon (DOC), the specific concentrations of these environmental modifying parameters used in the calculations must be provided. Additionally, incorrect benchmarks for Aluminum, Molybdenum, and Nitrate remain within the updated tables	1. Update Tables 8.2-2 and 8.2-3 to include footnotes with the concentrations of environmental modifying parameters such as pH, hardness and DOC used to derive guidelines for Aluminum, Cadmium, Copper, Lead, Manganese, Nickel and Zinc. 2. Update Tables 8.2-2 and 8.2-3 to include the correct benchmark guideline value for Aluminum, Molybdenum and Nitrate. Include the concentrations of environmental modifying parameters needed for deriving guidelines. If the most stringent guideline value is not selected for use, provide a rationale for use of the chosen guideline. 3. Update Tables 8.2-2 and 8.2-3 to include the calculated guideline value for manganese and the environmental modifying parameter concentrations used to calculate the	In follow up to outstanding corrections following the Feb 10th submission, supplementary information provided by Denison on July 2, 2024 resolved these issues.	Accepted

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					provided by the Proponent. No benchmark was provided for Manganese. It is not clear if Total Chromium or Hexavalent Chromium was measured as the table does not specify, and the benchmark provided was for Hexavalent Chromium. This information is required to understand potential changes to surface water quality from Project related activities and facilitate threshold confirmation. Use of the incorrect threshold could allow for effluent to be discharged at the wrong concentration.	guideline. A benchmark environmental quality guideline has not been provided for Manganese, however a chronic CWQG guideline exists that can be derived based on environmental modifying parameter concentrations. Update Tables 8.2-2 and 8.2-3 to specify if Total Chromium or Hexavalent Chromium was measured. See also related IR-115-R1.		
IR-109	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment	**Context:** In this section it is stated “Treated water from the IWWTP will be pumped to the three Effluent Monitoring and Release Ponds (each 3,300 m3). These ponds will be designed to hold effluent for 72 hours for testing before discharge to the environment” (p. 8-75). It is unclear what procedure will be followed if effluent in monitoring ponds does not meet discharge requirements following testing. Additionally, it is also stated that “Treated water in the Effluent Monitoring and Release Ponds will be monitored prior to release to a surface waterbody or injected into groundwater via deep well injection.” However, the MDMER pursuant to the Fisheries Act requires all mine effluent and seep. From the mine site that contain deleterious substances be discharged through a final discharge point. **Rationale:** In order to fully understand effluent management, more information is required regarding the procedure for managing effluent in monitoring ponds that does not meet discharge requirements. It is unclear how effluent that does not meet discharge requirements will be managed if it needs re-treatment and re-testing prior to discharge. ECCC reminds the Proponent that Project effluent from all final discharge points must meet federal legislation requirements.	Provide further information regarding management of effluent in monitoring ponds that does not meet the requirements for discharge under the MDMER.		Accepted
IR-110	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.1.1 Aquatic Environment Appendix 8-E, Section 2.1	**Context:** It is stated that the diffuser at the final effluent discharge point will be located in approximately 3m of water. However, in Figure 8.2-5 displaying the location of the proposed diffuser and lake bathymetry, the diffuser location seems to be located in 2-2.5m of water. A similar image in Figure 1 Section 2.0 of Appendix 8-E also indicates that the diffuser seems to be located in 2-2.5m of water. Additionally, while thermal effects are unlikely, this cannot be confirmed until a more detailed diffuser design is provided for review. **Updated Rationale:** The Proponent should confirm the location and depth of the proposed diffuser in order to confirm that modelling predictions for effluent discharged into the receiving environment are accurate. A review of the final discharge design is necessary to confirm the location and depth of the proposed diffuser and modelling predictions for effluent discharged into the receiving environment.	Provide confirmation of the diffuser depth and location. ECCC requests the opportunity to review the finalized diffuser design once it is available.	Denison has captured a commitment in version 2 of the Commitments Register (July 17, 2024) that the final diffuser configuration will not change the environmental assessment conclusions of risk to aquatic receptors and that water quality will remain below guidelines (ID 8-9), so this IR has been accepted. Note, if there are deviations from predicted effluent and near-field surface water concentrations of COPCs and risk to aquatic receptors due to the finalized diffuser design, this is expected to be addressed through Denison identifying and implementing mitigation measures (e.g., treatment) to ensure that the environmental assessment conclusions of risk to aquatic receptors will not change and that water quality will remain below guidelines. This must also be factored into Denison's EA Follow-Up Program *Any outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.*	Accepted

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IR-111	-	CNSC	Fish and fish habitat	Section 8.2.4.2.2, Controlled Discharge	**Context:** This section of the EIS indicated that the scenario was assessed using a conservative assumption of a continuous freshwater withdrawal rate of 40.5 m3/hr, and a continuous effluent discharge rate of 81.0 m3/hr. **Rationale:** The withdrawal rate assessed is half of the effluent rate, it is unclear from the text where the other half of the volume of effluent is coming from, if not drawn from the lake.	Please clarify where the other half of the total volume of effluent discharged is from in the water balance between water intake and effluent.		Accepted
IR-112	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.2, Aquatic Environment Appendix 8-E, Section 1.2.1 Appendix 10-A (ERA), Section 3.1	**Context:** This section of the EIS states that, "for the purpose of assessing the scenario of greatest potential effects, the Project was assessed as having a continuous freshwater withdrawal rate of 40.5 m^3/hr and a continuous effluent discharge rate of 81.0 m^3/hr." (p. 8-21) However, several sentences later it is stated that, "The approach to assessing Project-related effects on the Surface Water Quality VC was conservative for the following reasons: The assessment was based on a continuous (year-round) discharge rate at an expected average effluent discharge of 0.0101 m3/s (or 36.5 m3/hr) throughout Construction, Operation, and Decommissioning…" This is a continuous theme throughout Section 8, Aquatic Environment, where the discharge rate for the surface water quality assessment changes between 36.5 m3/hr and 81.0 m3/hr. However, in Appendix 10-A (ERA) the 36.5 m3/hr discharge rate is the only value used for the near and far-field modelling. It should be made clear in the main body of the draft EIS that the average effluent discharge rate of 36.5 m3/hr has been used as the input for the near- and far-field modelling for effluent, surface water and sediment quality predictions. The maximum upper bound discharge rate is 81 m3/hr; however, modelling for effluent, surface water and sediment quality was not completed for this discharge rate. **Rationale:** It remains unclear throughout the draft EIS that all predictions of COPC concentrations in effluent, and receiving environment surface water and sediment are based upon the effluent discharge rate of 36.5 m3/hr, and not the maximum upper bound discharge rate of 81 m3/hr. All conclusions about risk to the environment and aquatic and terrestrial biota must make this clear. If the Proponent wishes to make conclusions based on the maximum upper bound discharge rate of 81 m3/hr, modelling needs to be conducted using this rate of discharge.	1. Confirm that the surface water quantity, quality, and aquatic biota risk assessments and modelling, were conducted using the discharge rate for 36.5 m3/hr within the draft EIS. 2. Revise any statements or conclusions in the draft EIS to improve clarity about the usage of the maximum upper bound discharge rate of 81 m3/hr. Remove statements regarding use of the discharge rate of 81 m3/hr during modelling and risk assessments to the receiving environment as needed.		Accepted
IR-113	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment	**Context:** No quantitative assessment of climate change has been conducted. Representative concentration pathways (RPC) projections for climate change have not been integrated with near-and far-field modelling to assess impacts to surface water quality or sediment quality in the future. **Rationale:** Changes in air and water temperatures, precipitation, snow melt, ice formation, etc., due to climate change can all influence COPC concentrations in surface water and sediment. It is not possible to assess the potential impacts from climate	Provide a quantitative analysis of the potential impacts of predicted COPCs from mine effluent to surface water and sediment quality with climate change scenarios for the Project lifespan incorporated into modelling. Include modelling predictions regarding the influence of changes to air and water temperatures, precipitation, snow melt, ice formation, etc., on COPC concentrations in surface water and sediment.	In order to resolve this IR, CNSC Staff expect that Denison: 1. Make a commitment to not discharge during unusually low flow scenarios, and, 2. Make a commitment to complete a sensitivity analysis during licensing after the BATEA has been completed. These commitments must be reflected in the final EIS submission package.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					change on predicted surface water and sediment COPC concentrations with the current information.		*This IR has been accepted for the purposes of the current EA process, the outstanding issue below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent suggests that the requested quantitative analysis is not necessary and contends that potential climate change effects on water quality should instead be addressed through mitigation measures, monitoring and adaptive management. The Proponent's approach does not sufficiently characterize the range of potential effluent and water quality predictions. Climate change analysis is lacking, and a sensitivity analysis was not conducted in order to further understand uncertainty and drivers of the model results. Further, some aspects of water quality modeling are not sufficiently conservative, including use of the geometric mean (instead of the 95th percentile) as the baseline concentration for constituents, and pooling data from all lakes, which would mask any differences between the lakes. It is therefore not known whether water quality exceedances may be predicted under climate change scenarios. Without estimating the potential influence of climate change on water quality, it is unclear whether the proposed water quality mitigation measures are adequate. Climate change may impact the assimilative capacity of the receiving waterbody, therefore the present day 7Q10 or low flows may vary under future climate conditions. A sensitivity analysis would further refine predictions of how the 7Q10 or low flows may vary with climate change and therefore provide insight into how water quality may be impacted as well. In order to resolve this issue, Denison will be expected to: • Conduct a sensitivity analysis of low flows (7Q10 low flow, monthly low flow and monthly average flow) and high flows to assess how low and high flows may change under future climate conditions and the potential implications on water quality predictions made during the EA phase.	
IR-113	IR-113-R1	ECCC	Fish and fish habitat	Section 8.2.4.2.3 and Section 8.4.7.6, Aquatic Environment IR-113 Response from Denison	**Context:** The Proponent states the following, *"The PMP is very conservative (e.g., assumes effectively a full year of precipitation in one event) under both existing and future conditions (climate change)"*. This statement suggests that the PMP value utilized considers future climate changes such as possible changes in the frequency or intensity of extreme precipitation events. **Rationale:** As noted by the Proponent, increases in extreme rainfall are anticipated with a warmer climate. For precipitation extremes across Canada, the relative change in event frequency is expected to be larger for more extreme and rarer events. Given that the extreme precipitation is expected to intensify in the future (Kunkel et al. 2013), the Proponent should consider how these potential changes will influence design values such as PMP.	Clarify if climate change has been considered in the PMP value provided. If it has not been considered, discuss how potential increases in PMP have been and/or need to be considered in the Project design. **Reference:** Kunkel, K., Karl, T. R., Easterling, D. R., Redmond, K., Young, J., Yin, X., & Hennon, P. (2020). Probable maximum precipitation and climate change. *Geophysical Research Letters*, 1402-1408.	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent has not clarified if climate change has been considered in the PMP value provided or discussed how potential increases in PMP have been or need to be considered in the Project design. Thermodynamic effects on atmospheric moisture will lead to intensification of local extreme precipitation in the future. Probable maximum precipitation (PMP) is defined as the greatest accumulation of precipitation for a given duration meteorologically possible for an area (Kunkel et al., 2013). PMP values may increase with climate change. In the response to IR-113 R1, the Proponent states that "the design basis PMP is robust and inclusive of projected total annual precipitation under a high carbon scenario". It is	Accepted

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							unclear from this statement how the analysis provided indicates that the PMP is inclusive of climate change. The Proponent should clarify how the analysis that they provided shows that the design PMP considers climate change, and indicate if or how the potential for increased PMP has informed site water management for the mine life and into post-closure and considered in the development of mitigation measures. **Reference**: Kunkel, K. E., Karl, T. R., Easterling, D. R., et al. 2013. Probable maximum precipitation and climate change. Geophysical Research Letters 40(7), 1402–1408. Available at: 10.1002/grl.50334	
IR-114	-	ECCC CNSC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.3 and Section 8.2.4.2.4	**Context:** Tables 8.2-9, 8.2-10 and 8.2-13 demonstrate predicted maximum effluent concentrations of COPCs and maximum predicted receiving environment concentrations in the near- and far-field. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, TSS and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. For zinc, it is unclear how guidelines have been calculated when CCME thresholds can only be derived with hardness values <250 mg/L. Additionally, water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. Mercury has been identified as a COPC of interest to Indigenous groups for the proposed Project. Table 8.2-8 indicates that background concentrations of mercury in LA-5 are low, and predicted effluent concentrations are also low. However, no information has been provided on background methylmercury concentrations or expected atmospheric deposition of mercury from Project related emissions. Predicted effluent concentrations of 3915 mg/L of sulphate are quite high, and sulphate is known to increase mercury methylation rates in aquatic environments. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment. ECCC recommends the use of the most stringent guidelines for the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds. Increased sulphate availability can lead to increased methylation rates of mercury and methylmercury in sediment and surface water. Methylmercury is a toxin that can bioaccumulate within the food chain and present risks to aquatic biota and wildlife consuming aquatic biota. Potential changes to methylmercury concentrations in water	1. Update all tables to include all COPCs with required monitoring under the MDMER including acute and chronic thresholds. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and use water quality guidelines that are protective of aquatic biota. 3. Provide baseline data on the concentrations of methylmercury in surface water, sediment and fish tissues (i.e., large- bodied sports fish and small-bodied forage fish) in the LSA and RSA receiving environment to establish a baseline prior to potential Project impacts. 4. Provide an assessment of risk from methylmercury to ecological receptors due to changes in sulphate concentrations in effluent, and potential deposition of mercury from Project related atmospheric emissions in the receiving environment.	Following a supplementary submission on November 19th, 2024, this IR is accepted for the purposes of the EA process. It is important to note, Table 114-4 of the supplementary submission contained errors and must be corrected in the final submission package. Denison will be expected to confirm the calculations of all of the HQs (both scenarios) and update the table as needed.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					quality, sediment and fish tissues should be assessed due to the proposed sulphate loadings in effluent. Additionally, in accordance with the MDMERs, Denison will be required to demonstrate that their effluent quality meets the limits in the MDMER. Denison is expected to provide the predicted effluent quality for lead, nickel, and un-ionized ammonia to demonstrate compliance with the MDMERs.			
IR-115	-	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1	**Context:** Table 8.2-8 demonstrates baseline concentrations of COPCs in LA-5 South Whitefish Lake, their respective water quality guidelines from applicable sources, and proposed Project thresholds. General parameters such as temperature, pH, conductivity, etc. that would require Project thresholds and monitoring under the MDMER have not been provided in this table. Lead, nickel, Total Suspended Solids (TSS) and un-ionized ammonia were not provided, despite all being Schedule 4 substances with maximum monthly concentrations under the MDMER. Aluminum, iron, nitrate, thallium, and manganese have not been provided despite being required parameters under Schedule 5 Section 4 of the MDMER for effluent characterization. Water quality thresholds appear to have been calculated using estimated effluent concentrations rather than receiving environment baseline concentrations. The water quality objective selected for molybdenum is the 31 mg/L SEQG rather than the CCME guideline of 0.073 mg/L. **Rationale:** ECCC recommends the use of guidelines that will ensure the protection of aquatic biota. All water quality thresholds should be derived from receiving environment parameters to determine any baseline receiving environment and effluent COPC exceedances of water quality thresholds.	1. Update Table 8.2-8 to include all COPCs with required monitoring under the MDMER. 2. Ensure all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. 3. Provide additional information to justify the use of the selected water quality guideline for molybdenum.	Please see the response to IR-115-R1 (below).	Accepted
IR-115	IR-115-R1	ECCC	Fish and fish habitat	Section 8.2.4.2.3 Aquatic Environment Appendix 10-A (ERA), Section 3.1.1.1 IR-115 Response from Denison	**Context:** In the Proponent's response to item two, it is mentioned that the derived water quality thresholds used in Table 8.2-8 and in the assessment (Section 8.2.4.2.3, Aquatic Environment; Appendix 10-A (ERA), Section 3.1.1.1) are based on hardness concentrations found in effluent. The Proponent mentions that hardness derived from IWWTP discharge will consider IWWTP discharge on the receiving environment and provide "a reasonable estimate of expected hardness in effluent". However, this does not consider induced hardness (i.e., hardness concentration increases in the receiving environment over the lifecycle of the Project) from effluent contributions as a Project effect; the receiving environment baseline concentrations of hardness have been altered due to inputs from Project effluent. Providing only one estimate of expected effluent hardness in the receiving environment is not an appropriate means of conducting the effects assessment. Additionally, the following COPCs have not been included in the updated table provided in the Proponent's response: un-ionized ammonia, aluminum, iron, manganese, thallium and total dissolved solids (TDS). It is noted that these COPCs are also subject to monitoring	1. Update Table 8.2-8 to include the following COPCs: un-ionized ammonia, aluminum, iron, manganese, thallium and total dissolved solids (TDS). 2. Update Table 8.2-8 to include background concentrations of total hardness (in mg/L $CaCO_3$) in the receiving environment. 3. Provide rationale that all selected water quality thresholds are derived using baseline receiving environment concentrations and are at levels protective of aquatic life. See also related IR-108-R1	In a supplementary submission from July 5th, 2024 Denison has provided updated information. Denison will be required to update the screening criteria for ammonia, aluminum. iron and lead during licensing review of the ERA. These updates are not anticipated to impact the conclusions of significance to the EA, and therefore are not required at this time. *Any outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence.*	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					requirements under the *Metal and Diamond Mining Effluent Regulations* (MDMER). **Rationale:** Background concentrations of un- ionized ammonia, aluminum, iron, thallium, manganese and TDS are required to determine potential effects to the environment. The Proponent will also require this information to satisfy their obligations under the MDMER. The purpose of the surface water quality assessment is to determine if changes to the receiving environment over the project lifecycle will have significant adverse effects on biota. Changes from baseline in hardness concentrations in the receiving environment due to the deposition of effluent is a Project related effect and therefore providing a single baseline water quality threshold which is applicable only to one set of conditions is not an appropriate method to evaluate impacts across a shifting hardness baseline. Water hardness is an environmental modifying factor, various concentrations of hardness influence the toxicity of other COPCs in the aquatic environment. Using water quality thresholds that have been derived from high effluent hardness concentrations will not be protective of aquatic biota, particularly in the early stages of the project lifecycle when receiving environment water quality will be similar to baseline water quality.			
IR-116	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.4.2.5, Section 8.4.4.2.5 and Section 8.5.4.2.3	**Context:** Tables 8.2-14, 8.4-9 and 8.5-5 demonstrate predicted mass flux (in mg/s) of COPCs in groundwater during the future centuries scenario. The table does not provide any information on actual surface water concentrations of COPCs or accumulation in concentrations over time. It is not possible to determine what the COPC concentrations in surface water and sediment will be during the future centuries scenario with the current information. Additionally, only a subset of parameters have been provided in this table based on parameters that were elevated in effluent after treatment. Groundwater may have a variety of different COPCs with elevated concentrations as it will migrate directly from the ore body area and not receive treatment. **Rationale:** It is not possible for ECCC to assess the predicted concentrations of COPCs in surface water and sediment, and therefore risk to aquatic biota during the future centuries scenario with the provided information.	1. Provide the predicted water and sediment quality concentrations of COPCs in the receiving environment for the future centuries scenario. 2. Include data for a greater suite of COPCs that were assessed as having potential to be at elevated concentrations in groundwater.		Accepted
IR-117	-	CNSC	Human health with respect to hazardous contaminants	Section 8.2.4, Table 8.2-9	**Context:** CNSC staff note that some of the effluent quality predictions in the EIS are quite high for a uranium mine and mill facility compared to the existing facilities. For example, the upper bound effluent quality of molybdenum is 2.5 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.213 mg/L. Also, the upper bound effluent quality of copper is 0.022 mg/L. In 2021, the highest monthly mean concentration at the existing uranium mine and mill facilities is 0.002 mg/L.	Please provide the anticipated effluent quality of the constituents of potential concern during normal operations. Once Denison has refined the effluent quality predictions, Denison is expected to update the inputs into the surface water quality model.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: Surface water quality models should be based on the anticipated effluent quality. From discussions with Denison, it appears that the effluent quality predictions may change based on the results of more bench scale tests that are still being conducted and continued optimization of the design of the water treatment plant.			
IR-118	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.2.6.1, Section 8.4.6.1 and Section 8.5.6.1, Aquatic Environment	**Context:** It is unclear if Tables 8.2-16, 8.4-12, 8.5-7 and 8.5-8 take into consideration potential effects from groundwater seepages of COPCS to surface water and sediment quality in the future centuries scenario. No information regarding the future centuries scenario has been provided in the rationale summary for ratings. **Rationale:** Groundwater seepage of COPCs may have future impacts to surface water quality, sediment quality and aquatic receptors; however, the extent of residual effects is unclear without further information.	Provide further information regarding how groundwater seep. Of COPCs may have future impacts to surface water quality, sediment quality, and aquatic receptors, and any residual effects that may persist.		Accepted
IR-119	-	CNSC	Fish and fish habitat	Section 8.3.1.2, Table 8.3-1, Sediment quality	**Context:** Sediment quality isn't considered a key indicator for fish and fish habitat, but the accumulation of contaminants in sediment porewater without habitat alteration is similar to the key indicator 'change in surface water quality from baseline conditions' that is considered. **Rationale:** It is not clear whether sediment was just considered for physical disturbance, and why chemical changes are missing from key indicator list for fish and fish habitat.	Please provide the rationale for exclusion of sediment quality from the key indicator list for fish and fish habitat.		Accepted
IR-120	-	CNSC	Aquatic species	Section 8.3.3 and 8.5, Aquatic Environment	**Context:** Although downstream impacts are not predicted by Denison it is important from an ecosystem perspective to establish baseline locations to monitor for potential cumulative effects to the aquatic environment due to the Key Lake and Wheeler River Operations to ensure the aquatic environment is being protected from cumulative impacts. Denison should consider adding a far-field exposure location and collecting baseline aquatic ecosystem baseline data in Russell Lake including: • Water quality/chemistry • Sediment chemistry/quality • Benthic invertebrate chemistry /community • Large-bodied fish tissue/chemistry **Rationale:** Russell Lake is identified as part of the RSA for the aquatic environment, but it appears that no detailed aquatic baseline data was completed in far-field location in Russell Lake. In addition, several Indigenous Nations and communities and local resource users have indicated that Russell Lake is an important body of water both culturally for traditional use and was once used as commercial fishery.	If Denison has not collected baseline aquatic studies in the far-field downstream receiving environment of Russell Lake, please provide a rationale for why. If a far-field Russell Lake location was sampled as part of baseline data collection, more information about the process and results with regards to sampling at Russell Lake should be included in the EIS. This information would be valuable to help determine potential cumulative effects downstream in the Russell Lake drainage system (due to the Key Lake Operation) which has been identified as a key concern and area of interest by several Indigenous Nations and communities.	Response is accepted, but also see AD-51 in the Advice to Proponent table.	Accepted
IR-121	-	CNSC	Fish and fish habitat	Section 8.3.3.1, Methodology and Metrics	**Context:** In the description of methodology for fish communities and spawning surveys, there's no mention that could be found for an any evaluation of fish condition, other than sexual condition. **Rationale:** Exposure to other pre-existing stressors could result in abnormal conditions or deformation(s) in existing population, but the extent of existing conditions should be	Please provide reference to where fish condition is considered or provide a justification for its exclusion.	Response is accepted, but also see AD-52 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					evaluated to ascertain whether the rate is increasing as a result of proposed activities once in operation.			
IR-122	-	CNSC	Fish and fish habitat	Section 8.3.8, Monitoring and Follow-up	**Context:** Section 8.3.8 of the EIS states: "Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development." **Rationale:** Tracking changes in fish communities / populations in reference lakes over time should be conducted, as reference lakes can be used to differentiate natural temporal variation with potential project impacts.	Please include reference lakes, and if it is provided, please reference where in the EIS these are discussed. If there are no reference lakes, these should be included in the monitoring program.	Response is accepted, but also see AD-53 in the Advice to Proponent table.	Accepted
IR-123	-	ECCC	Change to an environmental component due to radiological contaminants	Section 8.4.3.2.3, Aquatic Environment Appendix 8-D, Table 3-5	**Context:** Table 8.4-3 provides a summary of the baseline concentrations of COPCs in sediments in the LSA. Sediment quality thresholds and justification for the selection of those thresholds have not been provided. Table 3-5 in Appendix 8-D does provide benchmarks but the selection of benchmarks is not discussed, and the most stringent guidelines are not used for some COPCs. Additionally, there is no data provided for sediment concentrations of mercury, which is a COPC that requires surface water quality monitoring and effluent characterization under the MDMER. **Rationale:** Further information should be provided regarding any exceedances of sediment quality thresholds in baseline concentrations of COPCs, which should be recommended for further assessment of risk due to effluent discharges.	1. Provide sediment quality thresholds and justification for the selection of those thresholds for comparison against measured baseline COPC concentrations in the LSA. 2. Provide data on baseline concentrations of mercury in sediment. 3. Identify any COPCs with baseline concentrations that exceed sediment quality thresholds in the LSA.		Accepted
IR-124	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.4.4.2.3, Aquatic Environment	**Context:** Table 8.4-7 provides maximum concentrations of surface water COPCs in sediment. The following COPCs, which are required to evaluate the risk from effluent to sediment quality, were not evaluated: 1. COPCs that have monitoring requirements in receiving environment surface water and effluent under the MDMER, 2. COPCs that exceed water quality guidelines in effluent, and, 3. COPCs that have baseline concentrations that exceed sediment quality thresholds in the receiving environment. **Rationale:** Due to the lack of information on COPCs with baseline concentrations that exceed sediment quality guidelines, and COPCs that require monitoring under the MDMER, a determination on risk to sediment quality and aquatic biota cannot be made.	1. Provide the information on baseline exceedances of COPCs in sediment. 2. Provide an assessment of risk for any COPCs that have baseline exceedances of sediment quality thresholds in the receiving environment. 3. Provide an assessment of risk from any COPCs that require monitoring in the receiving environment and effluent under the MDMER. Please include any COPCs in effluent that will exceed water quality guidelines.	Following review of a supplementary submission provided on July 2nd, 2024, concerns remain related to: • Denison's assessment of water/sediment quality for near field and regional receiving waterbodies using low flow scenarios based on return periods beyond 100 years, as well as near field and regional models. • The 7Q10 is considered acceptable low flow to provide conservative predictions for the assessment of water/sediment quality. • The modeled results for maximum concentrations of COPC's shown in tables 3.3 and 3.5 of Appendix 10-A, which show that copper may exceed the new FEQG in freshwater for both operational and post decommissioning phases of the project. For the purposes of this review, this IR is accepted, and these outstanding concerns will be addressed in responses to IR-113 (through sensitivity analysis) and IR-114. See also AD-76 in the Advice to Proponent table.	Accepted
IR-124	IR-124-R1	ECCC	Change to an environmental component due to hazardous contaminants	Section 8.4.4.2.3, Aquatic Environment IR-124 Response from Denison	**Context:** In the Proponent's response it is stated, "Schedule 5 parameters will be monitored as per the MDMER once under this regulation (i.e., meeting regulated criteria of discharge to the environment [50 m3/day). Please refer to Table 8.2-13 of attachment IR-114. In these cases, COPCs including Schedule 4 parameters were below screening criteria." If concentrations of Schedule 5 parameters in effluent exceed water quality thresholds, these parameters are necessary for ECCC to examine in the risk assessment to	Provide an assessment of risk from any MDMER Schedule 5 parameters that are required to be characterized in effluent and in surface water quality in the receiving environment and that have effluent concentrations that will exceed water quality guidelines derived from environmental baseline conditions.	See response for IR-124.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					determine the potential for effluent to be acutely lethal and for adverse effects to aquatic biota. These parameters will also be required to be characterized under Section 4, 5 and 7 of the MDMER. As per CSA N288.6-22 Section 7.2.5.2.1, "Screening of environmental concentrations of chemical and radiochemical substances released to the environment should be performed to identify COPCs for further evaluation in the risk assessment. Both measured concentrations and concentrations calculated from release rates may be used in the screening analysis. The screening concentrations should be compared to screening criteria, and chemicals that exceed screening criteria should be identified as COPCs." As per CSA N288.6-22 Section 7.2.5.4.2, "If COPCs exceed the screening level for one medium, they should be carried forward into the EcoRA for all media that are likely to contribute to exposure. For example, for a given COPC, if a water screening benchmark is exceeded, the same COPC should be carried forward for sediment if its concentration was above the detection limit." Additionally, updated Table 8.2-13 of attachment IR-114 has been found to be insufficient due **to** maximum concentrations in surface water for mercury, aluminum, total suspended solids, iron, thallium, manganese, nitrate and phosphorus being absent and the use of incorrect water quality thresholds. **Rationale:** Due to the lack of information on COPCs with concentrations that exceed water quality thresholds in effluent, a determination on risk to sediment quality and aquatic biota cannot be made.			
IR-125	-	CNSC	Fish and fish habitat	Section 8.5, Aquatic Environment and Fish health	**Context:** Indigenous Knowledge studies and information collected in relation to the Project clearly identified the importance of water quality and fish health to local Indigenous peoples and is discussed throughout the Draft EIS. For example: • "Russell is one lake where I commercially fish. How will this effluent impact the water quality, fish health? Will I be able to sell fish from here? If there is going to water" pollution, I just want to know" (19-LK-ERFNTrap-134.255) " • "How are you going to protect the water quality? We are concerned about mercury in fish, other animals, etc. Is there mercury or arsenic in the uranium solution?" (p. 8-53) **Rationale:** Several Indigenous Nations and communities and local resources users have indicated Russell Lake is an important body of water both culturally for traditional use and was used as commercial fishery in the past and from an aquatic ecosystem perspective.	One of the many mitigation measures mentioned throughout the aquatic environment section states: "Denison will work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system." (p.10-32) Has Denison considered the collection of additional baseline fish tissue species that are of importance to Indigenous Nations and communities and local cabin owners from Russell Lake? Assuming the species would be walleye (commercially and recreationally) and lake white whitefish that is traditionally an important species consumed. Please provide more information on the engagement to date on the development of the Surface Water Management Program and Monitoring program that Denison is developing and engagement to date with interested Indigenous Nations and communities in the region on fish and fish health.	Response is accepted, but also see AD-51 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-126	-	ECCC	Aquatic species	Section 8.5.3 Appendix 10-A (ERA), Section 5.3.1.1.8	**Context:** The Proponent has used the US Environmental Protection Agency (US EPA) guidelines for the assessment of selenium fish tissue concentrations in Section 8.5.3 of the draft EIS and in the Environmental Risk Assessment (ERA) in Appendix 10-A (ERA) of Section 10. **Rationale:** ECCC's Federal Environmental Quality Guidelines of 6.7 ug/g dry weight fish whole body tissue for selenium should be used, as it is more protective than the US EPA guidelines.	Update the selenium fish tissue assessment in the draft EIS and the Wheeler River ERA (Appendix 10-A (ERA) in Section 10) as needed using ECCC's FEQG.	Following the supplementary submission on October 15th, 2024, Denison has provided an estimate of error for the Northern Pike Bioaccumulation Factor (BAF) and for the results of the calculated fish muscle tissue, whole body and egg-ovary selenium concentration predictions for Northern Pike. Denison has provided sufficient information to address the information request.	Accepted
IR-127	-	CNSC	Aquatic environment	Appendix 8-E, Section 1.2.1, Hydrological Inputs	**Context:** Within this section it states that the 7Q10 low flow rate used in the mixing assessment "was provided verbally to Ecometrix by NewFields Canada during a project meeting on 26 April 2022" **Rationale:** The statement that this value was provided verbally is not an infallible method of communicating data, as the value could have been misheard, misremembered, or recorded improperly.	Please verify that the 7Q10 value used in the assessment is the correct value determined by NewFields.		Accepted
IR-128	-	CNSC	Current use of lands and resources for traditional purposes	Section 9 Various pages in section 11.1, Land and Indigenous Resource Use Section 12 Section 14	**Context:** The increased road traffic (14-18 trucks per day during construction/operations) may have indirect impact on ungulates, furbearers and wood land caribou presence/absence for traditional and subsistence hunting have been raised to CNSC staff when meeting with Indigenous Nations and communities and are presented in the EIS. **Rationale:** The increased traffic and therefore dispersal of game (moose, woodland caribou) due to increased traffic has been raised as a concern with respect to increased mortality on wildlife and decreased ability to practice traditional rights.	How have the potential residual impacts with respect to increased traffic and noise (due to current and future operations) been communicated to Indigenous Nations and communities who use the road #914 for cultural and traditional activities (such as moose harvesting, berry picking and small game and birds)? Please provide any additional information on the engagement that has taken place to date with Indigenous Nations and communities with respect to concerns and potential impacts on current use of lands and resources due to increased road traffic, and any mitigation measures proposed by Indigenous Nations and communities to minimize the potential impacts.	Response is accepted, but also see AD-54 in the Advice to Proponent table.	Accepted
IR-129	-	CNSC	Current use of lands and resources for traditional purposes	Section 9 Section 10 Section 11, including Section 11.1.4.3.1 (p. 11-46) Section 12 Section 16	**Context:** ERFN indicated they are concerned about declining moose populations from an influx of hunters; more people may be accessing the area year after year, and worried populations may be affected by the Project (21-EN-ERFN-473.13). Further, the EIS highlights that: "Vehicle collisions are the most likely source of direct mortality for moose. Effective mitigation measures (e.g., breaks in snowbanks; speed limits; and exclusion fencing around contaminated waste pads and ponds) will be implemented to reduce moose mortality." (p. 11-46) **Rationale:** The Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012 notes: "The views of affected Aboriginal groups on mitigation be considered and included in the EIS. This could assist in ensuring that the environmental effects on the current use of land and resources for traditional purposes are at an acceptable level for the community."	Please provide additional information on the discussions Denison has had with Indigenous Nations and communities on how to mitigate any residual project impacts on their traditional harvesting activities of large game such as moose. More information is required to determine if Denison has engaged directly with ERFN/KML and other Indigenous Nations who utilize the area to harvest moose to determine current baseline harvest numbers that provide subsistence, continued cultural identity and community well-being, as well as discussions on how the Project could potentially impact moose populations and the harvesting of moose for traditional practices.	Response is accepted, but also see AD-62 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Sources for indirect moose mortality (e.g., increased hunter access, changes to health due to sensory disturbances, changes to predator-prey dynamics) may result in mortality outside the Wildlife LSA. The residual effect of change in moose mortality is likely to occur. Although mitigation measures are expected to reduce, but not fully eliminate, the residual effect on moose. The potential residual impact on the moose and other large game populations in the broader regional study area may potentially impact Indigenous treaty rights, culture, and community well-being if the harvesting of moose and large game declines due to increased traffic, noise, and vehicle mortality or increased outside hunting pressure.			
IR-130	-	H. Mulye	Physical stressors (noise and vibration) on wildlife	Section 9, Terrestrial Environment	**Context:** Sensory disturbances such as noise have been identified as stressors for selected wildlife (Ungulates, Furbearers, and Woodland Caribou), birds and amphibians in the Project area. However, there is no consideration of impacts from vibrations on these species. Also, impacts of noise and vibration on reptiles have not been assessed in the Project area. **Rationale:** While noise has been qualitatively assessed for selected wildlife, birds, and amphibians, there is no consideration of project-related vibrations as a sensory disturbance/physical stressor. Sensitive terrestrial species (specifically, herpetofauna, amphibians, invertebrates, and caribou) can be impacted by vibrations emanating from the operation of heavy machinery, blasting activities, and other anthropogenic activities at the Project site. Also, impacts of physical stressors (noise and vibration) on reptiles were not assessed. These species should be included in this assessment due to their sensitivity to noise and vibrations.	Please provide a discussion of impacts of physical stressors (specifically vibrations) on wildlife, birds, and amphibians in the Project area. Specific mitigation measures and/or monitoring for impacts from project-related vibrations should be considered, as appropriate. Also, include reptiles in the assessment of project-related noise and vibrations as sensory disturbance/physical stressor, or a justification for their exclusion.		Accepted
IR-131	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** As per the requirement outlined in Section 79 of the Species at Risk Act (SARA): *The person must identify the adverse effects of the project on the listed wildlife species and its critical habitat and, if the project is carried out, must ensure that measures are taken to avoid or lessen those effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategy and action plans. This is accomplished by ensuring that the Proponent has identified, avoided, lessened and will monitor effects to species at risk.* As per the CNSC's Generic Guidelines for the Preparation of an EIS pursuant to the Canadian Environmental Assessment Act, 2012: "*The EIS will then describe mitigation measures that are specific to each environmental effect identified. Measures will be written as specific commitments that clearly describe how the Proponent intends to implement them and the environmental outcome the mitigation is designed to address. The EIS will describe mitigation measures in relation to species and/or critical habitat listed under the Species at Risk Act (SARA). These mitigation measures will be consistent with any SARA permit, applicable recovery strategy and/or action plan*". The draft EIS neither lists the adverse effects to all listed schedule 1 SARA species, nor outlines the measures that will be taken to avoid or lessen these effects. The Proponent	Identify all species at risk listed on Schedule 1 of the Species at Risk Act and their critical habitat that are likely to be affected by the Project and describe how they may be adversely affected by the Project. Describe what measures will be taken to avoid or lessen the effects of each Project activity and stage, and how these effects will be monitored to ensure they are avoided or minimized.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					references that additional species-specific mitigations will be detailed in environmental management plans but has not provided those plans for review.			
IR-132	-	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale:** ECCC has identified that three species at risk arthropods (yellow banded bumble bee, transverse lady beetle, and nine-spotted lady beetle) have ranges overlapping the Project area and these were not mentioned in the draft EIS.	1.Conduct an effects assessment for arthropod species at risk. 2. Explain what mitigation measures will be used to minimize potential effects.		Accepted
IR-133	-	ECCC		Section 9, Terrestrial Environment	**Context and Rationale:** There is potential for some species at risk (e.g., myotis species, barn or bank swallows, common nighthawk) to be attracted to and use mine infrastructure (buildings, roads etc.) once constructed for nesting, roosting, or foraging. Details on mitigation measures and adaptive management with respect to attraction to Project components should be identified to assess residual and cumulative impacts to species at risk.	For all Project phases, describe the mitigation measures and adaptive management to prevent and minimize effects on species at risk that may utilize mine infrastructure.		Accepted
IR-134	-	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context and Rationale**: The draft EIS states in multiple places that vegetation clearing may occur year-round. In order to correspond with the timing of emergence from hibernation, tree clearing should not be conducted during the bat roosting period. If maternity roost trees are removed after pregnant females have established a roost area, there is a higher likelihood of abortion than there would be otherwise. Species-specific mitigations are required to protect bat SAR.	Provide important roosting dates for bat species at risk in the Project area.	The Proponent provided a complete response regarding the roosting dates for bat species at risk, however follow-up IRs are required. See follow-up IR-134-R1.	Accepted
IR-134	IR-134-R1	ECCC	Wildlife and Wildlife habitat	Section 9, Terrestrial Environment	**Context:** The Proponent has committed to conduct pre-construction and pre-clearing surveys for multiple species, however the timing and methods for the surveys were not provided. Knowing the survey methodology for pre-construction and pre-clearing for little brown myotis and northern myotis is important for assessing cumulative impacts, effectiveness of adaptive management strategies as well as determining how bat species were considered in the EIS. **Rationale:** ECCC can determine whether the methodology the Proponent will use to collect data is appropriate and if the methodology would contribute to a more complete understanding cumulative effects and adaptive management strategies. A clear outline of how timing has been considered and incorporated into the methodologies is required to understand how sensitive periods for bats, such as roosting, have been considered in the EIS. An understanding of the methodologies and how these sensitive periods are being considered is required to evaluate the effectiveness of mitigation strategies and adaptive management strategies which are being developed by the Proponent.	The information provided by the Proponent regarding the roosting dates and potential habitat for bats is complete, however, the information related to the pre-construction and pre-clearing surveys is missing details on important habitat features for bat species at risk. As two Species at Risk Act (SARA) schedule 1 listed bat species, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis) have been identified in the Project area, effects need to be identified, avoided, lessened and monitored.	Following a supplementary submission by Denison on July 8th, 2024, this IR has been resolved. The response on bats is sufficient.	Accepted
IR-135	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat	Section 9, Terrestrial Environment	**Context and Rationale:** The mitigation measures for birds and wildlife presented in the draft EIS are very general. Additional detail is required for a complete assessment of residual and cumulative Project effects to birds and wildlife.	The following information should be included in the various plans and should be provided for review during the environmental assessment:		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					The Proponent has committed to providing a number of plans including, a Decommissioning Plan, a Spill Response Plan, a Waste Management Plan, a Surface Water Monitoring Plan, a Remediation and Closure Plan, a Radiation Protection Plan, a Soil and Vegetation Monitoring Plan, a Wildlife Monitoring Plan, and a Woodland Caribou Management Plan. In order to assess potential affects to migratory birds and wildlife from Project related activities, ECCC requires details on species-specific mitigation measures, and monitoring plans.	1. For all Project phases, describe the species-specific mitigation measures and responses to prevent and minimize effects on migratory birds or species at risk (SAR) birds and mammals that may utilize mine infrastructure. 2. Explain how light pollution will be managed and what specific mitigation measures will be used to minimize effects to migratory birds and SAR birds and mammals. 3. Provide details on what methods will be used for erosion control and how they will prevent sediment from entering waters frequented by migratory birds or SAR. Explain what actions will be taken if the erosion control measures are not successful. 4. Provide details on noise and other sensory disturbance monitoring and mitigations if noise levels surpass thresholds. 5. Describe time windows and species- specific mitigations related to maintenance activities such as vegetation management, road or building repair and stream crossing replacements.		
IR-136	-	CNSC	Soil Salvage Monitoring	Section 9.1.8.2	**Context:** The Proponent plans to salvage and stockpile soil and organic matter/peat in order to use it in reclamation activities during decommissioning. Periodic monitoring of the stockpiles is proposed to be conducted to verify that soil and organic matter/peat are delineated, stripped, handled, and stockpiled as recommended, and to evaluate the stability of salvaged soil, e.g., in relation to potential erosion and/or degradation. It is unclear whether monitoring includes soil quality in terms of concentrations of COPCs. **Rationale:** It is expected that project-related activities (road and airport traffic, drilling) can result in open-source (i.e., fugitive) dust and process-source dust (incl. radionuclides), which can accumulate and result in changes in soil quality of the stockpiled soil and organic matter/peat as described in Sections 9.1.4.2.2 and 9.1.4.2.3).	Please clarify if COPC concentrations monitoring is planned to be performed for stockpiled soil and organic matter/peat.		Accepted
IR-137	-	ECCC	Migratory birds, Wildlife and Wildlife Habitat, Vegetation and Wetlands	Section 9.2.1.3, Spatial and Temporal Boundaries for Vegetation and Ecosystems, Listed Plant Species and Wetlands Section 9.3.1.3.1, Spatial Boundaries for Ungulates,	**Context and Rationale:** The CNSC's Generic Guidelines for the Preparation of an EIS Pursuant to the Canadian Environmental Assessment Act, 2012 states that: "The EIS will describe the spatial boundaries, including local and regional study areas, for each VC to be used to assess the potential adverse environmental effects of the Project and provide a rationale for each boundary. Spatial boundaries will be defined taking into account the appropriate scale and spatial extent of potential environmental effects, community knowledge and Indigenous knowledge, current or traditional land and resource use by Indigenous groups, ecological, technical, social and cultural considerations."	Provide a biologically relevant rationale for the delineated study boundaries (LSA and RSA) for all different valued components. Include the following information: • Descriptions of how the RSA and LSA boundaries were derived for all VCs. Specific to boreal caribou: Project Footprint: • Include a 500-m buffer of area of maximum physical disturbance to represent functional habitat loss for boreal caribou		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Furbearers and Woodland Caribou 9.4.1.3.1, Spatial Boundaries for Raptors, Migratory Breeding Birds, and Bird Species at Risk	The information provided in the EIS does not enable a biologically relevant assessment of the Project's effects. The Proponent did not provide rationale for the selection of study areas for individual vegetation, wildlife or migratory bird valued components (VC). Different VCs may have different spatial boundaries for the LSA and/or RSA. For wildlife and bird VCs, the LSA is defined as a 1.7-km buffer from the Project area, and the RSA is defined as a 6.6-km buffer around the LSA. There is no information on how the spatial boundaries were derived. Specific to Woodland Caribou, boreal population (hereafter referred to as boreal caribou): Project Footprint: In a scientific assessment of critical habitat (Environment Canada, 2011) [1] ECCC demonstrated that the application of a 500-m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale. Adding a 500-m buffer to the Project footprint is required to represent functional habitat loss. The draft EIS does not appear to use a buffer for their Project area. The draft EIS (Section 9.3.1.3.1) states: "Project Area: the area within which the Project and all components/activities are located (i.e., the area of maximum physical disturbance). The Project Area covers 169.6 ha and is not VC-specific, but consistent throughout the EA." (p. 9-168) LSA: The defined LSA for boreal caribou has to consider avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance. This required information is not detailed in the draft EIS. Adverse effects of Projects including predator and prey access to undisturbed areas, reduction in connectivity, and sensory disturbance to individual boreal caribou can vary and extend several kilometers depending on Project activities and ecological context. At minimum, the LSA should capture the above- mentioned effects. For boreal caribou, the Project footprint should be defined as the immediate area to be cleared, plus a 500-m buffer to represent functional habitat loss. Following this guidance, the LSA should be defined as a buffer of the Project footprint with the 500-m buffer. RSA: The Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada states: *Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:*	LSA: • Include a description of how the LSA takes into account boreal caribou avoidance of disturbed areas, predator access to undisturbed areas, reduction in connectivity and sensory disturbance to individuals. RSA: • Include a description of how the RSA used in the draft EIS is an accurate representation of the SK1 boreal caribou range; **or** • Re-do the assessment with the RSA at the scale of the range See also related IRs: IR-154 and IR-156.		

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					• *Assess the impact of all disturbances (anthropogenic and natural) at the range-scale;* • *Monitor habitat conditions, including the amount of current disturbed and undisturbed habitat, and amount of habitat being restored;* • *Account for planned disturbances; and* • *Assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.* The proposed Project's cumulative effects for boreal caribou are possible at the scale of the SK1 boreal caribou range. The RSA used for boreal caribou for this Project is only 40,173.6 ha, compared to the SK1 range, which is 18,034,870 ha. As such, it is too small to capture cumulative effects to this species and does not follow the Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) or the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada. **Reference**: [1] Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011).			
IR-138	-	CNSC	COPC in Lichen	Section 9.2.4.2.2 Appendix 10-A (ERA)	**Context:** A quantitative assessment using modelling dispersion and uptake of COPCs in the environment was completed for the Project as part of the ERA, to support conclusions drawn in the EIS. In Appendix 10-A (ERA), COPCs in plant tissue was estimated for lichen. Table 5-5 of the ERA (p. 5.24) named "Complete Exposure Pathways for All Selected Ecological Receptors to be Assessed using the IMPACT Model" lists the exposure pathway for lichen as direct contact on soil. **Rationale:** Airborne COPC can deposition on lichen and subsequently enter the food chain; therefore, the "contact with air" pathway should be considered. In fact, lichen species are frequently used to monitor the deposition and accumulation of airborne contaminants (e.g., dust, metals). It is also noted that based on sampling results of the 2017 baseline studies, lichen frequently contain higher concentrations of COPC than blueberry (compare Table 9.2-6 and Table 9.2-7 in the EIS), especially at sampling sites with elevated concentrations (e.g., RSV9 and RSV10).	Please include the exposure pathway of direct deposition (dry and wet) of airborne contaminants on lichen in the quantitative ERA, or justify why this exposure pathway was not considered. See also related: IR-189.		Accepted
IR-139	-	ECCC	Change to an environmental component due to hazardous contaminants	Section 9.2.5.2.7, Waste and Hazardous Materials Management	**Context:** In this section, the Proponent outlines various measures to mitigate air emissions, including implementation of the air quality programs within the Environmental Management System, regular maintenance and inspection of equipment, and elimination of unnecessary idling of equipment. However, the intention to use industry-standard emission control systems has not been substantiated. **Rationale:** For the protection of air quality, it is important to specify the emission standards that equipment will have (e.g., Tier 3 or Tier 4 engines). Vehicles and equipment with Tier 4 engines have much lower emissions of contaminants than those with Tier 3 engines. If non-Tier 4 engines are used, ECCC recommends that best	Confirm if vehicles and equipment will be equipped with Tier 4 engines where feasible.	Response is accepted, but also see AD-55 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					management practices are followed, including proper maintenance of the engine and anti-idling measures.			
IR-140	-	CNSC	Change in the Areal Extent of Wetlands	Section 9.2.6.4	**Context:** Predicted residual effects on the areal extent of wetlands include the direct effect of loss of wetlands and several indirect effects of alteration of wetlands. As stated in the EIS, wetlands can exhibit low resilience and high susceptibility to disturbance. At the same time, wetlands tend to support a high species diversity, and are considered to have a moderate to high potential to support listed plant species. Lastly, wetlands are rare on the landscape compared to terrestrial ecosites (see Table 9.2-5). **Rationale:** Several wetland ecosites (BS19/24, BS25, BS27) occur only in small areas (< 30 ha) in the RSA but are predicted to experience disturbance of 6-64%, most notably the ecosite BS19/24 where 0.8 of 1.2 ha are predicted to be disturbed. It is noted that wetlands are scattered throughout the landscape as shown in Figure 9.2-8. More information is requested regarding the ecological impact of this disturbance.	1. Please provide a discussion on the ecological impact of disturbance to rare wetland ecosites. 2. Please provide information on whether adequate other habitat is available for species impacted in these disturbed sites in close proximity, taking into account the home ranges of susceptible species. 3. Please provide additional information on whether wetland connectivity is maintained through the landscape within the LSA/RSA. See also related: IR-141. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison conduct monitoring of species present in wetlands before and after disturbance, with a focus on listed plant species.		Accepted
IR-141	-	ECCC	Wetlands	Section 9.2.6.4.1	**Context and Rationale:** The Proponent states that: "Direct loss of wetlands has been mitigated by reducing the size of the Project Area to the extent practicable during Project design. However, up to 0.5 ha (less than 0.1%) of all wetlands within the Terrestrial RSA are anticipated to be removed from the Project Area during Construction (Table 9.2-16)." Information is not provided on whether wetlands in the terrestrial RSA are considered ecologically, economically or socially important to the region. Information on the regional importance of the wetlands that will be lost is needed in order to assess effects, including a wetland compensation plan if the wetlands are considered regionally important.	1. Provide information that accounts for whether wetlands are considered ecologically, economically and socially important to the region. 2. If the above is affirmative provide a wetland compensation plan to offset the loss. Consistent with the Operational Framework For Use of Conservation Allowance [1] a minimum ratio of 2:1 should be the starting point when determining the amount to be offset. [1] Available at : https://publications.gc.ca/site/eng/9.696852/publication.html See also related: IR-138.		Accepted
IR-142	-	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.3.2.1 Scientific Literature Review – Wolverine Section 9.3.5 Mitigation Measures Section 9.3.6 Residual Effects Evaluation	**Context:** The Proponent did not conduct any field work to identify potential wolverine dens in the Project area and therefore did not present any mitigations for the potential impacts to wolverine dens. In Section 9.3.3.2.1, the Proponent states: "Denning females are sensitive to disturbance during denning season in February to April and may abandon their dens and, in some cases, their litter, which may decrease their reproductive success. " In Section 9.3.6, the Proponent states: "In the Project Area, 145.0 ha or 100% of available wolverine habitat is assumed to be removed and will not be available to	1. Please provide additional information on whether the lost and/or altered wolverine habitat overlaps with wolverine home ranges. 2. Describe any important wolverine habitat feature (i.e., dens) that may be lost as a result of the Project. 3. Assess the need for pre- construction/pre-clearing surveys to identify any wolverine denning sites.	The information provided by the Proponent is complete, however, a follow up IR regarding survey methods for all pre-construction and pre-clearing surveys is required. See follow-up IR-142-159-167.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					wolverine for the duration of the Project (Table 9.3-13). Similarly, 145.0 ha (3.4%) of available wolverine habitat within the Wildlife LSA is anticipated to be removed, all from the Project Area, during site clearing in Construction. In the Terrestrial RSA, up to 0.5% (145.0 ha; from the Project Area) of available wolverine habitat is anticipated to be removed during site clearing in Construction." The residual effect assessment estimates that 8.2% of available wolverine habitat within the Terrestrial RSA may be altered or lost (Table 9.3-20). **Rationale**: As Wolverine is a Species at Risk Act Schedule 1 listed species, effects need to be identified, avoided, lessened and monitored. Mitigations, such as setback distances, should be used to protect important habitat features, such as dens. Wolverine occupy large home ranges and, therefore, need vast tracts of undisturbed land to maintain viable populations. The species avoids most human footprint types and linear features.	4. Please provide additional information on whether the remaining, available, undisturbed wolverine habitat size is suitable to maintain populations.		
IR-142 IR-159 IR-167	IR-142-159-167-R1	ECCC	Wildlife and Wildlife Habitat	**Reference to EIS:** Section 9.3.3.3, Baseline Studies Section 9.3.5 Mitigation Measures IR 142, 159, and 167 Responses from Denison	**Context:** The Proponent has committed to conduct pre-construction and pre-clearing surveys for multiple species, however the timing and methods for the surveys were not provided. **Rationale:** Knowing the survey methodology for pre-construction and pre-clearing surveys across multiple species is important because the Proponent is intending to collect data so that ECCC can determine whether the methodology used to collect the data is appropriate and if the methodology would contribute to understanding cumulative effects and adaptive management. Understanding how timing has been considered and incorporated into the methodologies is required to understand how sensitive periods, such as nesting, breeding, foraging and migration, have been considered in the EIS. An understanding of the methodologies and how these sensitive periods are being considered is required to evaluate the effectiveness of mitigation strategies and adaptive management being developed by the Proponent for each species mentioned in IR-142, IR-159 and IR-167.	Provide survey methodology and timing for all preconstruction and pre-clearing surveys, including avian and species at risk surveys (caribou, wolverine).	The proponent has referenced the Saskatchewan species detection survey protocols as requested and has revised the methodology as suggested. Moreover, the proponent indicated that surveys will be completed by qualified professional biologists that will refer to available guidance such as these protocols. The proponent has included this information into the EIS documentation and has updated commitments accordingly.	Accepted
IR-143	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies	**Context and Rationale:** The baseline caribou data is insufficient to understand potential Project impacts to this species. Presence/absence detection was provided by camera traps, incidental observations, winter track and pellet survey. Additional information and analyses on caribou use of the landscape during all life stages of the Project area is required to assess impacts and to determine significance of impact from the Project to caribou.	Provide details on the baseline caribou data including: • Revision of map 9.3-8 to include all observations, categorized by type, season and year (see also IR-145); and • Description of seasonal use of the LSA, RSA and caribou range. • Description of Project areas used by caribou. • Description of future studies planned to assess habitat use by caribou. Include specific details on how many additional years of aerial surveys will be completed to assess the caribou baseline conditions. Utilizing additional data noted above and specified in IR-145, explain how caribou use of the area could be affected by the	See also AD-81 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
						Project throughout all seasons and life stages (e.g., calving, post-calving, rutting, wintering). See also related: IR-152.		
IR-144	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Baseline Studies – map 9.3-8	**Context and Rationale:** The mapping of caribou observations during baseline studies provided in Figure 9.3-8, "Caribou Sign Observations in the Wildlife Study Areas," is insufficient to enable conclusions to be drawn. ECCC is not able to review the spatial aspect of caribou observations without a map of all available observations. Additional information is available, as stated in Section 9.3.3.3.3: *"A total of 200 observations were made between 2017 and 2019 and recorded as either caribou sign (i.e., tracks, pellets, and evidence of feeding activity based on ground feeding craters and arboreal feeding evidence) or photographs (collected through the wildlife camera study) to document caribou presence in the LSA and RSA. Most observations occurred in the Terrestrial RSA, with observations concentrated in the north and southeast portions.* *Three observations occurred in the southeast portion of the Wildlife LSA, and no caribou sign was observed in the Project Area. Figure 9.3-8 provides an overview of some caribou sign observed during the baseline studies."*	Update map 9.3-8 to show all caribou observations during baseline studies, broken down by type of observation (camera, incidental, pellet, track) and season/year when the observation was made. Include additional data from the Province of Saskatchewan (see also IR-145) to help characterize caribou use on a spatial map.	See also AD-81 in the Advice to Proponent table.	Accepted
IR-145	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3, Woodland Caribou	**Context and Rationale:** The Proponent has not provided sufficient information on how caribou use the landscape, including identification of areas for different life stages of caribou (calving, post-calving, rutting and wintering). The University of Saskatchewan published a report entitled Population and habitat ecology of boreal caribou and their predators in the Saskatchewan Boreal Shield. This report contains information on habitat types that are used during different life stages. Additionally, Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 20202 [1] details habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The scientific literature review (Section 9.3.3.3.1) on Woodland Caribou states: "While calving areas have not been documented within the SK1 range, it is recognized that caribou may use open fen and treed bog habitat types for calving during the spring/summer period. In Saskatchewan, caribou habitat used during the calving season in the SK2 range demonstrated a strong selection for treed muskegs, but avoidance of jack pine, mixed hardwood stands, and roads (Dyke 2008)." ECCC is not able to verify the Proponent's effects assessment without sufficient information on important habitat or biophysical attributes for caribou within the study areas. [1] https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/woodland-caribou-boreal-2020.html#toc0	1. Provide, based off existing literature or available data and the Amended Recovery Strategy for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada: • information on known important habitat features or biophysical attributes in Project areas for different caribou life stages (calving, post-calving, rutting, wintering), • a map(s) of the type and spatial extent of important caribou habitat features or biophysical attributes of the study areas as defined in Appendix H of the Recovery Strategy, ○ mapping should be at the RSA/LSA level as well as larger-scale mapping at the scale of the Project footprint. 2. Assess the potential direct and indirect effects based on additional information on caribou from bullet A above. See also related IRs: IR-143 and IR-152. **Suggestions for mitigation and follow-up measures:** ECCC recommends that the Proponent contact the Province of Saskatchewan to enquire about obtaining caribou telemetry data in the Project area. The data can be analyzed to determine important habitat features in the Project area.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-143 IR-144	IR-143-144-R1	ECCC	Wildlife and Wildlife Habitat	Section 9.3.3.3, Baseline Studies IR-143 and 144 Responses from Denison	**Context:** In the IR-143 response, the Proponent states: "As described in the EIS, caribou may use open fen and treed bog habitat types for calving during the spring/summer period. Information from Indigenous Knowledge (IK) was included in the EIS, including potential calving areas in the Terrestrial RSA." The Proponent provided a revised Map 9.3-8 to display these features. **Rationale:** While the revised Map 9.3-8 shows seasonal use, it is challenging to see the overlapping spatial and temporal features. The map is not adequate for fully understanding the seasonality of the data. The scale provided does not allow for a proper assessment of seasonal use, including differentiation of habitat use such as calving, movement or wintering habitats. Some habitats, based on use, may be more used for more critical functions than others and this information cannot be adequately assessed based on the information provided.	Provide individual maps by season and survey type or with larger scale insets that show areas with overlapping spatial and temporal features.		Accepted
IR-143 IR-145	IR-143-145-R1	ECCC	Wildlife and Wildlife Habitat	Section 9.3.3.3, Baseline Studies IR-143 and 145 Responses from Denison	**Context:** Information presented on boreal caribou in the study areas in the Proponent's response is insufficient to: • characterize and determine the risk of Project impacts, • and • calculate the appropriate level of offsetting required. Information on important habitat features and how caribou are using the landscape is required to complete an assessment of the Project impacts. Although the Proponent provided a map showing telemetry points (provided by the Province of Saskatchewan), the map lacked sufficient detail to assess habitat use and important biophysical features of the Project area. The IR-145 response states: "Available habitat was determined as the ecosites in which caribou / caribou sign were detected most frequently during the baseline studies, and the EIS used a precautionary approach by assuming caribou use of these areas during all seasons and life stages." As a part of the analysis, calving areas are particularly important to delineate if information is available as a key part of all life stages. In the draft EIS, the habitat types that are considered non-habitat for caribou are open bogs (BS20), leatherleaf shrubby fens (BS22), graminoid fens (BS24), open fens (BS25), rush sandy shorelines (BS26), sedge sandy shorelines (BS27) and waterbodies. **Rationale:** Woodland caribou are known to use treed bog and open fen (Section 9.3.3.3.1 of the draft EIS), however open fens and bogs are excluded from the identified available Woodland Caribou habitat, based on not detecting presence or not detecting presence as frequently. Mapping of important caribou habitat features is required to assess important potential impacts to caribou. In the absence of telemetry data, mapping of habitat quality, based on a combination of known ecosites and known important biophysical	1. Provide maps at the Project Development Area (PDA)/Local Study Area (LSA)/Regional Study Area (RSA) scale showing caribou habitat quality. 2. Provide maps at the PDA/LSA/RSA scale showing areas with the appropriate biophysical attributes for calving and other life stages, such as important wintering habitats and movement corridors. Indicate the source of telemetry data (i.e., University of Saskatchewan and/or the Province of Saskatchewan).		Accepted

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					features will provide a reasonable alternative where known important caribou habitat features cannot be mapped.			
IR-146	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.3.3.1, Woodland Caribou, Scientific Literature Review - Predation	**Context and Rationale:** The information on impacts of predation and apparent competition for caribou in relation to the proposed Project are insufficient. In the section on caribou predators (9.3.3.3.1), the Proponent provided details on densities of wolves and their overlap with caribou and speaks of apparent competition. The Proponent did not examine other predators, such as black bear. The analysis on impacts of predation and apparent competition is insufficient since known predators have been omitted without explanation from the assessment of effects. ECCC is not able to verify the Proponent's effects assessment since important species have not been considered in the assessment.	Provide further information and analyses on all potential predators of caribou, including impacts from apparent competition.		Accepted
IR-147	-	ECCC	SAR – Boreal Caribou	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** The process of in-situ recovery mining will likely create changes to the surface topography and potential ground subsidence as well as changes to groundwater elevations. These changes can affect the plant communities and ecosite types. In Section 9.3.4.2.1 the Proponent states that: "Following decommissioning and reclamation, wildlife habitat is expected to recover to baseline conditions." A more thorough explanation regarding post-decommissioning landscape is required to assess Project impacts.	1. Provide further rationale and/or analysis regarding the return of wildlife habitat to baseline conditions post-decommissioning. Incorporate other environmental impacts including: • Ground subsidence and impacts on wildlife habitat • Changes to aquifers and impacts on wildlife habitat 2. Describe reclamation activities/measures, including temporal information that will be implemented to help in the recovery to baseline conditions.		Accepted
IR-148	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.4.2.1, Alteration and/or Loss of Habitat	**Context and Rationale:** ECCC analyzes disturbance for caribou at the range level, in this case within the SK1 range. However, the Proponent did not provide an adequate assessment of total disturbance at the range level. The draft EIS (Section 9.3.4.2.1 p. 9-211) reads: "The SK1 Boreal Shield Woodland Caribou Management Unit has relatively low levels of anthropogenic disturbance and was exposed to large fire disturbances in the past 40 years (ECCC 2019). Environment and Climate Change Canada (2019) identified this caribou population as being self-sustaining at a threshold of 40% undisturbed habitat with the total anthropogenic disturbance not exceeding 5% of their habitat. The current anthropogenic disturbance levels (without areas burnt by past forest fires) for the study areas are below this threshold (with the exception of the already disturbed Project Area) and are estimated as: 24.8 ha (14.6%) for the Project Area, 168 ha (3.5%) for the Wildlife LSA, and 599 ha (1.5%) for the Terrestrial RSA." Analysis of habitat disturbance should be calculated at the range level in order to assess impacts and determine significance. Analysis should be consistent with the methodology described in the document Scientific Assessment to Support the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada (Environment Canada, 2011) [1].	Provide the following in order to support analysis of habitat disturbance: 1. Calculation of total disturbance including natural and anthropogenic disturbance at the range level. 2. Description of effects on existing habitat at the scale of the range (for < 40% undisturbed habitat in the SK1). Include: • an account (and GIS file if available) of existing habitat affected, using the following formula: (Project footprint + 500m buffer) – overlapping (permanent alteration(s) + 500m buffer) 3. A map of the SK1 range showing all disturbed and undisturbed habitat, including predicted disturbance (direct and indirect) resulting from the Project. 4. Description of whether the Project is expected to compromise the ability of the range to be restored to the undisturbed habitat threshold, and provide a rationale for the conclusion. See also related: IR-154.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					[1]https://publications.gc.ca/site/eng/401605/publication.html, p. 28/41			
IR-149	-	ECCC CNSC	Wildlife and Wildlife habitat	Section 9.3.5.2, Additional Wildlife-specific Mitigation Measures	**Context:** The EIS describes that ongoing research is performed to inform the development of a Woodland Caribou Management Plan. This includes studies on the effectiveness of linear disruption features on predator/prey movements, and a field program for long-term reclamation planning. Moreover, it is stated that the Plan will include a detailed assessment of the need for habitat offsets. The draft EIS Section 9.3.5.2 states: "A wildlife monitoring plan and a Woodland Caribou Management Plan will be developed to address wildlife-specific mitigation measures based on proven and accepted mitigation following standard industry guidelines and BMPs. The plans will provide guidance to avoid or minimize potential adverse effects of the Project on wildlife and wildlife habitat, including monitoring and follow-up programs, as appropriate. It will be in place during all phases of the Project and will be subject to ongoing review and revision as required. If monitoring identifies a need for additional or revised mitigation measures, a process of adaptive management (as described in the plan) will be triggered." **Rationale**: The draft EIS does not present sufficient species-specific mitigation measures for boreal caribou. ECCC is not able to assess potential residual impacts to caribou without specific mitigations. Since the Woodland Caribou Management Plan is still under development, it is difficult to judge whether the measures will be adequate to mitigate and/or offset potential project effects on Woodland caribou and its critical habitat.	Provide the Woodland Caribou Management Plan, to demonstrate effective mitigation of potential project effects, along with wildlife-specific mitigation measures for review. The Plan should be informed by and consistent with the Boreal Caribou Recovery Strategy and demonstrate that avoidance and minimization measures will be applied to mitigate for predicted Project effects to boreal caribou and its critical habitat prior to considering offsetting measures. That is, the Plan should follow the mitigation hierarchy and information should be provided as outlined below: 1. AVOID: Describe all measures that will be taken to avoid effects to boreal caribou and avoid the destruction or alteration boreal caribou critical habitat. 2. MINIMIZE: Describe all measures that will be taken to minimize the effects to boreal caribou and minimize the destruction of boreal caribou critical habitat. 3. RESTORE ON-SITE: describe the measures that will be taken to restore disturbed areas of the Project, related to construction, operation and maintenance, on boreal caribou critical habitat, remaining after considering the avoidance and minimization measures. 4. Characterize the risk of the adverse effects that are likely to result from the Project on boreal caribou and its critical habitat after avoidance minimization, and onsite restoration measures have been considered. 5. OFFSET: Describe the measures that will be implemented outside the Designated Project area to mitigate adverse effects, destruction or alteration of boreal caribou critical habitat by the Designated Project during construction and operation. 6. Characterize the risk of the adverse effects that are likely to result from the Project on boreal caribou and its critical habitat after avoidance, minimization, onsite restoration, and offset measures have been considered. Describe all relevant uncertainties on the effectiveness of the measures to address adverse effects on boreal caribou and the rationale for the selected measure, in light of the mitigation hierarchy.	This IR has been accepted for the purposes of the EA. Denison will be required to address this IR prior to commencing any work/activities at the project site. EA condition language along with any detailed expectations will be shared at a later date. See also AD-83 and AD-85 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
						See also related IRs: IR-157.		
IR-149	IR-149-R1A	ECCC	Wildlife and Wildlife Habitat	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149 IR-149 Response by Denison	**Context:** Much of the information presented in the Conceptual Caribou Management Plan is qualitative in nature and does not present specific details regarding a quantitative assessment of impacts following measures to avoid, minimize, and restore on-site and then assess residual effects and determine the offset required to counterbalance the remaining impacts. This is required to understand if offsetting is sufficient to address impacts to caribou. The Proponent also does not provide details on methods that will be used for pre- disturbance wildlife clearance surveys. ECCC is aware that that the Proponent will be participating in restoration trials as part of the 'Developing Eco-restoration Together' program. **Rationale:** ECCC requires the quantitative details on the assessment of impacts to be included within the Conceptual Caribou Management Plan to adequately assess how the Proponent has applied the mitigation hierarchy. Details on the methods that will be used for pre- disturbance wildlife clearance surveys will also be required to verify that the Proponent has adequately considered how they have avoided, mitigated, or restored impacts to caribou. While ECCC understands that the Proponent will be participating in restoration trials as part of the 'Developing Eco-restoration Together' program, however, more clarity on the Proponent's role in the program and the scope of the program is required. Details such as how the outcomes of these programs will result in mitigation measures and offsetting requirements and additional clarity on the scope of the program should also be provided so that ECCC can understand the objectives and deliverables of the program.	1. Provide a quantitative assessment of impacts following measures to avoid, minimize and restore on-site and then assess residual effects and determine the offset required to counterbalance the remaining impacts. 2. Provide details on methods to be used for pre-disturbance wildlife clearance surveys. 3. Provide details on the Proponent's role in the Developing Eco-restoration Together program and how that work may be used in offsetting requirements. 4. Provide the scope (i.e., quantitative habitat amount) of the Eco-restoration Together program.	This IR has been accepted for the purposes of the EA. Denison will be required to address this IR prior to commencing any work/activities at the project site. EA condition language along with any detailed expectations will be shared at a later date. See also AD-82 and AD-85 in the Advice to Proponent table.	Accepted
IR-149	IR-149-R1B	ECCC	Wildlife and Wildlife Habitat	Section 9.3.5.2, Additional Wildlife specific Mitigation Measures Proponent response to IR-149 IR-149 Response by Denison	**Context:** Section 4.2.2 of the Conceptual Caribou Mitigation plan states: "locating excessive noise generating activities such as the concrete batching operation as far away from sensitive wildlife locations as possible;". However, no specific mitigation measures are mentioned for impacts to caribou due to noise generated from the Project air strip. **Rationale:** Noise from the air traffic using the air strip will also generate excessive noise that can impact caribou. Additional information on the timing and frequency of air traffic, as well as specific mitigations related to impacts from air traffic, including mitigations related to frequency and timing of flights, will be necessary to evaluate impacts to caribou due to air strip noise.	1. Provide additional information on the timing and frequency of air traffic using the Project air strip. 2. Provide specific mitigations related to impacts from air traffic, including mitigations related to frequency and timing of flights.	Following the supplementary submission provided on July 8th, 2024, as well as the commitment (ID 9-36) provided in version 2 of the Commitments Register (July 17, 2024), this IR is accepted for the purposes of the EA review. However, the following must be corrected in the final EIS submission package: • Update the caribou management framework (EIS Appendix 9-E) to reflect the additional information and proposed mitigation measures, in the final EIS submission package. See also AD-78 and AD-85 in the Advice to Proponent table.	Accepted
IR-150	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.5.2.1, Best Management Practices for working in Boreal Woodland Caribou Range in Saskatchewan	**Context and Rationale:** In the draft EIS Section 9.3.5.2.1, the Proponent states: "Denison proactively initiated research to provide field-based findings on the effectiveness of linear disruption features on predator/prey movements." "Results will help the development of proactive and meaningful restoration strategies as an ongoing part of the overall Project (Omnia 2022). Additionally, the 2023 field program will support a program that uses the results from the 2021/2022 Caribou Trail Study in long-term reclamation planning. The program will be led by the University of Saskatchewan and is funded by Denison, an Indigenous-owned environmental company, the Northwest Communities Environmental Services (Métis owned), Mitacs, and the	Provide the report for 2021/2022 Caribou Trail study for long-term reclamation planning for ECCC review.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Natural Science and Engineering Research Council of Canada through an alliance grant. The Caribou Trail Study and the reclamation plan will culminate with the development of a Woodland Caribou Management Plan." ECCC is available to support the Proponent through review of study programs should those programs be made available during the review process. ECCC requests to see the 2021/2022 study to further our review of caribou use in the Project area.			
IR-151	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4	**Context and Rationale:** In the analysis of residual and cumulative effects for woodland caribou, information and analyses on impacts to connectivity and movement across the landscape is lacking.	1. Using available reports and data, provide an analysis of impacts to landscape connectivity for woodland caribou at the LSA and Range scales. 2. Determine whether the Project is expected to result in a reduction of connectivity within or between the ranges and provide a rationale for the conclusion. Describe how movement corridor(s) may be affected by Project activities and infrastructure.		Accepted
IR-152	-	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4, Appendix 9-B	**Context:** Baseline studies for Woodland caribou include: • Winter Track Count Survey to assess presence, abundance, feeding activity, and ecosite affiliation; • Pellet Group/Browse Availability Survey to detect presence and abundance of caribou, and frequency of occurrence and abundance of lichen; • Covert Camera Survey to determine presence and use of linear features (roads, trails, and hand-cut lines). The Saskatchewan Conservation Strategy for Boreal Woodland caribou [1] states that caribou are very susceptible to predation during the calf-rearing period, and populations are extremely sensitive to even minor changes in mortality rates. **Rationale:** It is unclear if, or how, any data on seasonal and spatial use of habitat was considered in the residual effect analysis, for example summer/winter home ranges, sensitive life stages including calving (e.g., location of calving sites). It should be noted that the English River First Nation have identified caribou calving areas in the vicinity of the Project footprint. **Reference**: [1] Saskatchewan Ministry of Environment. 2013. Conservation Strategy For Boreal Woodland Caribou (Rangifer tarandus caribou) in Saskatchewan. Saskatchewan Ministry of Environment. Fish and Wildlife Technical Report 2014.	Please provide a summary of available baseline data on habitat use during all seasons and life stages, in particular sensitive stages such as calving, and how habitat use during all seasons and life stages was considered in the residual effect analysis. See also IR-145 and IR-143.	See also AD-82 in the Advice to Proponent table.	Accepted
IR-153	-	CNSC	Woodland Caribou Residual Effects Evaluation	Section 9.3.6.4.1	**Context:** According to ECCC (2020), forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g., through loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and	1.Please provide further information on the suitability of ecosites BS3 and BS7 for Woodland caribou in different life stages.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					other food sources, although they may make limited use of burned areas to feed on new growth. The residual effects evaluation of alteration and/or habitat loss lists ecosites BS3 and BS7 (regenerating forest types) as available habitat in Table 9.3-22, which represent 43.5% of the Regional Study Area. **Rationale:** It is unclear whether the ecosites BS3 and BS7 (regenerating forest types) represent suitable habitat for Woodland caribou year-round. More information is required on the habitat quality (e.g., time since last forest fire) and suitability for different life stages of caribou. For conservatism, it is recommended to perform a second residual effect analysis not including regenerating forest ecosites.	2. Please provide the results of a residual effect analysis not including ecosites BS3 and BS7 for conservatism. 3. If 2 leads to habitat fragmentation, consider connectivity of habitat patches in the residual effect analysis.		
IR-154	-	CNSC	Woodland Caribou Alteration and/or Loss of Habitat	Section 9.3.6.4.1	**Context:** Lichen, the primary food source for Woodland caribou (up to 70% of the year-round diet), can be exposed to airborne contaminants and dust deposition at distances of 1–40 km (e.g., increased metal concentrations or dust were detected in lichen at distances of 1–40 km from a mine site [1, 2]). **Rationale:** Further information is requested on how the potential for contamination of the food source "lichen" is reflected in the applied buffers of direct and indirect disturbance for woodland caribou. **References**: [1] Watkinson et al. (2021). Effects of dust deposition from diamond mining on subarctic plant communities and barren-ground caribou forage. Journal of Environmental Quality 50(4): 990-1003. Doi: 10.1002/jeq2.20251. [2] Chen et al. (2017). Does dust from arctic mines affect caribou forage? Journal of Environmental Protection 8(3): 258-276. Doi: 10.4236/jep.2017.83020.	1. Please provide additional justification for how the potential for contamination of the food source "lichen" is reflected in the applied buffers for sensory disturbance. See also related IRs: IR-137, IR-148 and IR-156. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • COPC in Lichen monitoring is recommended in transects from the Project site to assess COPC concentrations and confirm whether the chosen buffer is conservative.		Accepted
IR-155	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1, Alteration and/or Loss of Habitat	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent presents figure 9.3-14 and table 9.3-22, which "depicts available woodland caribou habitat in the Project study areas" and provide a summary of available Woodland Caribou Habitat in the Project Area, Wildlife Local Study Area, and the Terrestrial Regional Study Area. The Proponent does not provide a biologically relevant explanation on the ecosites that are considered available woodland caribou habitat. According to the amended recovery strategy for Caribou, all habitat within SK1 range has been designated as critical habitat. To align with best current knowledge and the amended recovery strategy, the map and table should show the biophysical attributes, as outlined in Appendix H of the recovery strategy.	1. Provide a biologically relevant explanation about how available caribou habitat was determined or determine available habitat based on new data from the province of Saskatchewan (See IR-145). 2. Consider referencing Appendix H of the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 to define important biophysical features.		Accepted
IR-156	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.6.4.1 Section 9.3.7.3.1	**Context and Rationale:** In Section 9.3.6.4.1 of the draft EIS, the Proponent identified that 142 ha of available caribou habitat within the Project footprint will be directly impacted or lost, while an additional 1,165 ha will be indirectly impacted by Project	Provide a revised assessment of residual and cumulative effects, taking into consideration that the disturbance within		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					activities such as sensory disturbance. They assessed the residual and cumulative effect of alteration to habitat for woodland caribou as not significant: "The residual effect of alteration and/or loss of available woodland caribou habitat is not expected to result in a change that will alter caribou habitat integrity to the point where it would not be able to sustain the regional woodland caribou population. Therefore, the effect is assessed as not significant." Section 9.3.7.3.1 of the draft EIS states: "It is not expected that the cumulative effects of alteration and/or loss of habitat will alter the integrity of woodland caribou habitat within the Terrestrial RSA to the point where it is not sustainable or available to contribute to ecological functions. Therefore, the cumulative effects resulting from the Project's residual effect interacting with residual effects from other projects and activities is predicted to be not significant." For the residual effect of alteration and/or loss of available caribou habitat (Section 9.3.6.4.1, Table 9.3-24), the Proponent assessed the magnitude as low, the geographic extent as local, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high and the likelihood as likely. The rationale provided by the Proponent is insufficient to determine the accuracy of these assessments, given the lack of data and the small size of the assessment area. ECCC does not support the residual effects assessment of low magnitude, given the uncertainties related to seasonal use by caribou in the Project area and the current level of disturbance in the SK1 range. For the cumulative effect of alteration and/or loss of available caribou habitat (Section 9.3.7.3.3 , Table 9.3-30), the Proponent assessed the magnitude as moderate, the geographic extent as beyond the RSA, the duration as long-term, the frequency as frequent, the reversibility as fully reversible, the context as high, the likelihood as likely, the significance as not significant and the level of confidence as moderate. The rationale provided by the Proponent is insufficient to determine the accuracy of these assessments, given the lack to data presented for caribou and the small size of the RSA, compared to the SK1 region. ECCC does not support the conclusion of the cumulative effects assessments or for the level of confidence. The Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020 states that the range is currently at the 60% disturbance management threshold. Therefore, any activity likely to result in the alteration or destruction of critical habitat may impact on the species survival and recovery. In addition, the Proponent's assessment was based on information that was lacking data on calving, wintering and rutting areas, and connectivity and caribou movements. The absence of considerations of the regional context of disturbance does not provide a conclusion based on best available information.	the SK1 range is above the disturbance management threshold required for survival and recovery of the species. See also related IRs: IR-137 and IR-154.		
IR-157	-	ECCC	Wildlife and Wildlife habitat	Section 9.3.9 Ungulates, Furbearer and	**Context and Rationale:** The Proponent has committed to developing a Woodland Caribou Management Plan, which will include a "detailed assessment for the need for habitat offsets." The Woodland Caribou Management Plan will support ECCC's review of the Proponent's assessment of residual effects following mitigation and offsetting.	Provide the Woodland Caribou Management Plan for review. The plan should clearly demonstrate efforts to avoid and minimize any Project effects and restore on-site any disturbed areas prior to the consideration of offsetting. Details on how	This IR has been accepted for the purposes of the EA. Denison will be required to address this IR prior to commencing any work/activities at the project site. EA condition language along with any detailed expectations will be shared at a later date.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Woodland Caribou Summary	This plan should consider ECCC's Operational Framework for Use of Conservation Allowances (ECCC, 2012). ECCC is available to assist the Proponent in the determination of appropriate offsets that would balance against Project adverse effects after the application of measures to avoid, minimize and restore on-site are adopted. Based on the Amended Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada 2020, anthropogenic impacts to local caribou populations experience a lag effect, which occurs over extended periods. This lag effect needs to be adequately considered when proposing offsets. ECCC is available to assist the Proponent in understanding how critical habitat is described in the Recovery Strategy and the determination of appropriate offsets that would balance against Project effects based on the predicted impacts to caribou habitat.	severity of disturbance and vulnerability of the species were considered should be explained. See also related: IR-149. **Suggestions for mitigation and follow-up measures:** ECCC notes that the Woodland Caribou Management Plan should clearly explain efforts to address Project effects, including any contribution to cumulative adverse effects, after it has been determined that all options in the previous steps of the mitigation hierarchy (i.e., avoidance, and minimization,) have been fully considered and applied. In the Woodland Caribou Management Plan, provide details on how the factors outlined in the Operational Framework for Use of Conservation Allowances (ECCC, 2012) were considered in determining the offsetting amounts, including the severity of disturbance and vulnerability of the caribou population. Important factors including time lag (the amount of time from restoration work to when the habitat would be considered caribou habitat) would also need to be considered. ECCC typically recommends a minimum offset multiplier of 4:1 (offset outcome: area disturbed). This is a benchmark ratio applied to a project that is in the lower end of the risk spectrum, such as one with a low severity impact adversely affecting a low vulnerability ecological component. In general, the minimum 4:1 multiplier accounts for time-lags to restoration, uncertainty in outcomes, a precautionary approach, and the adverse impact itself in its specific context. Offset multipliers are variable and determined by project-specific circumstances and associated risks and uncertainties.	See also AD-85 in the Advice to Proponent table.	
IR-158	-	ECCC	Migratory birds	Section 9.4.1.2, Key Indicators and Measurable Parameters	**Context and Rationale:** In Section 9.4.1.2 the Proponent outlined key indicators for "Migratory Breeding Birds" which includes Waterbirds and Waterfowl, Upland Game Birds and Migratory Songbirds. These are broad categories, which do not allow for assessment of the variation in habitat requirements or ecology of individual species or guilds. **Updated Rationale:** The Proponent should identify additional focal species that can serve as indicator species by representing anticipated impacts to a broader guild of species. Indicator species should be demonstrably sensitive to the potential effect of interest, and suitable for inferring effects on other species. Species may be grouped into guilds for assessment based on similarities in ecology or vulnerability to Project effects, such as species at elevated risk of collision with vehicle traffic.	Identify focal species/guilds for each key indicator species within the Migratory Breeding Birds valued components. Provide an updated analysis of Project effects on migratory birds.	See also AD-79 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					By identifying focal species or guilds for each key indicator species within the Migratory Breeding Birds Valued Components (VCs), ECCC would be able to accurately review the Proponent's assessment of impacts and mitigation measures in order to assess the accuracy of the Proponent's conclusions and provide expert advice on the mitigation measures.			
IR-159	-	ECCC	Migratory birds	9.4.3.2.3 Baseline Studies – Migratory Songbirds Appendix 9-B, Section 2.10.2, Results	**Context and Rationale:** Information presented in the draft EIS is insufficient to accurately predict Project impacts to breeding birds. The Proponent collected a single year of breeding songbird point counts and aerial waterfowl surveys (including avian species at risk). A single year of surveys in which birds may be unusually scarce or abundant could severely compromise interpretation of post-construction monitoring data. Additionally, data presented in the draft EIS is from 2017 and ECCC advises that more recent data is needed for a comprehensive baseline to verify Project impacts. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal avian Modelling project contain information on avian densities and avian species at risk that could supplement field data. The national standard for major projects recommends a minimum of two years of field surveys to be provided, so that temporal variability can be considered when comparing post-construction against baseline records and other available data. **Updated Rationale:** ECCC recommends that for major projects, a minimum of two years of field surveys should be provided so that temporal variability can be considered when comparing post-construction against baseline records and other available data. More recent data is needed due to landscape changes that may have occurred since 2017 as well as cumulative effects that have occurred in that time. Additionally, if there was an unusually high population density of birds in 2017 due to extraneous circumstances, Project effects may be attributed to a non-existent decline in the population when the discrepancy can be due to natural variability. A more recent baseline will account for interannual variation and any regional effects and will allow for a more accurate review of mitigation and follow-up measures. Data from the Saskatchewan Conservation Data Centre (HABISask), the Saskatchewan Breeding Bird Atlas and the Boreal Avian Modelling project contain information on avian densities and avian species at risk that could supplement field data.	Supplement breeding bird point count data and aerial waterfowl data collected during 2017 with additional pre-construction field data or existing post-2017 data/modelling to provide a comprehensive baseline that can be used to verify Project impacts during construction and operational phases.	See also AD-80 in the Advice to Proponent table.	Accepted
IR-160	-	ECCC	Migratory birds	Section 9.4.3.2.3 Baseline Studies – Migratory Songbirds	**Context and Rationale:** ECCC advises that the results of the field studies need to be interpreted/analyzed in the context of the study area. The Proponent presents results on areas with highest richness and diversity but does not make a link to habitat that will be lost or experience indirect effects. **Updated Rationale:** Results regarding the effects of the Project, including a discussion on habitat types that will be lost or indirectly impacted during the life of the Project, and	Provide results interpreted in the context of Project direct and indirect effects. Include discussion on the habitat types that will be lost or indirectly impacted during the Project and the overall impact on the avian community, using results from the analysis of baseline studies and other supplemental data (as per IR-159).		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					a discussion on the overall impact on the avian community including results from baseline studies as well as other supplemental information as per IR-159 are required to assess the validity of the Proponent's conclusions and should be used in effects assessment.	Discussion should support the conclusions of the effects assessment. See also related IRs: IR-161 and IR-162.		
IR-161	-	CNSC	Bird Species at Risk	Section 9.4.3.3 Appendix 10-A (ERA)	**Context:** For the assessment of effects on Bird Species at Risk (SAR), in the EIS it was decided to use representative species for certain SAR birds: • Olive-sided Flycatcher and Common Nighthawk were selected to represent Barn Swallow. • Yellow Rail and Rusty Blackbird were selected as substitutes for Horned Grebe. No further rationale is provided to demonstrate that the identified surrogate species are representative of the Barn Swallow and Horned Grebe in the EIS. For example, do they share a common diet? Moreover, in the residual effects assessment, limited discussion is provided on the conservatism of chosen suitable habitat types for both surrogate and represented species, in the calculation of habitat loss and alteration, as well as change in mortality. For example, how does habitat for Common Nighthawk and Barn Swallow overlap (do they use identical habitat types?) and how does this affect the calculation of habitat loss and alteration used to evaluate the magnitude of residual effect? Finally, in the ERA, Lesser Scaup is the surrogate for Horned Grebe. Yellow Rail is also represented by Lesser Scaup but Rusty Blackbird is represented by Olive-sided Flycatcher. **Rationale:** It is unclear what criteria were applied to select surrogate species for Barn Swallow and Horned Grebe, and how the chosen surrogates relate to Barn Swallow and Horned Grebe in terms of habitat type and range, nesting, and feeding requirements etc. There is also inconsistency with respect to the use of surrogate species for the Horned Grebe between the EIS and ERA supporting document.	1. Please provide additional information to justify the selection of surrogate species for Barn Swallow and Horned Grebe in the EIS. This should include a description of the similarity of SAR and associated surrogate species and any relevant uncertainties. 2. Please provide conservative estimates of habitat loss and alteration for the represented and not directly assessed species (Barn Swallow, Horned Grebe). 3. Please provide clarity as to why different surrogate species are used for Horned Grebe between the EIS and ERA. See also related IRs: IR-160 and IR-162.		Accepted
IR-162	-	ECCC	Migratory birds	Section 9.4.3.3, Bird Species at Risk	**Context and Rationale:** Not all avian species at risk present in the study area were included as Key Indicators in the avian species at risk (SAR) valued component (VC). Barn swallow and horned grebe were recorded in the study area, but not included as VCs. Additionally, bank swallow may inhabit the Project area. Impacts to Species at Risk Act Schedule 1 listed species need to be identified, avoided, lessened and monitored. In Section 9.4.3.3. the Proponent states: "It is acknowledged that the listed Barn Swallow (Hirundo rustica) and Horned Grebe (Podiceps auratus) could potentially occur in the Terrestrial RSA. Incidental observations occurred during the baseline studies (Appendix 9-B). To focus the effects assessment on a few key species (described in the following) it was decided to use Olive-sided Flycatcher and Common Nighthawk to represent Barn Swallow as well, and to use Yellow Rail and Rusty Blackbird as a substitute for Horned Grebe. Unlike Horned Grebe, Yellow	1. Explain how nesting habitat requirements of barn swallow is represented by common nighthawk and olive-sided flycatcher as a VC or assess individually each SAR that overlaps with the Project and is likely to be affected. 2. Explain how nesting habitat requirements of horned grebe are represented by yellow rail and rusty blackbird as a VC, or assess individually each SAR that overlaps with the Project and is likely to be affected. 3. Assess individually each SAR that overlaps with the Project and is likely to be affected.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rail and Rusty Blackbird are also listed provincially." Barn swallow, bank swallow and horned grebe may have different nesting habitat requirements than the representative species discussed in the draft EIS. An explanation of how differing species are representative of one another is required, or if an explanation cannot be provided, the species should be assessed individually. **Updated Rationale:** The management plans for these three species demonstrate the variability in their habitat selection. The Management Plan for the Yellow Rail (*Coturnicops noveboracensis*) in Canada (Environment Canada, 2013) states "Yellow Rails inhabit shallow wetlands and other wet areas with grass-like vegetation. They breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes (Bookhout 1995, Alvo and Robert 1999, COSEWIC 2009), shallow prairie wetlands, and wet montane meadows (Peabody 1922, Sherrington 1994, Popper and Stern 2000). " The Management Plan for the Rusty blackbird (*Euphagus carolinus*) in Canada (Environment Canada 2015), states: "Rusty Blackbirds tend to select breeding sites with a combination of freshwater bodies with shallow water and emergent vegetation for foraging that are adjacent to wetlands with conifers or tall shrubs with cover for nesting (Matsuoka et al. 2010a, Matsuoka et al. 2010b, Greenberg et al. 2011)." The Management Plan for the Horned Grebe (*Podiceps auritus*), Western population, in Canada (ECCC, 2022) states: "The Horned Grebe breeds in small (generally 0.5 to 2 ha, but ranging from 0.24 to 18.2 ha), shallow (at least 20 cm deep, but on average 40 cm), and usually fishless, perennial wetlands, but they can also nest on larger lakes with shallow edges and sufficient emergent vegetation. Breeding sites usually contain at least 40% open water with beds of emergent vegetation, such as sedges (Carex spp.), rushes (Juncus spp.) and cattails (Typha spp.) (Faaborg 1976, Kuczynski et al. 2012, Routhier 2012, Stedman 2018)." Due to differing habitat selection and use, ECCC recommends that each selected VC is given an individual assessment with specific mitigation measures. This will allow for a more accurate review of the chosen mitigation measures.	See also related IRs: IR-160 and IR-161.		
IR-163	-	ECCC	Migratory birds	Section 9.4.3.3.3, Baseline Studies – Avian species at risk VCs	**Context and Rationale:** The baseline studies and data analysis for species at risk (SAR) birds is insufficient to accurately predict Project effects. ECCC recommends the use of predictive modeling in relation to survey data and habitat attributes to produce distribution and density maps. Sites within the study area that support particularly high densities or diversity of an individual species, based on direct observation and, where appropriate, distribution or occupancy models, would greatly improve confidence in Project impact predictions. Additional information on specific habitat use or models of habitat used by SAR would facilitate a more complete analysis of Project effects.	Provide additional information, including mapping/modelling of specific habitat requirements for each avian species at risk or provide a justification of models used in the draft EIS.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-164	-	ECCC	Migratory birds	Section 9.4.4.2.1, Alteration and/or Loss of Habitat – Migratory Breeding Birds	**Context and Rationale:** The discussion on impacts to migratory songbirds presented by the Proponent is not sufficient to understand the impacts on various guilds of birds (e.g., aerial insectivores, forest birds, wetland birds, habitat specialists). As per IR-158, focal representative species/guilds should be used as key indicators (KI) in the Migratory Breeding Birds Valued Component. A greater level of detail on Project impacts to migratory songbirds with differing habitat requirements is needed for a fulsome assessment of effects. **Updated Rationale:** A greater level of detail, including a discussion on impacts to different focal species and/or guilds within the Migratory Breeding Birds Valued Component, is required for a more fulsome assessment of effects and identification of mitigation measures. Additionally, mapping detailing important features or habitat types that will be lost due to the Project for different guilds of migratory birds will be required to assess Project effects. This information will be required in order for the Proponent to apply adaptive management, and for ECCC to review the adequacy of these management plans.	1. Provide further discussion on impacts to different focal species/guilds within the Migratory Breeding Birds Valued Component. 2. Provide mapping of important features or habitat types that will be lost due to the Project for different guilds of migratory birds.		Accepted
IR-165	-	CNSC ECCC	Birds (all species)	Section 9.4.4.2.2 Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment Appendix 10-A (ERA)	**Context:** On p. 9-364 of the EIS, it is stated that exposure to hazardous materials through contact with contaminated waste ponds could affect avian health and contribute to mortality. However, the ERA places the avian receptors only in waterbodies and locations outside of the Project area (see Figure 5-2 in the ERA), i.e., Whitefish Lake, McGowan Lake, the inlet to Russell Lake, and Kratchkowsky Lake. Further, there are insufficient details on the potential effects of the water quality in the water management and treatment facilities on birds, species at risk, and other wildlife, including the risk of bioaccumulation of contaminants. The Proponent should assess potential effects of water quality from these areas using applicable CCME guidelines. **Rationale:** It is unclear whether the ecological risk assessment based on the chosen exposure locations is protective and conservative for avian species potentially exposed to contaminated waste ponds on the Project site. While mitigation measures such as physical, visual, and/or auditory deterrents are proposed in Section 9.4.5.2.4, the possibility of avian species coming into contact with waste ponds cannot be excluded based on the available information in the EIS. The possibility of birds, species at risk, and other wildlife accessing the water management and treatment facilities for drinking water or other purposes is not discussed in the draft EIS.	Please perform an ecological risk assessment with avian receptors located at the contaminated waste ponds, including: 1. Describe and analyze the possibility of birds, species at risk and other wildlife using the water or waste management facilities and provide an analysis to determine if there is a risk to wildlife that may access these areas. 2. Identify the potential toxicity of water management ponds to aquatic migratory birds and species at risk (SAR). 3. Describe what measures will be taken if the waters are found to be toxic to migratory birds and SAR. **Suggestions for mitigation and follow-up measures:** CNSC recommends that Denison ensure adequate mitigation measures are implemented to minimize the potential for avian exposure to pond waters.		Accepted
IR-166	-	ECCC	Migratory birds	Section 9.4.5.2 Additional Avian Species-specific Mitigation Measures	**Context and Rationale:** Avian species-specific mitigation measures are not presented in the draft EIS. The Proponent has committed to providing a variety of environmental management plans.	Provide details on species-specific mitigations for species at risk (SAR) and other avian species that will include: • details on what activity restrictions will be implemented for migratory birds and SAR and when they will be applied;		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Section 9.4.5.2 reads: "Additional mitigation measures specific to the Raptors, Migratory Breeding Birds, and Bird Species at Risk VCs, in accordance with the Migratory Birds Convention Act, and tailored to Project features will be incorporated into various Project management and monitoring plans such as the, the erosion and sediment controls, soil and vegetation monitoring, wildlife monitoring, the Decommissioning Plan, air quality monitoring, Spill Response Plan, Radiation Protection Plan, surface water and effluent monitoring, and Waste Management Plan." Migratory birds, the nests of migratory birds and/or their eggs can be inadvertently harmed or disturbed as a result of many activities, including but not limited to clearing trees and other vegetation, draining or flooding land, or using fishing gear; this is known as incidental take. This inadvertent harming, killing, disturbance or destruction of migratory birds, nests and eggs is prohibited under the MBCA. Incidental take, in addition to harming individual birds, nests or eggs, can have long-term consequences for migratory bird populations in Canada, especially through the cumulative effects of many different incidents. For further details, please refer to the Avoiding Harm to Migratory Birds website at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds.html In order to assess the effectiveness of species-specific mitigations and need for additional mitigations ECCC requires details on the species-specific mitigation measures proposed, and the monitoring plans.	• details on mitigations used during regular maintenance activities such as vegetation management (e.g., mowing), access road repair (e.g., aggregate stockpiles), and infrastructure repair; • details on methods used to detect species listed on Schedule 1 of the *Migratory Birds Convention Act* (e.g., Pileated Woodpecker) and mitigations/setback distances and timing to reduce risk to these species.		
IR-167	-	ECCC	Migratory birds	Section 9.4.5.2.1 Work Timing Windows and Habitat Disturbance	**Context and Rationale:** The Proponent has stated that when it is not practicable to clear outside of the breeding bird window, they will conduct pre-clearing surveys. Section 9.4.5.2.1 states: "Prior to commencing any site clearing (i.e., vegetation clearing and/or soil disturbance) during the nesting season, pre-clearing nest surveys will be conducted at that location within the Project Area." ECCC does not recommend the use of nest searches or pre-clearing surveys for active bird nests during the breeding season as a mitigation, given the difficulty associated with finding nests reliably and the high likelihood of disturbing nesting birds when searching. Instead, ECCC recommends that clearing and grubbing activities not be conducted during the breeding bird season. The Migratory Birds Regulations 2022 (MBR 2022) brings new scenarios that need to be considered: 1. Most migratory birds: - Nests are protected only when they are in use or when live eggs or chicks are present. 2. Migratory birds listed in MBR 2022 Schedule 1: - For the 18 species of migratory birds identified on Schedule 1, the MBR 2022 provide year-round nest protection until they can be deemed abandoned. 3. Migratory birds listed under SARA: - For some SARA listed migratory birds, the residence prohibition (s.33) will protect nests that are not active, but are re-used in subsequent years, and the critical habitat prohibition (s.58) will protect nests that are part of the critical	Provide the following information: • details on how vegetation clearing related to site development will be conducted to minimize risk to migratory birds and species at risk (SAR). • the timing window that will be used for vegetation removal to reduce risk to migratory birds and SAR	Response is accepted, but also see AD-57 in the Advice to Proponent table and follow-up IR-142-159-167-R1.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					habitat identification. Those prohibitions apply everywhere in Canada and at all times of the year. In these cases, a SARA permit will be required.			
IR-168	-	ECCC	Migratory birds	Section 9.4.5.2.4, Avian Deterrence and Prevention of Entrapment	**Context and Rationale:** The Proponent mentions that avian deterrents will be used on power transmission lines, buildings and other Project infrastructure. However, the Proponent does not mention any deterrents that will be used for deterring birds from the water or waste management facilities. Details on deterrents for all Project components should be identified to assess residual and cumulative impacts to migratory birds.	Provide information on avian deterrents to be used to prevent birds or other wildlife entering water or waste management ponds. 2. Explain how proposed timing of use of deterrents will reduce risk of migratory birds making contact with treatment waters outside of the nesting season (i.e., during migration and stop overuse). 3. Explain which deterrents will be used, which deterrents were considered, and what alternative, adaptive measures will be considered if deterrents are unsuccessful for any Project components.		Accepted
IR-169	-	ECCC	Migratory birds	Section 9.4.6.3, Residual Effects Evaluation for Migratory Birds, Table 9.4-15 and Map 9.4-11	**Context and Rationale:** The analysis of available habitat types for migratory songbirds appears incorrect. In their interpreted ecosite mapping, the Proponent identified 25 different ecosite types. In their table 9.4-15 and map 9.4-11, the Proponent only lists 8 ecosite types that are available migratory songbird habitat. Section 9.4.6 Residual Effects Evaluation for Migratory Songbirds reads: "Considering the baseline data (Appendix 9-B), migratory songbird habitat is described in the following text without species-specific differentiation and referred to as available habitat for migratory songbirds. Based on the baseline study results, 66.8%, 52.2%, and 50.7% of the Project Area, Wildlife LSA, and Terrestrial RSA, respectively, are assumed to provide available habitat for migratory songbirds (Table 9.4-15)." All Project areas, except some anthropogenic features and open water, would be considered available habitat for migratory songbirds. Although some ecosite types may have lower density and diversity, it is expected that all ecosites provide migratory songbird habitat.	1. Explain how information in Table 9.4-15 and map 9.4-11 were derived. 2. Explain why other habitat types were not considered as available habitat for migratory songbirds.		Accepted
IR-170	-	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation for Bird SAR, Table 9.4-19	**Context and Rationale:** The table and map presented by the Proponent do not appear representative of all available habitat for common nighthawk (CONI). Although CONI do preferentially use open areas such as gravel (often an anthropogenic disturbance) and regenerating forest, as identified in the draft EIS, they also use rock outcrops that can be within forested areas. As this area lies within the pre- Cambrian shield, there are likely rock outcrops that are also available habitat. As aerial insectivores, CONI select nesting areas in close proximity to wetlands or lakes where there is abundant forage. **Rationale:** Habitat requirements and preferences for all species at risk is required for developing effective mitigations and adaptive management.	1. Provide an updated table and map that considers all available habitat for common nighthawk. 2. Additionally, as part of environmental management plans the Proponent should include species-specific mitigations that are biologically relevant to all the species at risk for all Project phases and components.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-171	-	ECCC	Migratory birds	Section 9.4.6.4, Residual Effects Evaluation	**Context and Rationale:** Section 9.4.6.4 Residual Effects Evaluation for Bird SAR – Common Nighthawk reads: "Progressive reclamation is anticipated to begin during Construction. However, a conservative approach is used, with Common Nighthawk (CONI) habitat in the Project Area considered to be unavailable for the duration of the Project, only becoming available as habitat following Post-Decommissioning (i.e., during the regeneration of vegetation following Decommissioning)." CONI may nest on the roadsides of access roads within the Project area. As such, the Project area should still be considered available habitat for the duration of the Project and appropriate mitigations and adaptive management should be discussed for this species.	Develop mitigation plans appropriate for avoiding collisions of common nighthawks with vehicles, when and where nighthawks are observed foraging near or roosting on gravel roads. Demonstrate how the planned mitigation activities will result in reduced residual effects from this pathway.		Accepted
IR-172	-	CNSC	Birds (all species)	Section 9.4.6.4.2	**Context:** Populations of listed species may be less resilient to changes in mortality. CSA N288.6:22 Clause 7.2.4.3 states that effects on a few individuals of endangered, threatened, or vulnerable species would not be acceptable. The residual effects assessment for "Change in Mortality" for bird species at risk states that Project mitigation measures identified in Section 9.4.5 are expected to limit interactions between bird species at risk and potential sources of direct and indirect mortality. However, the mitigation measures are not discussed with respect to their effectiveness to limit interactions, specifically for bird species at risk. **Rationale:** It is unclear if the proposed mitigation measures are effective in preventing mortality in bird species at risk for which even only a few deaths could negatively impact the population.	Please provide a discussion on mitigation measures with respect to their effectiveness in minimizing mortality for bird species at risk, for which effects on a few individuals would not be acceptable.		Accepted
IR-173	-	ECCC	Migratory birds	Section 9.4.8 Monitoring and Follow-up	**Context and Rationale:** Monitoring and follow up programs are part of adaptive management and implementation of additional mitigations. In Section 9.4.8 the Proponent states: "Considering the Project planning, baseline survey results, and proposed mitigation measures, no follow-up programs are considered to be warranted at this time." Project impacts related to mortality of birds, such as collisions with the transmission line, mortality along roads and use of waste and water management facilities should be monitored during all phases of the Project and adaptively managed.	Provide details on the follow-up program to monitor impacts to avian mortality. The follow-up plan should include: • Monitoring of avian use of waste and water facilities • Monitoring of mortality along access roads • Monitoring of mortality related to transmission lines • Monitoring of effectiveness of avian deterrents.		Accepted
IR-174	-	ECCC	SAR – Bats	Appendix 9-B, Denison Mines Corporation Wheeler River Project, Terrestrial Environment, Wildlife and Vegetation Baseline	**Context:** The Proponent conducted acoustic surveys for bats and confirmed presence of two Species at Risk Act (SARA) schedule 1 listed bat species in the Project area, little brown myotis (Myotis lucifugus) and northern myotis (Myotis septentrionalis). However, the Proponent did not do an effects assessment of either of these bat species. **Rationale:** Although bats are present in the study area, no work was done to identify hibernaculum or maternal roosting sites. All species at risk that are expected to be present in the Project area should be assessed and species-specific mitigations detailed.	1. Conduct an effects assessment for little brown myotis and northern myotis, including the likelihood that tree clearing during the bat roosting period, is likely to 'kill', 'harm', or 'harass' Little Brown Myotis and Northern Myotis and its ability to carry out its life processes. 2. Describe and map locations of suitable myotis hibernacula and/or maternal roost habitat within the Local Study Area and	This IR is being accepted for the purposes of the EA process. The proponent will be expected to conduct additional bat baseline surveys prior to commencing any work/activities at the project site. The resulting baseline data, along with a discussion on whether the EA predictions and conclusions remain valid, and an update to the environmental risk assessment, must be submitted to CNSC staff for review and acceptance prior to the commencement of site preparation activities.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Inventory, Section 2.1.4 Acoustic Bat Surveys		Regional Study Area and explain how these habitats may be affected by Project activities. 3. Describe what mitigation measures will be taken to avoid the breeding period for bats. 4. Describe any pre-construction/pre- clearing surveys will be conducted to identify any hibernaculum and maternal roosting sites. Describe how monitoring will support adaptive management.	The submitted materials must demonstrate that the baseline data is sufficient to obtain a basic understanding of within-year and between-year variation for bat species. EA condition language along with any detailed expectations (if required) will be shared at a later date.	
IR-175	-	CNSC	Provincially Listed Species	Appendix 9-B; section 2.2.2	**Context:** Vegetation and wildlife habitat characterization field surveys were completed in 2017, based on which ecosite factsheets were prepared. The factsheets list observations of two provincially listed plant species with a rank of S3 (vulnerable/rare to uncommon; Table 2.4-2) according to the Saskatchewan Conservation Data Centre, which are not discussed in the main EIS document: • Angle-leaved sundew (Drosera anglica) observed in ecosites BS19, BS20, BS22, BS25 • Neat Spike-rush (Eleocharis nitida) observed in ecosite BS25 Table 9.2-12 in section 9.2.6.2.1 of the EIS indicates that there may be indirect disturbance to some of these ecosites (BS19, BS20, BS25). In section 9.2.6.3.1 it is discussed that listed plant species are not likely to return once lost from a specific location. **Rationale:** Given that not all areas in the revised Project footprint were surveyed for listed plant species in baseline studies, there is uncertainty as to whether any species were missed, in particular those that have been observed in ecosites present in the LSA/RSA (e.g., Drosera anglica and Eleocharis nitida, see also Appendix 2 Table of Appendix 9-B). It should also be noted that rare plant surveys were completed in summer 2017 only (section 2.4.2 of Appendix 9-B), which may underestimate annual rare species that may be dormant in the seed bank in some years due to specific seed emergence requirements. It is acknowledged that the Proponent committed to pre-construction listed plant surveys targeted on ecosites encountered in the Project Area but not previously surveyed, as well as ecosites within the Project Area with high potential to support listed plants. More information is requested on the potential indirect effects on rare plant species as well as the planned pre-construction surveys.	1. Please provide a discussion on the potential risks from indirect effects on ecosites with observed rare plant species 2. Please provide additional information on the ecosites included in the planned pre-construction listed plant surveys **Suggestions for mitigation and follow-up measures:** CNSC recommends focusing monitoring on ecosites that have known observations of listed plant species outside of the Project Area (e.g., BS19, BS20, BS22, BS25).		Accepted
IR-176	-	CNSC	Human Health with respect to radiation exposure	Section 10.1.4.2.1 Section 10.1.6.1.4 Appendix 10-A (ERA)	**Context:** In section 10.1.4.2.1, the Proponent provides an evaluation of air quality constituents of potential concern to human health. It states: "A screening value for radon gas of 200 becquerels per cubic metre (Bq/m3) was available from Health Canada, which applies to total radon including background sources (Health Canada 2009). The radon concentrations which were predicted are incremental concentrations (i.e., above background) and were therefore compared to the applicable incremental screening	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit. 2. Reporting the assessment results as the total dose, from all radionuclides combined including radon		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					value of 60 Bq/m3 for indoor air established by the Canadian Nuclear Safety Commission (CNSC) (Health Canada 2010a; Radiation Protection Regulations. SOR/2000-203).” The 60 Bq/m3 radon concentration value also appears in section 7.1.2 of Appendix 10-A (ERA). Further in section 10.1.6.1.4, it is stated: “Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 Bq/m3.” The Radiation Protection Regulations do not stipulate a limit for radon above background for sites Licensed by the CNSC. The effective dose limits for Nuclear Energy Workers (NEWs) and persons that are not NEWs are listed in section 13 of these regulations, and in subsection 1(3) of these regulations for the general public. The annual effective dose from all sources associated with the Licensed activities and within the scope of the Nuclear Safety Control Act and Regulations must be compared to the applicable effective dose limit. For members of the public this limit is 1 mSv per calendar year. In Section 4.2.5.3 of Appendix 10-A (ERA), there appears to be no reference mentioned for the radon equilibrium factors. These factors are a significant input into the dose calculations for radon. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations.	progeny, and by comparing this annual effective dose to the effective dose limit. Provide a summary of the conservative assumptions that have been included in the dose calculations. Provide a reference that shows how the radon equilibrium factors were determined.		
IR-177	-	HC	Change to an environmental component due to radiological contaminants	Section 10.1.4.2.1 (p. 10-22) Appendix 10-A (ERA) : Appendix B Table B.9, Ref. 19-2638 Section 6, Table 6.1-1 (p. 6-7)	**Context:** Section 10.1.4.2.1 states that, “Screening values for radionuclide concentrations in ambient air were not available. All relevant radionuclides were assessed in the HHRA in terms of their contribution to the total radiological dose to human and ecological receptors” (p. 10-22). Section 10 Appendix 10-A (ERA) states that, “No formal screening was conducted for radionuclides. However, since radiation dose to human receptors is of public and regulatory interest, the radionuclides in the uranium-238 decay series are carried forward as COPCs for further assessment” (Appendix 10-A (ERA): Appendix B Ref. 19-2638). Table 6.1-1 lists radionuclides as a key indicator for air quality, but only uranium and radon are considered in Section 6, and Section 10 Table B.9 does not include doses from uranium progeny in air. **Rationale:** Health Canada recommends using screening values that are available for radionuclides if they are appropriate for the dose and if the screening values have listed assumptions (such as particulate size and worker exposure time that can be adapted to in Denison’s models). Two examples are ICRP 96, which CNSC uses in their regulatory reports to derive reference air quality values for Pb-210, Ra-226, and Th-230 (CNSC:	1. Assess predicted radionuclides in Section 10 Appendix 10-A (ERA) using appropriate available screening values. Alternatively, provide a justification for why a screening wasn’t conducted for radionuclides despite the availability of screening values (e.g., ICRP 96 and NORM Guidelines, 2011). 2. Clarify if uranium progenies in air are considered in the atmospheric transport and air quality modelling and are simply not reported, or if they are not included in the models because no screening criteria are available.	Response is accepted, but also see AD-55 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Regulatory Oversight Report for Uranium Mines and Mills in Canada 2019); and Health Canada's Guidelines for Management of NORM (Health Canada: Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials, 2011).			
IR-178	-	HC	Change to an environmental component due to hazardous contaminants	Section 10.1.4.2.1 (p. 10-22) Section 6.1.4.2, Potential Project Related Effects (p. 6-31)	The Baseline + Project scenario was not provided for radon levels. **Context:** Section 6.1.4.2 states that the predicted levels for radon were not added to the respective baseline air quality levels (p. 6-31), and further explains that "In all modelled phases of the Project, annual average radon concentrations at receptors beyond the Property Boundary are expected to be indiscernible from background levels." In Section 10.1.6.1.4, a different approach to evaluating predicted radon levels is mentioned: "the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3"(p. 10-44). **Rationale:** Without a rationale as to why baseline levels of radon were not included in the assessment, HC cannot fully evaluate the appropriateness of the air quality assessment. While Health Canada is of the opinion that using background radon levels as a screening value is appropriate in this case from a health perspective, different approaches to screening predicted radon levels in different sections appear to be used (i.e., background radon levels vs. CNSC incremental concentration).	1. Provide further information on whether and how baseline radon concentrations in air were determined. 2. Include baseline radon concentrations in the predicted total concentrations when comparing to existing guidelines; alternatively, provide a rationale for why baseline concentrations of radon were not included. 3. Discuss the potential health implications of the project-only increment-over-baseline radon levels		Accepted
IR-179	-	CNSC	Groundwater quality decommissioning objectives.	Section 10.1.4.2.2, Release of Treated Effluent to Whitefish Lake During Decommissioning	**Context:** It is stated that "This process would continue until the recovered water meets acceptable groundwater quality decommissioning objectives". **Rationale:** The information provided does not include groundwater quality decommissioning objectives nor a reference to these objectives.	Please provide groundwater quality decommissioning objectives or a reference to the information.		Accepted
IR-180	-	CNSC	Human health with respect to hazardous contaminants	Section 10.1.6.1.1, Human Receptors Selection and Characterization	**Context:** Within the Human Health assessment, offsite receptors during the operation period are only considered downstream of Whitefish Lake. The only identified concern was for Se to the Fisher/Trapper located at Russel Lake. This section cites Indigenous Knowledge as informing the receptor selection and location. **Rationale:** While the assessment is fairly conservative in the assumptions made on intake and receptor habits, it stands to reason that if the trapper receptor was located closer to the operation, such as at McGowan or Whitefish Lakes, this exceedance of Se could be more pronounced. In terms of maintaining a conservative assessment, if the most vulnerable receptor can be shown to be protected at the point of highest expected COPC concentration, it can be concluded that this receptor would be protected further away from the Project. Considering this, why was the hunter/trapper receptor not also assessed at Whitefish or McGowan Lake? Was Indigenous Knowledge specific in mentioning Whitefish or McGowan Lakes were not used for the activities carried out by identified receptors?	Please provide justification for excluding a receptor from occupancy at lakes closer to the Project during operation (McGowan, Whitefish). Alternatively, conduct a risk assessment to a receptor at these lakes during operation to determine if there is a predicted risk that may require monitoring or mitigation. **Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Assessment of a receptor located closer to the point of effluent release may need to be considered to ensure there are negligible risks • If Se is expected to exceed hazard quotients further upstream, selenium removal technology may be required as part of the effluent treatment process as a mitigation measure. Other COPC's exceeding an HQ of 1 may also be identified under this process that could require specific monitoring or mitigation measures.	Response is accepted, but also see AD-59 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-181	-	CNSC	Human Health with respect to radiation exposure	Section 10.1.6.1.4	**Context:** In section 10.1.6.1.4, it is stated: "The maximum incremental radon concentration at the camp worker site during Operation was predicted to be 12.4 Bq/m3, which is below the CNSC limit of 60 Bq/m3 for incremental radon." As per IR-176, there is no such CNSC limit for incremental radon. The camp worker would be considered a person who is not a nuclear energy worker (NEW) and subject to the dose limits of section 13 and 14 of the Radiation Protection Regulations, not the dose limit for the general public as per subsection 1(3) of the Radiation Protection Regulations. The CNSC has regulatory requirements for the ascertainment and recording of doses of radiation as per section 5 of the Radiation Protection Regulations. Every Licensee must ascertain and record the magnitude of exposure to radon progeny, the effective dose and equivalent dose received by and committed to a person who performs duties in connection with any activity that is authorized by the Nuclear Safety and Control Act or is present at a place where that activity is carried on. The camp worker performs duties in connection with the Licensed activity and is present at the location where the activity is carried out. Hence, they are not considered to be a member of the general public (who has no connection with the activity) Further, the Proponent indicates that the maximum incremental radon dose to the camp worker was estimated to be 0.13 mSv/year during Operation. The assessment assumes that the camp worker spends 100% of the time indoors. Table 10.1-11 shows the maximum total incremental dose for the camp worker to be 0.02 mSv/year. This appears to be a discrepancy. Table 5.2 in Appendix 10-C provides internal annual dose from radon inhalation. The radon doses to some NEW workers (9.44E-02 mSv/a Driller 1 and 1.03E-01 mSv/a Wellfield Operator 1, 2) here appear less than the radon dose (0.13 mSv/year from section 10.1.6.1.4) to the camp worker, who is a non-nuclear energy worker. **Rationale:** The reason for the requested change is to ensure consistency with the Radiation Protection Regulations and the environmental impact statement.	The EIS and appendices should be aligned with the Radiation Protection Regulations by: 1. Removing the reference to a 60 Bq/m3 limit for incremental radon. 2. Revising all references to the 'public dose limit' applied to camp workers (non-NEWs) to align with section 13 and 14 of the Radiation Protection Regulations. The Proponent should explain why the radon dose for the camp worker appears as 0.13 mSv/year in one instance and 0.02 mSv/year in another. The Proponent is also asked to provide the rationale as to why a non-NEW has a higher radon dose than a NEW.		Accepted
IR-182	-	HC	Change to an environmental component due to radiological contaminants	Section 10.1.6.1.4, (p. 10-44)	**Context:** Section 10.1.6.1.4 states, "The limit is incremental and is exclusive of natural background, such as natural levels of radon and medical exposures. A dose constraint of 0.3mSv/yr was established for the public from all radionuclides and all pathways for the Project, as recommended by Health Canada (2010a). The dose constraint represents a dose lower than the public dose limit that ensures the combined dose from multiple sources does not result in exceedance of the public dose limit. Radon dose was calculated separately from the dose due to other radionuclides; however, the predicted radon concentration was compared against the CNSC incremental concentration limit of 60 BQ/m3" (p. 10-44). **Rationale:** Calculating radon separately from all radionuclides may underestimate the health risks by not considering combined doses from multiple sources when comparing	1. Provide clarification on how combined doses from all sources would be accounted for in respecting the public dose limit of 0.3 mSV/yr if radon concentrations are being calculated separately.	Response is accepted, but also see AD-65 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					to the public dose limit constraint of 0.3 mSv/yr recommended by Health Canada (2010a).			
IR-183	-	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C	**Context:** Exposure scenarios for workers have been identified and high-level summaries of the assumptions and resultant dose estimates have been provided. However, the detailed dose calculations have not been provided. **Rationale:** The method used to estimate effective, equivalent and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data, for at least the most dose significant scenarios.	Provide the dose calculations for deriving the dose estimates for workers in all exposure scenarios, for at least the most dose significant scenarios.		Accepted
IR-184	-	CNSC	Human Health with respect to radiation exposure	Section 10.2 Appendix 10-C, 2.0	**Context:** It is stated in Appendix 10-C, section 2.0 that: “In addition, the CNSC has proposed a 100 mSv 5-year equivalent dose to lens of eye, in accordance with recent recommendations of the International Commission for Radiological Protection (ICRP, 2012a). This implies an average annual equivalent dose to lens of 20 mSv/a and will be considered as an applicable dose limit for workers.” As per section 14 of the Radiation Protection Regulations, the equivalent dose limit for the lens of an eye for nuclear energy workers (NEWs), effective January 1, 2021, is 50 mSv in a one-year dosimetry period. **Rationale:** The reason of the requested change is to ensure consistency with the Radiation Protection Regulations.	The EIS and Appendix 10-C should be aligned with the Radiation Protection Regulations regarding the equivalent dose limit for the lens of an eye for NEWs.		Accepted
IR-185	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2 Appendix 10-C Table 3.10-3.12	**Context:** The Geometries for External Exposure Scenarios Modelled in MicroShield for Sources in various locations were provided in tables 3.10-3.12 in appendix 10-C. The doses from those scenarios were omitted. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	The Proponent is asked to provide all the necessary information and assumptions required to perform the MicroShield calculations independently and to list the resulting calculated values from the listed scenarios.		Accepted
IR-186	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Section 10.2.4 Appendix 10-C, Section 3.2	**Context:** In sections 10.2.3.2.4 and 10.2.3.2.6, as well as section 3.2 of Appendix 10-C, the Proponent has stated that workers in the drying and packaging areas of the processing plant will be required to wear powered air purifying respirators (PAPR) to reduce/eliminate inhalation exposure. Further in section 10.2.4, which elaborates mitigation measures, it is stated: “For the drying and packaging/loading areas of the ISR plant, use of PAPR has been assumed. It will be needed in these areas, and it has been planned in these areas to substantially reduce doses from inhalation of uranium dust. Dust levels in these areas will be monitored and kept ALARA.” The use of respirators appears to be in contradiction of the requirements of section 13 of the Uranium Mines and Mills Regulations, which states: *No Licensee shall rely on the use of a respirator to comply with the Radiation Protection Regulations unless the use of the respirator (a) is for a temporary or unforeseen situation; and (b) is permitted by the*	Provide the rationale for mandating the use of respirators by workers in the drying and packaging areas of the processing plant. Include the demonstration of the application of the hierarchy of control for radiological protection within the design of these areas of the processing plant. Justify that this approach complies with section 13 of the Uranium Mines and Mills Regulations.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					code of practice referred to in the licence. The Proponent is also reminded that respirators should not be the first choice for dose reduction in workplaces. They should only be used when the hierarchy of control (elimination, substitution, engineering, or administrative controls) is not possible. **Rationale:** At this stage of the Project, the Proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*			
IR-187	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.3.2.4 Section 10.2.3.2.6 Appendix 10-C, Section 3.3, 6.0	**Context:** The exposure scenarios and assumptions for the workers in the drying area and the packaging/loading area of the processing plant include the wearing of PAPRs, which is assumed to provide a 1000-fold reduction in dust exposure. Further to reference IR-186, the use of a respirator as well as in worker dose predictions for the Project, appears to contravene section 13 of the Uranium Mines and Mills Regulations, and does not follow the hierarchy of controls for radiological protection of workers as described in REGDOC-2.7.1, Radiation Protection. **Rationale:** At this stage of the Project, the Proponent is expected to identify design improvements to these areas of the ISR plant/processing plant following the hierarchy of control for the radiological protection of workers, as per regulatory requirements and as described in REGDOC-2.7.1, *Radiation Protection.*	Modify the exposure scenarios and assumptions (i.e., remove the use of a respirator) for the workers in the drying area and the packaging/loading area of the processing facility. Assess the resultant exposures against CNSC regulatory dose limits and the ALARA principle. Identify mitigation measures as per the hierarchy of control for radiological protection.		Accepted
IR-188	-	CNSC	Human Health with respect to radiation exposure	Section 10.2.4	**Context:** The following is stated in section 10.2.4: "Dust inhalation is also a potentially substantial component of worker dose at the core shack. At this location, PAPR will not be required; however, N95 masks will be used, and dust levels will be monitored here…It may be possible to increase air exchange in the core shack, above the planned six exchanges per hour, should this be necessary. This would also reduce radon exposure in the core shack." If it is possible to increase air exchanges in the core shack, it is not clear why this was not assessed and incorporated in the design of the core shack. **Rationale:** It appears that a control measure (e.g., air exchange protocols in the core shack) to reduce the exposure to workers has been identified. However, it is not certain if it has been formally documented to ensure that it is incorporated in the engineered design of the core shack.	Provide details on how the control measures to reduce the exposure to both workers through the air exchange protocols in the core shack have been formally documented to ensure that it is incorporated in the engineered design of the core shack.		Accepted
IR-189	-	CNSC	Woodland Caribou Ecological Model	Appendix 10-A (ERA)	**Context:** In the ERA (p. C.12, section 2.3.6 Woodland Caribou) it is stated: "For the ecological model a diet comprised of 50% browse, 20% lichen and 30% macrophytes is assumed for the woodland caribou." In the EIS, section 9.3.3.3.1, it is stated: "Research has shown that up to 70% of the year-round diet of caribou may consist of ground and arboreal lichens."	Please provide additional evidence to support that those Woodland Caribou who may have higher consumption rates of lichen as part of their diet, will remain protected. This can be provided through including a second model that assumes 70% lichen in the diet. See also related: IR-138.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: It is unclear whether the assumptions in the ecological model in the ERA regarding Woodland caribou diet are conservative, given only 20% lichen intake in the model. Lichen is known to accumulate COPC such as metals and dust from the atmosphere.			
IR-190	-	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-8 (p. 3.31) and Table 3-9 (p. 3.36) Appendix 6, Table 5 (p. 16)	NO2 criteria is not being consistently compared. **Context**: Provincial and federal air quality criteria/screening values for NO2 have been used inconsistently. Table 3-9 in Appendix 10-A (ERA) uses the 2015 Saskatchewan Ambient Air Quality Standards (SAAQS) value of 300 µg/m3 to compare the maximum concentrations of NO2 at receptor locations for the 1-hour average period, while Table 5 of Appendix 6 uses the 2025 Canadian Ambient Air Quality Standards (CAAQS) of 79µg/m3 for the same average period time. **Rationale**: By utilizing the SAAQS screening value for NO2, the maximum concentrations at receptor locations exceed the 1-hour threshold solely during the decommissioning stage (Table 3-9). However, if the 2025 CAAQS are applied, the screening values would be exceeded at receptor locations for all project phases. It is best practice to use the more protective air quality standards to evaluate potential human health risks associated with project activities.	1. Compare the predicted maximum concentrations to the most protective applicable air quality standards available. Alternatively, provide a rationale as to why the SAAQS for NO2 were used rather than the more protective 2025 CAAQS to determine potential exceedances and screen for the need for additional mitigation measures. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the standards from the 2025 CAAQS for NO2 in future mitigation and follow-up plans.	Following the supplementary submission by Denison on July 5th, 2024, one minor correction remains outstanding. There is an error in Section 3.2.1.3.1 Nitrogen Dioxide (updated text in the ERA in Appendix 10-A): The results reported in the paragraph under the Summary of Exceedances at Human/Ecological Locations sub-heading (0.3% of the year for approximately 28 hours per year) is associated with the <u>operation phase</u> and not the decommissioning phase. This editorial error must be corrected in the final EIS submission package. This IR is accepted for the purposes of the EA review. *The following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1) In their documents to support their licence application, the proponent will have to describe mitigation measures to minimize releases of NO2. If this information is not described, CNSC staff will request the proponent to provide the information. 2) 1-hour threshold for NO2: Denison should not rely on a single study (Hesterberg et al., 2009) to support a 1-hour threshold for NO2. Denison is expected to consult more than one study. Denison will be required in their environmental risk assessment submitted as part of licensing to demonstrate that there will be no unreasonable to the environment and to the health of people as a result of NO2. --- World Health Organization (WHO), 2021. WHO global air quality guidelines. Particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide. 273 p. Available online at: <u>https://apps.who.int/iris/handle/10665/345329</u>	Accepted
IR-190	IR-190-R1	HC	Change to an environmental component due to hazardous contaminants	Section 6.1.3.2.2 (p. 6-21) Table 6.1-8 (p. 6-22); and, Table 6.1-9 (p. 6-22) Section 6.1.8 (p.6-44) IR-190 Response from Denison	Limitations with the proposed use of passive NO_2 monitoring would not allow comparison of measurement results to the 2025 CAAQS for 1-hour NO_2. **Context:** In response to IR-190, there was agreement to using the 2025 CAAQS for NO_2 in future mitigation and follow-up plans, which Health Canada supports. However, the proposed air quality monitoring and follow-up plans (Chapter 6.1.8) anticipate continued use passive NO_2 samplers, which do not measure hourly (1-hour) concentrations. Section 6.1.3.2.2 indicates that the assessment makes use of passive samplers to measure NO_2 at two sampling locations. The results from those samplers are presented in tables 6.1-8 and 6.1-9, for a ~30-day sampling period (i.e., a total concentrations for NO_2 in ambient air over ~30 days).	1.Provide additional details on proposed air quality monitoring for NO_2 that will allow for comparisons to both the 1-hour and annual 2025 CAAQS and how that will be used to support mitigation and follow-up plans. Distinguish between comparisons with measured and modelled monitoring data, as well as use of passive and active samplers. 2. If multiple approaches will be used to monitor NO_2 (e.g., use of passive and/or active samplers, modifications due to differences between project phases, etc.), describe their intended contribution to the monitoring objectives and	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Please provide the following information: 1. Clarify the conditions under which a switch from passive to continuous monitoring would be warranted (e.g., if the 30-d measured NO_2 concentration, after conversion to a 1-h concentration, approaches or exceeds the 1-h CAAQS value).	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					While passive samplers provide measurement data for comparison to the annual 2025 CAAQS for NO_2, measurement data for the 1-hour NO_2 standard commonly requires use of an active sampler. **Rationale:** Health Canada encourages the monitoring of air contaminants when exceedances or near-exceedances of air quality criteria, standards and/or guidance values are predicted or reported, to: • determine the accuracy of predictions; • help verify whether standards are being met; and, • assist with implementing or modifying mitigation measures.	outcomes (e.g., determine the accuracy of predictions; assist with implementing or modifying mitigation measures).		
IR-191	-	HC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Table 3-9 (p. 3.36) and Table 3-10 (p. 3.46) Section 6.1.8 (p. 6-44)	Non-threshold substances are not included in screening and monitoring plans. **Context:** Fine particulate matter (PM2.5) is not being considered further in secondary air quality screening for short and long-term exposure at human and ecological receptors because it is not predicted to exceed the screening values of the Ontario Ambient Air Quality Criteria (OAAQC) or the Canadian Ambient Air Quality Standards (CAAQS) for both annual and 24-hour average periods (Tables 3-9 and 3-10). Furthermore, it is not compared against the baseline for analysis. Table 3-9 indicates that coarse PM (PM10) is predicted to exceed the 24-hour CAAQS during all phases of the Project. However, Appendix 10-A p. 3.46 states that, "There were no exceedances of PM2.5 which is generally considered to be a more reliable indicator of potential health effects. However, health effects would be infrequent and reversible, subsiding after exposure; therefore, PM10 was not considered for further quantitative assessment in the ERA." PM10 and PM2.5 were not included in the air quality monitoring plan (Section 6.1.8). **Rationale:** Particulate matter and NO2 are considered non- threshold pollutants, meaning that health effects can occur at any level of exposure, The CAAQS for PM2.5 PM.10, and NO2 recognize that there is no population health threshold for human health effects; therefore, any increase in exposure will result in an incremental population risk (Environment Canada and Health Canada, 2012; CCME, 2000). The CAAQS values should not be construed as limits to which polluting up to is allowed. In addition, based on the principles of keeping clean areas clean and continuous improvement, proposed mitigation measures should not be confined to meeting the standards but should also be targeted towards reducing population exposure to CACs associated with the proposed project. Furthermore, although health risks associated with PM2.5 are higher than those associated with PM10, both fractions are considered non- threshold pollutants and identified by IARC (2013) as causes of cancer. **Reference**: [1] International Agency for Research on Cancer (IARC). 2013. IARC monographs on the	1. Include PM2.5 and PM10 in the secondary air quality screening for short and long- term exposure at human receptors. 2. Include PM10 and PM2.5 in the air quality monitoring plan as they are non- threshold substances. 3. Provide a discussion of the significance of predicted exceedances of health- based standards. 4. Identify additional mitigation measures to reduce concentrations of non- threshold air contaminants associated with the Project. **Suggestions for mitigation and follow-up measures:** Health Canada recommends use of the 2025 CAAQS Management Levels to develop mitigation measures that reduce project contributions of non-threshold pollutants (e.g., PM2.5, NO2).		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					evaluation of carcinogenic risks to humans. Volume 109. Outdoor air pollution. Lyon: International Agency for Research on Cancer.			
IR-192	-	CNSC	Human Health with respect to radiation exposure	Appendix 10-A (ERA), Section 3.1.1.2, including Tables 3-1 and 3-2	**Context:** Section 3.1.1.2 in Appendix 10-A (ERA) provides the method of how select constituents including cadmium, chromium, selenium and lead-210 were determined. This section does not mention how the other constituents as listed in Tables 3-1 and 3-2 are determined. The values for Th-230 and U-238 in Table 3-1 are unexpected. Typically, these values should be at equilibrium. **Rationale:** The technical basis for the selection of constituents of concern is required as part of the environmental and human health risk assessments.	1. Provide the methodology of how all listed constituents are determined. 2. Provide the rationale as to why Th-230 and U-238 are not in equilibrium.		Accepted
IR-193	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.1.2 Section 8.2.4.2.3	**Context:** Appendix 10-A (ERA) Table 3-1 'Screening of Effluent Quality against Surface Water Quality Guidelines for the Wheeler River ERA' does not include acute water quality thresholds for all COPCs compared against predicted effluent quality. For example, it is stated that the final effluent quality discharge target for uranium is 0.057 mg/L. However, the CCME water short term (acute) water quality guidelines for the protection of aquatic life is 0.033 mg/L. The proposed effluent discharge target for uranium exceeds the acute water quality guidelines, indicating effluent may pose the risk of being acutely lethal to aquatic biota at end-of-pipe. All water quality thresholds should be derived from receiving environment parameters, and there are discrepancies between the values used in Appendix 10-A (ERA) Table 3-1 and the values presented in Tables 8.2-8 and 8.2-10 in Section 8.2.4.2.3 of the draft EIS. No selected screening value for TSS has been calculated from baseline conditions. Un-ionized ammonia, which is a regulated Schedule 4 substance under the MDMER, has not been included. **Rationale:** A review of all modelling results for all COPCs under the MDMER will assist ECCC in understanding the potential risks to the receiving environment.	1. Provide acute and chronic water quality thresholds for all required COPCs with monitoring required under the MDMER. 2. Ensure all water quality thresholds are derived from receiving environment baseline parameters and that these thresholds are consistently applied throughout the draft EIS.	In Denison's July 2nd, 2024, supplementary submission, it is unclear what value Denison is applying as the screening criteria for un-ionized ammonia. The screening value provided in other tables (ex. Tables 8.2-2, 8.2-8, 8.2-10, 8.2-13, 8.2-14) all list the SEQG/CCME water quality guideline of 0.019 mg/L as the screening criteria. The recommendations for phosphorus and inclusion of the HC values in Table 3-1 are editorial and have no influence on the assessment results, therefore can be addressed in licensing. This IR is accepted for the purposes of the EA review, but Denison are expected to correct the remaining errors in Table 3-1 of the ERA in the final EIS submission package: 1. Un-ionized ammonia - The screening value of 0.0156 mg/L for un-ionized ammonia provided in Table 3-1 differs from what has been provided in other tables (ex. 0.019 mg/L in Tables 8.2-2 8.2-8, 8.2-10, 8.2-13, 8.2-14). Denison should confirm what screening criteria is used for un-ionized ammonia and which source it is referenced from. 2. Zinc – The screening value of 0.007 mg/L for zinc provided in Table 3-1 differs from what has been provided in other tables (ex. 0.013 mg/L in Tables 8.2-8, 8.2-10, 8.2-13, 8.2-14). Denison should confirm what screening criteria is used for zinc and which source it is referenced from. 3. Manganese – The CCME value of 0.26 mg/L for zinc provided in Table 3-1 differs from what has been provided in other tables (ex. 0.21 mg/L in Tables 8.2-8, 8.2-10, 8.2-13, 8.2-14). While a minor difference, the 0.21 mg/L value appears to be the correct value calculated using site-specific hardness and pH. Denison should verify which value is correct. 4. Molybdenum – the screening criteria used for the EcoRA is the SEQG of 31 mg/L. This is significantly higher the CCME guideline of 0.073 mg/L. The CCME guideline is outdated, however the SEQG guideline does not have a safety factor applied to it, and is significantly higher than other guidelines for Molybdenum. The BC WQG of 7.6 mg/L is both up-to-date and has a safety factor applied. Use of this guideline aligns with the principles of the Precautionary Approach and does not lead to any changes in risk conclusions in ERA (i.e. Molybdenum is still not screened into EcoRA	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							assessment as the predicted effluent concentration is 2.5 mg/L and does not exceed screening criteria). It is recommended that in alignment with CSA N288.6 and the Precautionary Approach that Denison update the screening criteria for molybdenum for the EcoRa to utilize the BC WQG of 7.6 mg/L.	
IR-194	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.1.1.2 and Section 3.1.2.3	**Context:** In the ERA, COPCs should be selected for further assessment based upon the following factors: 1. COPC concentrations in effluent that exceed selected water quality guidelines for the protection of aquatic biota, and 2. Baseline COPC concentrations in the LSA that exceed selected surface water and sediment quality guidelines for the protection of aquatic biota. However, only COPCs that had concentrations in effluent that exceeded guidelines were assessed further. Baseline concentrations of COPCs in sediment were not considered. In addition to this, not all COPCs that require monitoring under the MDMER had predicted effluent concentrations. From Section 8.2.3.3 Table 8.2-2 of the Aquatic Environment Report, it appears Aluminum in McGowan Lake and Whitefish Lake South and North, and pH in Whitefish Lake North exceed water quality guidelines. Predicted effluent concentrations or near-field surface water concentrations for Aluminum and pH are not provided. **Rationale:** It is not possible to determine if there is risk from effluent to the receiving environment and aquatic receptors based on the current information provided.	1. As noted in IR-114, provide the information on predicted effluent quality for COPCs with required monitoring under the MDMER. 2. Provide the information on predicted maximum receiving environment surface water concentrations for COPCs with required monitoring under the MDMER in IR-114. 3. Update the ERA to assess the risk of any additional MDMER COPC concentrations in effluent that exceed water quality guidelines. 4. Update the ERA to assess the risk of COPCs that had elevated baseline water and sediment quality concentrations in the receiving environment.	There are multiple elements of this IR outstanding. This IR is being conditionally accepted, but these issues will need to be resolved during the licensing process. It is expected that a fully revised ERA that both incorporates revisions following closure of EA related IRs and addresses outstanding issues that will be further assessed during the licensing review. *This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* Item one of the IR has been met. However additional information is required for items two, three, and four. Similar to ECCC's rationale provided for IR-124, "the ERA primarily relies on modelling results to identify the maximum predicted levels of COPCs in the receiving environment." However, due to the upper bound discharge rates being the only model input evaluated, it is unclear whether the model considered scenarios where maximum COPCs might occur as the exclusion of other environmental variables may have resulted in inaccurate maximum environmental concentrations of the COPCs. The Proponent's responses regarding baseline exceedances of COPC thresholds in the receiving waterbodies requires additional information. The modeling of surface water and sediment COPC's described in Appendix 10-A, Figures 6-1 and 6-2 respectively, show results for the receiving waterbodies. However, it is unclear if these modeled values are based on the worst-case scenarios that account for environmental variables such as seasonal changes in hydrology and chemistry, or if they have only accounted for changes in operational effluent discharge scenarios to consider the upper bound discharge rates. Including the upper bounds of operational effluent discharges regardless of the variability of the receiving environmental conditions is important factor for determining whether the baseline data and risk assessment fully considered the effects of the operations of the proposed mine, including environmental concentrations of the COPCs, on water quality. The Proponent should provide baseline data and a risk assessment that includes consideration of maximum COPC scenarios for the receiving water bodies, including seasonal variability and sediment depositional areas. The Proponent should provide supplemental information to identify if the environmental model has considered environmental variability such as seasonal changes in water levels, flows and sedimentation. The Proponent should also demonstrate that the model has considered a reasonable expected worst case scenario, such as a 100 year return.	Accepted
IR-195	-	ECCC	Change to an environmental component due to	Appendix 10-A (ERA), Section 3.1.2.1	**Context:** Figure 3-2 depicts modelled concentrations of COPCs in the receiving environment surface water during all Project phases. Effluent discharge rates during Operations and Decommissioning are not anticipated to differ significantly. However,	1. Provide further information on modelled maximum COPC concentrations for each individual Project phase with	Following Denison's July 2nd, 2024 supplementary submission, this IR is Accepted.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
			hazardous contaminants		COPC concentrations seem to decrease rapidly after the end of the operations period despite effluent releases continuing into the decommissioning phase. **Rationale:** There has been no information provided on predicted changes in effluent COPC concentrations and discharge rates during the decommissioning phase. It remains unclear how COPC concentrations would decrease so quickly following the end of operations.	estimated timing for peak concentrations to appear in the receiving environment. 2. Provide further information on predicted effluent quality during the Project decommissioning phase. 3. Update ERA figures and conclusions as needed.		
IR-196	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Section 3.1.2.3	**Context:** Table 3-6 provides predicted maximum sediment concentrations of COPCs compared to sediment quality guidelines. Several selected sediment screening values are not the most stringent sediment quality guidelines, with no justification provided. Additionally, copper and lead appear to be missing guidelines that are available from the Burnett-Seidel and Liber (2013) study. **Rationale:** The most stringent guidelines should be used for the sediment quality risk assessment in the ERA. Use of the most stringent guidelines will allow the most protective assessment to analyze risks to the receiving environment, aquatic and terrestrial biota.	1. Provide further information and justification for the selection of less stringent thresholds. 2. Update the ERA as needed.		Accepted
IR-197	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 3.2	**Context:** It remains unclear if atmospheric deposition from Project related emissions has been incorporated into modelling for the ERA and surface water and sediment quality assessments. **Rationale:** While expected Project air emissions are unlikely to have direct impacts on the aquatic receiving environment and aquatic biota, this Project effect pathway may have indirect effects through accumulation of COPCs over time or deposition of contaminants that are not expected in effluent, which should be evaluated with predicted emissions data incorporated into water quality modelling predictions.	Incorporate atmospheric deposition from Project-related emissions into water quality modelling and assess any Project related effects to aquatic receptors from this pathway.	In Denison's July 5th, 2024 supplementary submission, items one, two, and three were addressed. However, the sample calculation was not added to Section 2.2 of Appendix A, which would support the February 2024 statement that atmospheric deposition is negligible. This IR is accepted for the purposes of the EA review, but Denison is expected to add this sample calculation in the final EIS Submission package.	Accepted
IR-198	-	HC	Change to an environmental component due to radiological contaminants	Appendix 10-A (ERA) Appendix B, Tables B.7 and B.8 Ref. 19-2638 Appendix 10-A (ERA), Table 4-3 Ref. 19-2638 (p. 4.17)	**Context:** Section 10 Appendix 10-A (ERA) contains Table 4-3 (p. 4.17), which lists ingestion rates for traditional foods and includes the category "organs" for Mammals. Tables B.7 and Table B.8 in Section 10 Appendix 10-A (ERA) Ref. 19-2638 provide the predicted concentrations of radionuclides for ecological receptors during the Project phases and during future centuries, respectively. They list the concentrations of radionuclides in moose and in moose organs, which is presented as a single cumulative organ value. Other terrestrial and aquatic animals (such as the black bear and woodland caribou) that are a part of the traditional diet of nearby Indigenous communities have higher concentrations of radionuclides than moose, yet concentrations are not provided for organs of these species. **Rationale:** While Health Canada is not aware of transfer factors to individual organs, or to organs in animals that are not ruminants, it would be beneficial to have a better understanding of radionuclide concentrations in the organs of other animals that may be consumed by local Indigenous communities.	1. Provide more clarification on how the mammalian organ ingestion rates are calculated (which animals and relative contribution percentages). 2. Provide a rationale for why concentrations of radionuclides were not assessed in organs of animals (other than moose) that are consumed as country foods by Indigenous people harvesting in the area.	*This IR is accepted for the purpose of the EA review, but the following outstanding issues will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1. It is stated that the transfer factor (TF) for moose organs was scaled based on the beef organs transfer factor. What was this scaling value and was it similarly done for the caribou organs? (TF's for beef, moose, and caribou are presented in Table 2). 2. In Table 2, Denison used the feed-to-animal TFs for "Beef-liver" provided in Table G.3 of N288.1-20 for each of their listed RNs. Nowhere in Table G.3 is a TF for Lead-210 provided. Denison is requested to provide the reference for this TF value for Lead-210. 3. CNSC staff are interested in the worked calculations for one of the estimated tissue concentrations presented in Table 3.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-198	IR-198-R1	HC	Change to an environmental component due to radiological contaminants	Annex 1 Response to Information Requests (Denison Mining) – August 18, 2023 IR-198 Response from Denison – COPC Concentrations in Organs (*Pages 74, and 354-357 of 419*) Appendix 10-A (ERA)	*Environmental Risk Assessment for Wheeler River* (September 9, 2022) does not include an assessment of radionuclides based on their mass concentrations in country foods (the assessment is only based on radionuclide concentrations). **Context:** As part of the response to IR-198 estimated Pb-210 concentrations in moose organ and caribou organ of 7.15 and 49.4 mg/kg (ww) are reported, respectively. However, Appendix 10-A: *Environmental Risk Assessment for Wheeler River* (September 9, 2022) does not include an assessment of lead among the non-radionuclide COPCs. Using the organ meat consumption figure from the Patuanak community (16.2 g/day), exposure to Pb-210 from caribou organ meat is estimated at over 11 ug/kg bw per day (based on the response to IR-198) which would be close to 10 times greater than the 95th percentile dietary lead exposure estimates for the general Canadian population consuming retail foods. **Rationale:** While the abundance of radionuclides may pose a health risk with respect to radioactivity, their presence as chemical contaminants may also have an impact on health. This is demonstrated by the case of Pb-210 described above. Due to their potential toxicological significance to human health, Health Canada recommends assessing arsenic, cadmium, lead and mercury as part of country food assessment, regardless of the method employed to determine COPCs.	1. Provide a rationale on why radionuclide mass concentrations were not assessed for their impact to human health. 2. Provide an assessment of Lead (Pb) as a chemical contaminant (non-radionuclide) COPC to better understand potential health risks and inform management, mitigation, monitoring and/or follow-up planning.	Version 2 of the Commitment Register (July 17, 2024) included a commitment (ID 8-44) related to monitoring mercury in country foods. The wording of this commitment is specific to methylmercury. It was identified that the draft text provided to Denison by CNSC in the May version of the IR review that the request for commitment was missing the following details: "…monitoring lead and mercury in country foods, as well as including **arsenic, cadmium,** lead, and mercury in any further assessment conducted to determine their potential risk to human health from consumption of country foods". The wording for Commitment 8-44 should be revised to fully capture these other COPCs. As well, CNSC staff noted that in their responses to IR-212-R2 and IR-100-R3, Denison has proposed a conceptual trigger-response mechanism framework. It is unclear to CNSC staff if this is referring to the monitoring detailed under Commitment 8-44, or if it is separate. If the latter, this conceptual trigger-response framework should be submitted to CNSC for review before it is finalized for implementation, for review as part of the licensing process. This IR is accepted for the purposes of the EA review, and the following must be corrected in the final EIS submission package: 1. Revise the wording for Commitment 8-44 to fully capture the other COPCs that Denison intends to include in their country foods monitoring. 2. Clarify if Commitment 8-44 will also include Denison's proposed conceptual trigger-response framework. *The following elements of this commitment will be further assessed as part of licensing technical reviews, prior to the granting of a licence*: 1. Establishing/confirming baseline concentrations of Hg in water, sediment, and fish tissues before construction; 2. Regular monitoring during construction, operation and post-closure; and, 3. Undertaking an HHRA should monitoring results exceed established/confirmed baseline levels, to inform decisions on adaptive management and mitigation measures	Accepted
IR-199	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 10-A (ERA), Sections 3.2.1 and 3.3.1, Wheeler River Project IMPACT Model	**Context:** Model calibrated concentrations of selenium, uranium, and lead- 210 are under-predicted compared to measured baseline concentrations for water quality in the IMPACT modelling based on Figure 3-2. Calibrated concentrations of cobalt are under-predicted and there is poor agreement between model calibrated and measured concentrations of arsenic, lead-210, polonium-210, and radium-226 for sediment quality in Figure 3-3. **Rationale:** It is unclear how poor agreement between model calibrated and measured baseline concentrations of COPCs impacts the near-field and far-field modelling predictions of COPCs during all Project phases. It is also unclear why measured	1. Provide justification as to why model calibrated concentration inputs of COPCs were preferable for use in predictive modelling of water and sediment quality over measured baseline concentrations. 2. Provide a rationale detailing how under- or over-predicted model calibrated COPC concentration inputs influence IMPACT model predictions and uncertainty for water and sediment quality. Provide specific details on how this may impact the risk analysis for parameters that have been highlighted as	*This IR has been accepted for the purposes of the current EA process, and the outstanding issues below will be further assessed as part of licensing technical reviews, prior to the granting of a Licence.* The Proponent has not fully responded to either item for this IR. In the response for item one, the table provided in the response supports the statement added to Section 3.2.1 of Appendix A from Appendix 10-A, that there is little difference between the geometric and arithmetic means for parameter concentrations in water. It is important to clarify if this is also the case for sediment. Apart from arsenic and radionuclides, all modelled sediment concentrations are at or below geometric mean for sediment. Given that geometric	Accepted

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					concentrations of COPCS could not be used directly as model inputs when there was poor agreement.	having poor agreement between calibrated and measured concentrations (i.e., arsenic, selenium, uranium, lead-210, polonium-210, and radium-226).	means are typically lower than arithmetic means (and at most equal) this might indicate a consistent underestimation by the model for parameter concentrations in sediment. The proponent indicates that the geometric mean is more representative of the central value of the data distribution. ECCC does not support this view because a median or mode would be used to find a central value, depending on what was meant. The geometric mean may have been used because it is less influenced by outlier values, but these should be analyzed and removed if necessary before calculating the mean, as described in Section 6.3.3.6 of CSA N288.6:22. The only reference to geometric means in CSA N288.6:22 is for calculating means of literature values. Otherwise, when considering field data, an arithmetic mean is referred to. Typically, parameter concentration statistics are calculated individually for each site to highlight differences and help identify more sensitive sites. Differences between sites are expected because of differences in lake size, catchment area and other environmental factors. Pooling data from all sites smooths out high and low values, which compounds the smoothing done by using a geometric mean. This reduction in precision causes unreliability when evaluating model predictions, since the range of parameter concentrations at baseline is not well characterized. To address the lack of clarity, the Proponent should provide a table comparing arithmetic and geometric means for parameter concentrations in sediment, as they have done for water concentrations. If differences are significant, then modify graphs in Figure 3-3 of Appendix A from Appendix 10-A to compare arithmetic means of baseline data with modelled results. For parameters with sufficient data to calculate meaningful statistics, the Proponent should demonstrate that concentrations in Russell Lake are not significantly different than those in McGowan and Whitefish Lakes. If water quality is significantly different between lakes, then the Proponent should modify graphs in Figure 3-2 of Appendix A from Appendix 10-A to compare lake-specific baseline and modelled concentrations. In the response to item two, the statement "*it is not appropriate to calibrate the model to baseline conditions as we are most interested in impacted conditions*" is incorrect, because the point of calibration is to demonstrate the model correctly simulates site conditions to predict concentrations. Inaccurate model predictions during baseline indicate the site and its system of interactions is not well understood, and the model would not be able to produce accurate predictions during operations either. Section 7.3.6 of CSA N288.6:22 states "*The models may be calibrated to give the best possible agreement with available monitoring data so that risk assessors can have confidence in model-predicted concentrations for areas and media that are poorly represented in monitoring programs.*" The monitoring data is insufficient to characterize baseline concentrations for most of the parameters in water since there are often less than 50% of samples with concentrations above the detection limits. This limits the parameters that can be used to evaluate the model to concentrations in water of chloride, sulphate and arsenic, as well as concentrations in sediment. The Proponent should demonstrate the accuracy of the model by comparing model outputs with measured concentrations for those parameters where there is sufficient data to calculate meaningful averages,	

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
							quantify model uncertainty, and discuss the influence of uncertainty on risk assessment conclusions. Denison is expected to: 1. Calculate the model to baseline conditions, compare arithmetic and geometric means for parameter concentrations in sediment; 2. Calibrate model to baseline conditions; 3. Calculate parameter concentration statistics individually for each site; and 4. Modify graphs as needed if significant differences are observed.	
IR-200	-	HC	Indigenous Peoples' health / Socio- economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19)	Indigenous consultation should be included in the Country Foods analysis. **Context**: The Proponent obtained country food consumption data through engagement with a single local fisher/trapper and from a dietary survey administered by CanNorth to the English River First Nations (ERFN) in 2017. However, the potential health risks to consumers of traditional food were only assessed using the data obtained from the CanNorth dietary survey. Section 10 of the EIS *states the following:* ***"***The diet assumptions for the fisher/trapper are conservative and are based on engagement with a local fisher/trapper. The diet of the fisher/trapper is representative of one person, who consumes a unique composition and quantity of traditional foods (e.g., ingestion rate of 175 kg/yr of caribou, equivalent to approximately 2 to 3 servings per day). Most people fishing, hunting, and trapping in the Local Study Area and Regional Study Area would consume traditional foods more consistent with the average traditional foods consumer diet which was developed from the ERFN country foods study. In comparison, the ERFN country foods study in Section 10 Appendix 10-A (ERA) Table 4- 4 indicates a caribou ingestion rate of 2.6 kg/yr (1 to 2 servings per month) and a total game ingestion rate of 21.3 kg/yr***"*** *(p. 4.10).* **Rationale:** Health Canada is in general agreement that the dietary habits of the local fisher/trapper may be an outlier and not necessarily representative of most of the local population. However, a rationale has not been provided to demonstrate whether and how the 2017 ERFN dietary survey results are representative of consumption patterns of local Indigenous communities. Also, it is unclear whether or how the ERFN dietary survey results account for the consumption patterns of vulnerable or more sensitive subgroups (e.g., heavy consumers, children and women of child-bearing age)	1. Evaluate the suitability of using the 2017 EFRN survey results and consider surveying additional community members (such as local hunters/trappers) to obtain more representative country food consumption rates for use in the traditional foods risk assessment, and for communicating the results to the communities. 2. Additionally, consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately. **Suggestions for mitigation and follow-up measures:** Health Canada recommends providing the community with the opportunity to validate the ERFN 2017 survey results.		Accepted
IR-200	IR-200-R1	HC	Indigenous People'' health / Socio- economic conditions	Section 10 (p. 4.10) Appendix 10-A (ERA), Table 4-4 (p. 4.19) IR-200 Response from Denison	The traditional foods risk assessment should be updated to include an "Intense Land User" scenario and consider all relevant sub-groups. **Context:** See 'Rationale for Status' in IR-200 **Rationale:** Health Canada notes that the response to IR-1 confirms that the use, diet and consumption rates used to assess the "Trapper" receptor are representative of "intensive land users" from the ERFN and possibly others. This change in the assumption is significant and should be integrated into the traditional foods risk assessment. Suggestions and follow-up measures have been provided to assist in responding to this information request, which benefits from the clarity provided in response to IR-1. Health Canada also notes that the response to IR-200 did not consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g.,	1. Update assumptions used in the risk assessment to reflect the new information provided in response to IR-1. (e.g., the *ERFN Trapper's use of the area as* ***representative*** *of current and future land users*). 2. Update the risk assessment in the EIS and ERA for the "Trapper" receptor (i.e., Intensive Land Users) to account for the **representative** nature of their described diet (i.e., consumption rates and composition). 3. Update the rationale and decisions related to management, mitigation, monitoring and follow-up. Include a specific		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately.	discussion for those COPCs that contribute to elevated health risks among "intensive land users" and those raised by Indigenous communities (i.e., selenium, mercury & cadmium). 4. Revise receptor's descriptor/title from "Trapper" to "Intensive land users" throughout the EIS and ERA to be consistent with proposed revisions made in response to IR-1. Consider evaluating consumption patterns (and applicable TRVs) of sensitive or vulnerable populations (e.g., elders, toddlers, women of childbearing age) in the traditional food risk assessment and provide risk levels for these sub-groups separately. Alternatively, provide a fulsome rationale to justify their exclusion.		
IR-201	-	ECCC	Aquatic species	Appendix 10-A (ERA), Section 5.0	**Context:** For the ERA methodology the Proponent followed CSA N288.6-12 for the assessment of risk to aquatic biota from radionuclide and non-radionuclide COPCs. This is the 2012 version, and a more recent 2022 version was publicly released. **Rationale:** The Proponent should review the most up-to-date version of the standard to ensure no changes to the methodology of the COPC exposure assessment are required for the ERA.	Update the COPC exposure assessment methodology in the ERA using the most recent CSA N288.6-22 standard, as needed.		Accepted
IR-202	-	CNSC	QA/QC	Appendix 10-A (ERA), Section 6.0- Quality Assurance	**Context:** This section provides only Quality Assurance (QA) of the ERA, including planning and preparation of the ERA. **Rational:** The Quality Control (QC) aspects are not included. Both QA and QC aspects provide confidence that ERA results are defensible and fit for use in decision-making. The N288.6 (Clause 10.2) requires that "Appropriate QA/QC requirements shall exist for all aspects of the ERA and should be specified prior to conducting the ERA".	Please include appropriate QC aspects, as per a Clause 10.2 of the N288.6.		Accepted
IR-203	-	CNSC	Sediment Quality and Benthic Invertebrates	Appendix 10-A (ERA), Section 6.2 Future Centuries Sensitivity Analysis	**Context:** This section of the ERA states "If treated effluent was released at the maximum upper bound discharge rate, the modelled concentrations of all COPCs are expected to be below their corresponding sediment quality guidelines." It appears from Figure 6-2: "Comparison of maximum concentrations of COPCs in sediment at expected and upper bound discharge rate" that cadmium and vanadium would be over their sediment quality guidelines indicated if maximum upper bound discharge rates are used. **Rationale:** It is not clear which is correct; the statement that no exceedances of sediment quality guidelines when considering the maximum upper limit effluent release, or the figures indicating there could be exceedances for cadmium and vanadium. This discrepancy in the ERA should be explained and corrected.	Please provide clarity on if cadmium and vanadium are expected to be over the sediment quality guidelines for the maximum upper bound discharge rate scenario.		Accepted
IR-204	-	CNSC	Human health with respect to hazardous contaminants	Appendix 10-A (ERA), 7.1.1, Non-radiological Human	**Context:** In the human health risk assessment of the non-radiological COPCs, it was determined that the Project incremental HQ was predicted to remain below 0.2 for all non-carcinogens and all pathways during all phases of the Project, except for selenium for the fisher/trapper at Russell Lake from the fish ingestion pathway.	Please provide a discussion of measures that could be applied to mitigate the risk of selenosis in exposed individuals who consume fish from Russell Lake and other waterbodies closer to the mining operation.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
				Health Risk Assessment	**Rationale:** Given that the fisher/trapper receptor will likely be exposed to higher concentrations of selenium from the consumption of fish at Russell Lake, there is an elevated risk of selenosis in exposed individuals. This potential for selenosis would be further exacerbated in individuals who consume fish taken from other lakes closer to the mining operation. There is, however, no discussion of mitigation of these risks to exposed individuals.	**Suggestions for mitigation and follow-up measures:** CNSC recommends the following: • Selenium abatement technologies may be considered to eliminate or reduce selenium in effluent entering the lake system. • If HQs continue to exceed 0.2, then it may be necessary to post fish consumption advisories, in consultation with the Medical Officer of Health for the jurisdiction where the Project is located.		
IR-205	-	CNSC	Geology and Groundwater	Section 7, appendix H	**Context:** In this appendix the analytical concentration of various groundwater samples taken from monitoring wells is reported. **Rationale:** There is one sample labeled as "Tracer Tank" with no definition available in the current report. It is difficult to judge whether the results presented are relevant to the EIS and how it may impact the findings therein.	Please clarify the definition of "tracer tank".		Accepted
IR-206	-	CNSC	Current use of lands and resources for traditional purposes	Section 11 Section 12 Section 15 Section 16	**Context:** Impacts to Lands and Resources Use have been identified by Indigenous Nations and communities. **Rationale:** Additional information is required to demonstrate whether Indigenous Nations and communities were engaged directly by Denison regarding the cumulative effects assessment, significance determination and residual effects, and thus the overall conclusions on potential adverse impacts of the Project on the potential or established Indigenous and/or treaty rights and effects of changes to the environment on Indigenous peoples, pursuant to paragraph 5(1)(c) of the CEAA 2012.	Please describe any outstanding or residual issues or concerns raised by Indigenous Nations and communities that Denison was unable to address. In addition, outline any plans to find solutions or continue discussions with the potentially impacted Indigenous Nations and communities.		Accepted
IR-207	-	CNSC	Current use of lands and resources for traditional purposes	Section 11, Perceived Risks to Lands and Resources	**Context:** The EIS states: "Resource users may also experience changes in their perception of the quality of resources for consumption such as the palatability of fish or wildlife or have apprehensions about the safety of resources for consumption. These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning. The ERFN refer to this indicator as a "psycho-social' effect, meaning that even if people know their fears are "*perceived fears, the fear … is real and has real impacts on ERFN members' perception of their overall health and well-being*" (ERFN and SVS 2022a)." (p. 11-11) Resource harvesters may experience Project-related disturbances and, depending on how these changes are perceived, it may cause some resource harvesters to avoid the Project Area. Reductions in harvests may occur based on fear or uncertainty about the ongoing quality of country foods. For example, "*People stopped picking berries in this area when Key Lake mine was established because of concerns about health impacts*" (ERFN and SVS 2022b).	How does Denison plan to work directly with Indigenous Nations and communities who currently use the potentially impacted areas, including the RSA, to mitigate and monitor the perceived risks and/changes to the RSA? Has Denison had discussions with the potential impacted Indigenous Nations and communities on how fear and avoidance behaviors and related impacts on traditional land use will be mitigated, especially within the RSA? Additional information is needed to determine if Denison has engaged directly with the Indigenous Nations and communities to develop potential mitigation measures to address fear and avoidance impacts, such as a community monitoring program, which could help to reduce the perceived risk to lands and resource use through education, collaboration, and long-term monitoring with Indigenous Nations, in order to build trust.	Response is accepted, but also see AD-60 in the Advice to Proponent table.	Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Rationale: CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS will document specific suggestions raised by Indigenous groups for mitigating the effects of changes to the environment on Indigenous peoples (section 5(1)(c) of CEAA 2012). For the mitigation measures intended to address the effects of changes to the environment for Indigenous peoples, the Proponent must discuss the residual effects with the Indigenous groups prior to submitting the EIS." These changes may affect the patterns of ILRU during all Project phases including Post Decommissioning.	**Suggestions for mitigation and follow-up measures:** It is recommended that Denison consider engaging with potentially impacted Indigenous Nations and communities on the collaborative development and implementation of a monitoring program to help address concerns about potential impacts on lands and resources as a result of the Project. The program(s) could help to monitor changes over time related the potential perceived risk of contamination of the land from Project activities and subsequent effects on the quality of fish, vegetation, and wildlife resources, which in turn could affect the safety of traditional foods and human health, and impacts on culture practices, and overall community well-being that travel to region yearly.		
IR-208	-	CNSC	Indigenous physical and cultural heritage	Tables 11.1-3, 11.1-4 and 11.1-5 Section 11.1.3.2.6	**Context:** Black bear is listed as a species hunted by several Indigenous nations, including Pinehouse residents. CNSC participated in an in-person engagement with Pinehouse residents in October 2022 and bears eating waste was identified as a concern for hunting and consumption. **Rationale:** Perceived risk of eating animals that are contaminated by hazardous or radiological wastes could deter community members from harvesting animals that are normally part of their traditional diet. Fencing for waste was specified as a deterrent for human trespassers, not animals.	Please specify measures that Denison will take to ensure bears and other animals do not scavenge from waste facilities.		Accepted
IR-209	-	CNSC	Indigenous Peoples' health / Socio-economic conditions	Section 12.1.4.2.1 (p. 12-22) Section 12.1.5 Section 12.1.6.2	**Context:** KML indicates that working at a mine camp could inhibit community members from participating in cultural activities and sharing them with family and community members, resulting in a loss of cultural knowledge and language, thus impact knowledge transmission (p. 12-22). **Rationale:** Denison addresses this by briefly identifying culturally sensitive policies which would eliminate residual effects (p. 12-30)	Please provide detailed proposed mitigation measure for KML's concerns related to loss of cultural knowledge and language should they work for Denison.		Accepted
IR-210	-	CNSC	Current use of lands and resources for traditional purposes	Section 12.1.4.2.2, Potential Effect 2: Change in Traditional Diet, Perceived Suitability of Country Foods (p. 12-26)	**Context:** The EIS states: "Project activities could change the perceived suitability of country foods. An ecological risk assessment (ERA) was conducted to consider both radiological and toxicological risks to ecological receptors such as terrestrial and aquatic invertebrates, terrestrial and aquatic vegetation, fish, and terrestrial and aquatic mammals and birds. Results for the radiological assessment predicted no exceedances of the radiation dose benchmark for the ecological receptors. For non-radiological COPCs, no exceedances were predicted except for selenium in fish from Russell Lake, based on a conversative dietary assumption for one resource user. The traditional foods diet for the fisher/trapper is conservative as it assumes that their annual fish consumption (183 kg of fish per year) would be obtained from Russell Lake, meaning the exceedance of the benchmark for selenium from fish would only occur if fish were only sourced from this one lake. This one exceedance could potentially change the perceived safety of country foods for community members and make country foods a less desirable part of a traditional diet.	Given concerns with psycho-social impacts and the influence of perception discussed by ERFN earlier on in the EIS, does Denison have information on the perspectives from Indigenous Nations and communities to validate this conclusion is applicable?		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					Experience from other uranium operations in northern Saskatchewan suggests that resource use will continue despite the potential selenium exceedance. An examination of members of the Hatchet Lake Denesųłiné First Nation who live in Wollaston Lake near the Rabbit Lake operation found that over years of being active on the landscape both with and without the presence of the uranium industry, members had developed their own culturally appropriate practice of risk assessment and management based on their relationship with the land. Hatchet Lake Denesųłiné First Nation members appear to be more concerned with the direct effects of uranium mining on the local environment and less concerned about uranium mining's effects on their health through consumption of plants and animals. This is likely due to their high level of confidence in recognizing affected plants and wildlife and avoiding them (Elias et al. 1997). The usage patterns of the ERFN Trapper have similarly allowed for continued use and access to areas proximal to other uranium operations. The ERFN Trapper had a positive relationship with other uranium operations in the ILRU LSA. He also continued to trap (i.e., used his trapline in Fur Block N-18), fish, and opportunistically pick berries, and consumed those resources during operations (KPI Program 2021). Good relationships between Denison and a new trapper who eventually takes over the trapline from the ERFN Trapper would promote continued use." (p. 12-26) **Rationale**: The underlined reference suggests that negative perceptions may not prevent traditional resource users from continuing to consume, due to adaptation to potential risks in the environment.			
IR-211	-	CNSC	Accidents and Malfunctions	Section 14.6.1, Bounding Scenario 1, Vehicle Accident and Aquatic Release of Radioactivity	**Context:** Scenario 1 describes a spill of uranium concentrate into the lake. It's not clear how the ecological risk assessment was performed. It is stated that sediment concentrations in post-remediation conditions are expected to exceed the benthic invertebrate benchmark and that these results indicate that a spill of uranium concentrate could potentially affect benthic invertebrate populations following a spill, but the spatial extent would be limited. For water, it is stated that when evaluating the potential effect, a comparison was made between the results of the estimated short-term water quality 1,892 µg/L (1.892 mg/kg) and the guideline (33 µg/L). This indicates that there may be some aquatic species that could be affected, but the effects are expected to be transient as the water concertation quickly drops to a long-term level of 0.19 µg/L. However, when looking at dose to other receptors, the results of the ecological risk assessment indicated short-term ingestion of contaminated water resulting from an accident would not result in potential risks to grouse, vole, or deer, however rationale for how these receptors were chosen is not provided. **Rationale:** It's not clear from the EIS, why the receptors grouse, vole, and deer were chosen to evaluate ecological effects from a potential spill, and why they differ from receptors in the ERA. It is also not clear if the pathway from sediment ingestion/contact was considered for semi-aquatic receptors as they could be exposed to the increased concentrations post-spill. It is also not clear if SARA species exposure to sediment and water post-spill was considered.	Please clarify why grouse, vole, and deer were chosen as receptors for the ecological risk assessment performed for accidents and malfunctions scenario 1 and clarify if the sediment pathway to receptors post-spill was considered, as well as if SARA species were considered.		Accepted

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IR-212	-	HC	Human health with respect to hazardous contaminants	Section 14 (p. 14-3) Appendix 16-C (p. 14 & 15)	The follow-up plan does not sufficiently describe how various parties will be engaged in the design, implementation, and review of monitoring programs. **Context:** Section 14 of the EIS states that "The overarching fear of contamination from the mine is woven in to almost every other concern noted by participants in the TK study. It is worth acknowledging this concern separately given the potential for mental health impacts related to people's experiences of fear and anxiety" (p. 14- 3). The commitment regarding monitoring and follow-up activities appears limited to *"shar[ing] information in a transparent manner with the General Public, and specifically those Communities of Interest and Nearby Land Users with whom Denison is regularly engaging about the Project. Such an information-sharing program would consider the involvement of the Regulators to make sure the information available addresses the issues identified as concerns"* (p. 14). **Rationale:** Country food safety is not regulated federally unless foods are sold commercially. Certain aspects of country food safety and availability may be covered by provincial regulators. It is unclear whether and how various levels of government and potentially affected communities would be involved in the development of the follow-up and monitoring program. It is also unclear what the information sharing program entails and how it would inform any adaptive management if monitoring results deviated from the prediction	1. Provide details of how local, provincial and federal authorities, and Indigenous Nations and communities will be engaged in developing the follow-up and monitoring program, including the information-sharing program. 2. Describe the steps that will be taken if there are any exceedances of established benchmarks or deviation from predictions. **Suggestions for mitigation and follow-up measures**: Health Canada recommends that the Proponent's plan for communicating follow-up results (environmental and country foods) aims at, among other things, responding to community concerns regarding country foods to minimize avoidance of this resource. This goes beyond a passive dissemination of information and developing a strategy based on dialogue and the direct involvement of communities in monitoring, surveillance, and risk communication activities.		Accepted
IR-213	-	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A	**Context:** The Proponent states that the assessment of accidents and malfunctions began with the initial identification of hazard scenarios. Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. The hazard identification was conducted to identify a comprehensive list of potential project-related accident and malfunction scenarios associated with the key project components and activities with further details provided in Appendix 14-A. The initial hazards were then screened qualitatively based on likelihood and consequence to determine overall risk level using a risk matrix approach. Bounding scenarios were then selected from this initial list of hazard scenarios. The results of numerical analyses (RESPEC, 2021) of detailed strip model suggest that the deformation imposed on the cemented steel casing from downward movement of the rock mass may exceed the assumed casing-strain yield limits and the failure limit locally after extracting the uranium ore. However, this potential hazard is not identified in the hazard identification. **Rationale:** Exceedance of steel casing yield limits and failure limit would either compromise the steel casing integrity or damage the steel casing and result in the leakage of injected solution, which could impact on mine operation and contaminate the surrounding groundwater.	Please include the hazard of steel casing yield or damage in the table of hazard identification evaluation and conduct an initial risk screening and further detailed assessment as required.		Accepted

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IR-214	-	CNSC	Accidents and Malfunctions	Section 14.5.3 Appendix 14-A, section 3.2.3	**Context:** Hazard scenarios were identified using a systematic approach that considered the existence of sources of hazards and initiating events for the Project in consideration of Project activities and components. Details for how each of these project components and activities are considered in the initial hazard scenario identification process are provided in the accidents and malfunctions TSD (see Appendix 14-A; Ecometrix 2022). However, in Table 3-1 to Table 3-14 in Appendix A of Appendix 14-A, the following inconsistencies were identified: i. consequences for the hazards ID# 1.1, 1.5, 1.7, 14.2 include occupational major injuries; however, the severity (S) is denoted as number 2 that appears to be inconsistent with consequence rating number in Figure 14.5-2 ii. Hazard ID# 1.5 has a L=2, but it is described as a highly unlikely event, which is inconsistent with the term in Figure 14.5-2 iii. Hazards ID# 3.6 and 3.7 have a L=1, but they are described as low probability event that is inconsistent with the term in Figure 14.5-2 iv. Hazards ID# 8.2, 8.3, 9.1, 10.1 to 10.5, 11.1, 11.5 have a L=1, but they are described as unlikely events, which are inconsistent with the term in Figure 14.5-2. Rationale needs to be provided how stockpile erosion is considered to have a L=1 v. Hazard ID# 12.1 has a L=2 and S=3, but it's risk ranking is moderate, which is inconsistent with the term in Figure 14.5-2 vi. Hazard ID# 13.3 has a L=2. Based on the operation experience in the similar projects in the northern Saskatchewan, ponds lining failure and leakage is a very likely event. Rationale needs to be provided to support L=2 or change the number for L. **Rationale:** Inconsistent or inaccurate/incorrect information was included in Accidents and Malfunctions assessment.	Please clarify or correct all inconsistent and/or inaccurate information in Tables 3-1 to 3-14 in Appendix A of Appendix 14-A.		Accepted
IR-215	-	CNSC	Human health with respect to hazardous contaminants	Section 14.6	**Context:** One of the potential risks of a uranium mine and mill is a spill of untreated effluent. **Rationale:** In the EIS, it doesn't appear that the scenario of a spill of untreated effluent to the environment has been considered. A failure of the piping containing the untreated effluent could result in an uncontrolled release to the environment and could affect the groundwater, soil quality, and terrestrial biota.	Please evaluate and provide the results for a bounding scenario of a spill of untreated effluent or provide justification for its exclusion.		Accepted
IR-216	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.1 Section 14.6.7 Appendix 14-A	**Context:** Radiological doses to human receptors, including workers (i.e., driver(s) of the vehicles), from the Bounding Scenarios 1 (Vehicle Accident Including Rollover, Collision, Run Off Road) and 7 (Vehicle Accident Including Rollover, Collision, Run Off Road) have not been assessed. **Rationale:** An estimate of the effective doses to human receptors, including workers, are required to determine whether the expected doses meet the dose limits set out in the Radiation Protection Regulations.	Provide estimates (including calculations) of the potential radiological doses to human receptors, including workers, resulting from Bounding Scenarios 1 and 7.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
IR-217	-	CNSC	Accidents and Malfunctions	Sections 14.6.1 and 14.6.2	**Context:** Highway 914 crosses the Wheeler River 10 km southwest of the access road junction. A vehicle accident, including a rollover, collision, or run off road, at or near the bridge could potentially result in a release of uranium concentrate and release of fuels and chemicals into the surface water at this location. Denison believes that a release of uranium concentrate and a release of fuels and chemicals at this location would bound the releases at any other water crossing along the transportation corridor. However, no information on what other water crossings along the transportation corridor exist and how bounding scenarios 1 and 2 would bound the risk of releasing uranium concentrate and fuels and chemicals at other crossings. **Rationale:** The release of uranium concentrate and fuels and chemicals at water crossings would contaminate the water body at the crossings and pose a risk to the environment and public health.	Please provide information on all water crossings along the transportation corridor and justification why bounding scenarios 1 and 2 would bound the effects of the accidental releases of uranium concentrate and fuels and chemicals at these crossings.		Accepted
IR-218	-	CNSC	Accidents and Malfunctions	Sections 14.6.1.1 and 14.6.1.4	**Context:** Table 14.6-1 indicates that the average flow of Wheeler River south of Russel Lake is 17,340 L/s or 17.34 m3/s. This rate is used for uranium dissolution rate calculation. However, in section 14.6.1.4, it states that the average annual flow is 24.3 m3/s. In Table 14.6-3, the last two rows appear to be added wrongly. It also states that sediment quality results are shown in Table 14.6-5 for post-remediation conditions. During minimum flow conditions, the affected volume is expected to be smaller, resulting in a higher sediment concentration. In comparison, higher flow conditions are expected to result in a greater footprint and lower concentrations. However, in Table 14.6-5, the average sediments concentration and porewater concentration appear to be incorrect and switched between average flow and maximum flow. **Rationale:** Inconsistent/inaccurate information provided in the EIS.	Please clarify and correct the inconsistent information on average flow rate of Wheeler River at the crossing and incorrect information in Table 14.6-3, and average sediment concentration and porewater concentration under average and maximum flow conditions in Table 14.6-5.		Accepted
IR-219	-	CNSC	Accidents and Malfunctions	Sections 14.6.1.1.1 and 14.6.1.4.1; Sections 5.1.1 and 8.1 of Appendix 14-A	**Context:** When assessing the release characterization of Bounding Scenario 1, the Proponent assumed that 95% of the released uranium concentrate can be recovered from the release location without sufficient justification, and that different water column depths, i.e., 10 cm and 5 cm, and average water depth of 1.2 m at the release location were used without explanation. **Rationale:** As the recovery rate of the uranium concentrate would have an impact on the assessment of its potential effects, it is necessary to understand how the recovery rate and water level were selected for assessing this bounding scenario.	Provide further rationale for assuming 95% recovery rate and for using different water column depths for uranium concentrate release characterization.		Accepted
IR-220	-	CNSC	Accidents and Malfunctions	Section 14.6.1.1.1 Appendix 14-A, Section 5.1.1	**Context:** The Proponent states that based on drum deformations performed in a previous analysis (McSweeney et al. 2004), if a drum experienced a crush force of 100,000 lbs., then the deformation of the drum would cause the lid to detach from the drum. Using this drum failure mechanism, and assuming the drums weigh 450 kg and are arranged four across in the truck, at a speed of 48 km/h, the front 25% of the drums would fail, at 60 km/h to 97 km/h 55% would fail, at 145 km/h 75% would fail, and at	Please provide information and/or rationale as to whether drum stacking would impact drum failure at different speeds and confirm whether 55% drum fail for such an accident is still valid.		Accepted

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					≥193 km/h all would fail. Given that the speed of the truck is likely between 60 km/h to 97 km/h, it was concluded that less than 55% of the drums would fail upon a traffic accident scenario. It is assumed to be 40 drums per shipment, so some stacking or rows of drums should be expected in this scenario. The drums stacked above could be at greater risk of deformation in a traffic accident. It is not clear whether drums stacking was considered in the previous study cited by the Proponent and whether less than 55% fail is still an adequate percentage of drum failures in such traffic accident scenarios if drums stacking is needed. **Rationale:** Drum failure percentage will impact the release quantity of uranium in such an accident scenario and then impact the consequence assessment. Therefore, the drum failure should be adequately assessed and supported with sufficient information and justification.			
IR-221	-	CNSC	Accidents and Malfunctions	Section 14.6.1.3, Appendix 14-A, Section 7.1	**Context:** It is projected that there would be about 100 drums packaged per mill operating day. One trip per day for 330 days per year is assumed for the probability evaluation. This means 100 drums per trip, which is inconsistent with description in section 14.6.1.1.1 where assuming 40 drums in one shipment per day. **Rationale:** Shipments per day will impact the probability evaluation, and number of drums per trip will impact the release of uranium during an accident.	Please clarify the number of shipments per day and number of drums per shipment that are expected and re-calculate the probability as necessary.		Accepted
IR-222	-	CNSC	Accidents and Malfunctions	Section 14.6.2.4	**Context:** Bounding Scenario 2 consists of the aquatic release of fuel and hazardous chemicals due to traffic accidents. The EIS states that amongst the fuels considered for this scenario, the consequences of the release of gasoline and solvents are bounded by the consequences associated with the release of diesel. Both gasoline and solvents are lighter with higher vapour pressure; therefore, they have a shorter half-life in the aquatic environment and a lesser tendency for adsorption to sediments and suspended solids in the water column. There is no other justification provided to show that the release of diesel can bound other chemicals such as sulfuric acid and sodium hydroxide that are heavier than diesel. **Rationale:** The release of either sulfuric acid or sodium hydroxide during accident could change the water PH significantly at the releasing location, which would post a negative impact on the local environment.	Please provide further justification that the consequences of the release of sulfuric acid and sodium hydroxide can be bounded by the consequences associated with the release of diesel.		Accepted
IR-223	-	CNSC	Accidents and Malfunctions	Section 14.6.4.1 Appendix 7-A, Appendix K	**Context:** The EIS states that the 3D strip numerical model predicted that stresses and displacements did not show instability in the altered sandstone or basement rock at the location where a freeze wall would be placed around the Phoenix Deposit boundary (RESPEC 2021). The potential damage to the freeze wall due to mine-induced stresses and displacements under this scenario is excluded. **Rationale:** One outer section of the freeze wall (i.e., north-east freeze wall of the phase 4 mining area) and some internal cross walls are located in the desilicified zone. The RESPEC 2021 report (i.e., Appendix K of Appendix 7-A) appears not to have included the	Please provide information on the stresses and displacements/deformation of the area northeast of the phase 4 ore body from the geomechanical studies to demonstrate the resulted stresses and displacements will not impact on the freeze wall integrity after IRs for geomechanical studies for ore extraction are addressed. **Technical Discussion Required**: Yes		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					desilicified zone in the geomechnical modeling, nor is provided the stresses and the displacements/deformation of the area northeast of the phase 4 ore body where a significant extent of the desilicified zone exists.			
IR-224	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** For the Bounding Scenario 5 (Process System and Piping Failure), doses to receptors at distances of 100 and 500 metres (0.25 and 0.01 mSv respectively) are predicted. The assessment also indicated that the dose to the unprotected worker staying inside the processing plant during the spill could exceed the 50 mSv dose limit specified by CNSC if workers did not leave the area quickly after the spill. The Proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 5 (Process System and Piping Failure).		Accepted
IR-225	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.5.4 Appendix 14-A	**Context:** With the Bounding Scenario 5 (Process System and Piping Failure), the Proponent states that Denison ensures that the process is designed to include control measures to reduce the exposure to both workers and members of the public as low as achievable. The measures would ensure that the processing plant is adequately ventilated, and that spills or leaks are detected by loss of system pressure, observation, or flow imbalance. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 5, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 5, have been formally documented and incorporated in the engineered design of the processing facility.		Accepted
IR-226	-	CNSC	Accidents and Malfunctions	Sections 14.6.6.1 and 14.6.6.4	**Context:** It is stated that in the case of the accident and for a release amount of 1 kg inside the processing plant, the dose to offsite receptors at 200 m from the Project site was calculated to be less than the CNSC public dose limit of 1 mSv. The analysis also indicated that the dose to a worker in a full-face-piece powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. **Rationale:** Section 14.6.6.1 indicates that 2 kg of uranium concentrate could be released in case of the accident. No rationale is provided why 1 kg rather than 2 kg uranium concentrate is used for dose calculation. If 2 kg is used as the source term, the dose to offsite receptors at 200m and workers in the area would be higher.	Please provide the rationale for using a source term of 1 kg rather than 2 kg of uranium concentrate for the dose calculation to offsite receptors and workers. If sufficient rationale cannot be provided, the doses to offsite receptors and workers should be recalculated using 2 kg uranium concentrate, and the results provide.		Accepted
IR-227	-	CNSC	Accidents and Malfunctions	Section 14.6.6.1.1	**Context:** Bounding Scenario 6 involves a fire and/or explosion within the processing plant, resulting in the release of a large amount uranium to the atmosphere. The airborne source term for this scenario is estimated with equation developed by the United States Department of Energy (USDOE), where the respirable faction is assumed	Provide rationale for only considering 10 mm and smaller particles for the respirable fraction.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					to only include particles of 10 mm and smaller. **Rationale:** No rationale was provided to support the consideration of only 10 mm and smaller particles. As provided in Table 14.6-3, the particle size of uranium <15 mm is less than 20%. Majority of the uranium particle size is larger than 10 mm. The airborne source term is an important factor for the effects assessment and should be calculated with transparent and justified information/data.			
IR-228	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** For the Bounding Scenario 6 (Facility Fire and/or Explosion), the predicted dose is less than 1 mSv to a member of the public 200 metres away from the Project site. The analysis also indicated that the dose to a worker in a full-face powered air-purifying respirator who stays in the area would be 88 mSv, which exceeds the annual worker dose limit of 50 mSv. The Proponent did not provide the dose calculations for deriving the dose estimates. **Rationale:** The method used to estimate effective, equivalent, and committed dose is required to be verified. Sample dose calculations should be included, to confirm use of acceptable input data.	Provide the dose calculations for deriving the dose estimates for workers and members of the public for Bounding Scenario 6 (Facility Fire and/or Explosion).		Accepted
IR-229	-	CNSC	Human Health with respect to radiation exposure	Section 14.6.6.4 Appendix 14-A	**Context:** With the Bounding Scenario 6 (Facility Fire and/or Explosion), the Proponent states that Denison would ensure that the design of the plant includes control measures to reduce the exposure to both workers and members of the public to levels that are as low as achievable. The measures would ensure that the processing plant is adequately ventilated. It is not indicated where these additional measures have been detailed/elaborated within the EIS. **Rationale:** Control measures to reduce the exposure to both workers and members of the public as low as achievable, that are identified in the assessment of Bounding Scenario 6, must be formally documented to ensure that they are carried over into the engineered design of the processing plant.	Provide details on how the control measures to reduce the exposure to both workers and members of the public, identified in the assessment of Bounding Scenario 6, have been formally documented and incorporated in the engineered design of the processing facility.		Accepted
IR-230	-	CNSC	Accidents and Malfunctions	Section 14.6.7.4	**Context:** It is stated that a conservative penetration time of 15 min was applied in the assessment. Based on this assumption, the maximum depth of contamination could be 90 cm (for penetration rate of 0.1 cm/s). It is not clear why the penetration time of 15 minutes is considered conservative as the penetration time would depend on the time needed for the emergency response team to respond. It is also stated that the wide range of the calculated velocities is a result of variation of soil conditions and the slope of the surface. The distance that the groundwater can travel under these extreme (i.e., conservative) conditions ranges from 0.15 m to 100 m. It is not clear how the groundwater travel distance of 0.15m and 100m is calculated. **Rationale:** The penetration time will influence the penetration depth of the released	Please provide justification for applying 15 minutes of penetration time, and why it is considered conservative. In addition, please provide information on how the groundwater travel distance of 0.15 m and 100 m was obtained.		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					materials, which in turn, considering the groundwater travel distance, will impact the potential areas and volumes of contaminated soils and shallow groundwater.			
IR-231	-	CNSC	Accidents and Malfunctions	Sections 14.6.6.4 and 14.6.6.5	**Context:** The EIS states that in the unlikely event of an unmitigated accidental release of uranium due to a dryer explosion, doses to the workers are expected to have a moderate effect, while doses to members of the public are expected to have a minor effect. Based on this evaluation, the severity of the consequences of this accident and malfunction scenario is predicted to be moderate. In consideration of both probability and consequences, the overall risk related to Bounding Scenario 6 is predicted to be low. **Rationale:** When there is an explosion within the process plant, it is likely there will have worker fatality. The severity of the consequences of an explosion would be catastrophic and the risk of Bounding Scenario 6 would be higher.	Please re-evaluate the consequence and the risk of Bounding Scenario 6 by considering the potential worker fatality resulted from an explosion.		Accepted
IR-232	-	ECCC	Change to an environmental component due to hazardous contaminants	Appendix 14-A, Table 3-7, ID# 7.1 Appendix 14-A, Table 5-5	**Context:** The Proponent indicates in Appendix 14-A, Table 3-7 that a release of sulfuric acid is a low consequence event therefore would not require further assessment. However, according to a Safety Datasheet on high concentrated sulfuric acid (ICSC–0362 - SULFURIC ACID, concentrated (> 51% and < 100%) (ilo.org)), the substance is incompatible with certain materials and can give off toxic fumes. Furthermore, it reacts with various metals to produce hydrogen gas, which is explosive. The Proponent provides estimates of chemicals, including sulfuric acid, to be transported to site in Appendix 14-A, Table 5-5. The annual consumption of sulfuric acid is estimated at 15,417 m3, in 617 trucks per year, but the concentration is not stated. **Rationale**: Given the high reactivity and inherent corrosive nature of sulfuric acid combined with the volume and concentration that may be stored on site, ECCC requests that the Proponent provide a detailed risk assessment related to a terrestrial spill of sulfuric acid, specifically at the processing plant.	1. Provide the volume and the concentration of sulfuric acid that will be stored on site. 2. Provide a detailed risk assessment of the fate and behavior of sulfuric acid during a release into the environment.		Accepted
IR-233	-	HC	Human health with respect to hazardous contaminants	Appendix 14-A, Section 8.7 (p. 8.10)	An effects assessment for a transportation accident scenario involving radioactive materials was not included. **Context:** The Proponent provided an effects assessment relating to a diesel spill on the ground (Section 14 Appendix 14-A, Section 8.7). However, no information was provided regarding the potential human health effects of a uranium concentrate release at the two locations considered (Section 14 Appendix 14-A p. 8.10). **Rationale:** An accident involving radioactive material may have an impact on human receptors, based on the proximity of receptors and the proposed response protocols.	1. Assess and describe the potential health effects (chemical and radiological) of a transportation accident involving a uranium concentrate spill at the following locations: a) km 160 of Hwy 914, which is the location of a cultural camp that has been established by the ERFN. b) km 67 of Hwy 914, which is a gathering location for the Kineepik Métis Local associated with the Northern Village of Pinehouse. c) All other potential sites of importance for the public and Indigenous peoples.		Accepted
IR-234		CNSC	Effect of Environment	Section 15.2.2	**Context:** Effects of seismic events on the uranium extraction and post decommissioning are not assessed. **Rationale:** Seismic events could further exacerbate the stability of the voids induced by the uranium extraction, which will result in extra stresses and displacements/deformation in the overlying rock formations. These extra stresses and	Please provide an assessment of seismic events on the mine-induced voids stability and the resulted effects on the mine operation and post decommissioning. **Technical Discussion Required**: Yes		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					displacements/deformation could impact on the mine operation and post decommissioning groundwater flow and contaminant transport.			
IR-235	-	ECCC CNSC	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** In this section it is stated that: "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit, following the RPC4.5 and RCP8.5 scenarios, respectively, as indicated by the Climate Atlas (PCC 2019)." RCP4.5 represents predicted climate conditions of a moderate carbon future. RCP8.5 represents predicted climate conditions under a high carbon future. The values shown in Tables 15.5-1 and 15.5-2 show averages of 25.9 and 26.7 mm for RCP4.5 and 25.9/27.5 mm for RCP8.5. These values do not correspond to the source indicated by the Proponent. **Rationale:** Based on the Proponent's description we would expect to find the same values for "Max 1-Day Precipitation (mm)"in the Climate Atlas for RCP4.5 and RCP8.5 scenarios. ECCC was unable to duplicate the results. ECCC queried the Climate Atlas for Tomblin Lake and returned a result of "Region Geikie River." https://climateatlas.ca/find-local-data ECCC then queried the Climate Atlas for Max 1 Day Precipitation (mm). https://climateatlas.ca/data/grid/782/maxdaypr_2030_85/line https://climateatlas.ca/data/grid/782/maxdaypr_2030_45/line The results displayed an array of values ranging from 83.6 mm (2050) to 87.3mm (2092) for a Regional Concentration Pathway RCP8.5 scenario and values ranging from 48.9mm (2050) to 89.5 mm (2083) for an RCP4.5 scenario. These values do not match the averages shown in Tables 15.5-1 and 15.5-2.	1. Provide the source of the data displayed in Max 1-Day Precipitation (mm) category in Tables 15.5.1 and 15.5-2. 2. Provide detailed calculations for the following average values: • 25.9 mm 26.7 mm in Table 15.5-1: Predicted Climate Conditions of a RCP4.5 Moderate Carbon Future • 25.9 mm 27.5 mm in Table 15.5-2: Predicted Climate Conditions of a RCP8.5 High Carbon Future 3. Explain how the data shown in Tables 15.5.1 and 15.5.2 were used in the precipitation risk assessment. 4. Denote the differences between "mean", "value/max value", and "fluctuation", in the calculation of extreme event risk. 5. Compare model derived data against: 1. Natural variability of the observed data. 2. Variability in the statistics generated via observation based time series. **Technical Discussion Required**: Yes		Accepted
IR 236	-	ECCC ERAD	Fish and fish habitat	Section 15.5.2, Expected Environmental Conditions	**Context:** It is stated that, "Table 15.5-1 and Table 15.5-2 summarize the predicted mean values of the climate variables for the Tomblin Lake regional grid unit…" As per the Proponent's description, Tomblin Lake was chosen as representative location for Wheeler when Climate Atlas was used as data source. **Rationale:** In those two tables, for the "Max 1-Day Precipitation (mm)" the historical average is given as 24.1mm. Local time series analysis for the climatic region in which Wheeler Project is located provide averages (for 1-day max precipitation) of approximately 30+ mm. It is the Proponent's responsibility to keep the required database current and up to date, because the length of the time series influences all derived statistics. Statistical analysis	1. Provide a clear explanation on how the historical mean for 1-Day Max Precipitation was calculated. 2. Compare the values obtained via various means (ex: copied from the internet, modeled via some online algorithm, derived from specialty literature), against time series analysis based on observations. **Technical Discussion Required**: Yes		Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					of extreme events is highly dependent of the mean with extreme values reaching values 3 to 4 times higher than the mean.			

IR-237		CNSC	EA follow-up and monitoring program	Appendix 16-C throughout, including Table 1.5-1: Wheeler River Monitoring and Follow-up Program Summary (p. 8-15)	**Context:** CNSC's Generic Guidelines for the Preparation of an EIS state: "The EIS should provide discussion on the follow-up program's requirements, and include:
					• objectives and structure of the follow-up program and the VCs targeted by the program
					• tabular summary and explanatory text of the main components of the program including:
					  ○ a description of each monitoring activity under that component
					  ○ which of the two generic program objectives the activity is relevant to (e.g., verify EA predictions, determine effectiveness of mitigation measures)
					  ○ the specific statement from the EA that goes along with that generic objective and will be the focus for that activity (e.g., program objective: verify predicted effects; environmental assessment effect: no potential adverse effects)
					  ○ the specific monitoring objective for that activity
					  ○ planned schedule
					• roles and responsibilities to be played by the Proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the program results
					• possible involvement of independent researchers
					• program funding sources
					• information management and reporting (reporting frequency, methods and format)
					• possible opportunities for the Proponent to include the participation of the public and Indigenous groups, during the development and implementation of the program
					
					The follow-up program plan should be sufficiently described in the EIS to allow independent judgment as to the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures." (Section 11)
					
					Rationale: The Summary of Monitoring and Follow-up Programs provided in Appendix 16-C contains very high-level information, and while some of the aspects detailed in the Generic EIS Guidelines are included, the aspects underlined are missing or appear incomplete.
					
					Further, all information from throughout the EIS should be incorporated into this Summary. For example, the EIS notes that: "Groundwater samples will be collected at least monthly and semi-annually in the wells within the freeze wall and on the freeze wall perimeter, respectively" (p. 7-109) and that "At least five to seven multi-well
						It is recognized that this document will evolve over the planning process and be finalized prior to the EA Decision; however, as plans are developed and revised, CNSC staff expect that updates will be made to this document and provided with any future versions of the EIS.
						
						Appendix 16-C Summary of Monitoring and Follow-up Programs must include sufficient details to allow CNSC staff to determine the likelihood that it will deliver the type, quantity and quality of information required to reliably verify predicted effects (or absence of them) and confirm the effectiveness of mitigation measures. This includes concrete monitoring plans (sampling locations, frequency, etc.).
						
						Additionally, please incorporate any relevant information included in the EIS into this Summary.
								Accepted

Original IR#	Follow-Up IR #	SME	Project Effects Link	Reference to EIS, appendices, or supporting documentation	Context and Rationale	Information Requirement (IR)	Rationale for Status	Status
					clusters are proposed across the mined area (Figure 7.8-2). Sampling will include KI parameters or the full suite of COPC at different times in the remediation process" (p. 7-111). These details (only examples) are not included in Appendix 16-C.			
IR-238	-	CNSC	Current use of lands and resources for traditional purposes	Various sections of the EIS, including: Section 8 Section 9 Section 10 Section 11 Section 12 Section 15 Section 16 Appendix 16-C (p. 3)	**Context:** The EIS indicates that "further detailed [follow-up and monitoring programs] will be developed as Project designs are finalized that may influence the nature, frequency, and locations of monitoring. In addition, input from regulatory agencies, the public and Indigenous Peoples will be considered." (Appendix 16-C, p.3) It is not clear in several section(s) of the EIS and the Indigenous Engagement Report, whether Denison has provided the interested Indigenous Nations and communities with the opportunity to participate in the development, implementation, and review of monitoring and mitigation measures, as per the guidance of REGDOC-3.2.2 and CNSC's Generic EIS Guidelines. **Rational:** As outlined in Section 11 of CNSC's Generic Guidelines for the Preparation of an EIS, please include roles and responsibilities to be played by the Proponent, regulatory agencies, Indigenous people, local and regional organizations and others in the design, implementation and evaluation of the monitoring program results as well as possible opportunities for the Proponent to include the participation of the public and Indigenous Nations and communities, during the development and implementation of the program.	Please provide additional information to demonstrate whether Indigenous Nations and communities were engaged directly on the potential mitigation and monitoring measures to address the concerns raised regarding potential impacts of the Project on the potential or established Indigenous and/or treaty rights. Provide a rationale if this engagement has not been completed. As the Project develops, please provide concrete actions Denison will take in the follow-up and monitoring programs to engage Indigenous Peoples to alleviate concerns and incorporate their interests, and when this engagement is planned to take place.		Accepted

[i] **Additional Lung Cancer Mortality from PM2.5: Recommended Approach and Sample Calculation**
Health Canada, Water and Air Quality Bureau, October 2022

Health Canada (2022) provides a quantitative estimate of the risk of lung cancer associated with exposure to PM2.5 in Canada. The pooled hazard ratio (HR) for lung cancer mortality in the Canadian population is 1.127 (95% CI: 1.085, 1.170) per 10 µg/m3 increase in long-term exposure to ambient PM2.5. The slope coefficient (β) for this relationship is 0.01196, as derived below:

$$e^{(\beta\times 10\ \mu g/m^3)} = pooled\ hazard\ ratio\ per\ 10\ \mu g/m^3$$

$$e^{(\beta\times 10\ \mu g/m^3)} = 1.127$$

$$\beta \times 10\ \mu g/m^3 = \ln 1.127$$

$$\beta = (\ln 1.127)/(10\ \mu g/m^3)$$

$$\beta = 0.01196$$

The additional lung cancer mortality (over the baseline rate) from PM2.5 derived from a given source can be determined using the equation below, based on the attributable fraction or (HR-1)/HR (Greco et al. 2020):

$$ALCM = \left[{(e^{\beta \cdot Exposure} - 1)}\Big/{e^{\beta \cdot Exposure}} \right] \cdot Baseline\ rate \cdot Years$$

ALCM = additional lung cancer mortality cases per 100,000 population

β = 0.01196 (slope coefficient from meta-analysis in Health Canada (2022))

Exposure = estimated PM2.5 exposure concentration from the relevant source(s) (µg/m3) (does not include baseline PM2.5 exposure)
Baseline rate = 45.5 per 100,000 (current Canadian Age Standardized Mortality Rate (ASMR) for lung cancer from Canadian Cancer Statistics Advisory Committee 2021); the Canadian baseline rate is appropriate as the slope coefficient was derived from Canada-wide studies and an updated ASMR of Canada (if available) would be appropriate for use in the calculation

Years = years of project or project phase

Sample calculation:

Project estimates an exposure from relevant source(s) of 0.067 µg/m3 over 50 years of operation

$$ALCM = \left[\left(e^{\beta \cdot Exposure} - 1\right) / e^{\beta \cdot Exposure} \right] \cdot Baseline\ rate \cdot Years$$

$$ALCM = \left[\left(e^{0.01196 \cdot 0.067} - 1\right) / e^{0.01196 \cdot 0.067} \right] \cdot 45.5 \cdot 50$$

ALCM = 1.8 additional lung cancer mortality cases per 100,000

References:

[1] Canadian Cancer Statistics Advisory Committee in collaboration with the Canadian Cancer Society, Statistics Canada and the Public Health Agency of Canada. Canadian Cancer Statistics 2021. Toronto, ON: Canadian Cancer Society; 2021. Available at: cancer.ca/Canadian-Cancer-Statistics-2021-EN
[2] Greco, S.L., MacIntyre, E., Young, S. et al. An approach to estimating the environmental burden of cancer from known and probable carcinogens: application to Ontario, Canada. BMC Public Health 20, 1017 (2020). https://doi.org/10.1186/s12889-020-08771-w
[3] Health Canada. Lung cancer and ambient PM2.5 in Canada: a systematic review and meta-analysis.
[4] Health Canada, 2022. Available online at: https://publications.gc.ca/site/eng/9.907038/publication.html

October 29. 2024

Sarah Benson
Environmental and Regulatory Manager
Denison Mines Corp.
345 4th Avenue South
Saskatoon, SK, S7K 1N3

RE: Denison Wheeler 2024 Replicate Bat Surveys

Dear, Ms. Benson,

As per your request, please see the following brief summary of the 2019 and 2024 bat echolocation bat surveys.

Acoustic Bat Surveys

Acoustic bat surveys were completed to determine the presence/non-absence, diversity and relative abundance of bat species in the Wheeler River Project area during baseline surveys in 2019 and again using replicate surveys in 2024. Acoustic surveys measure bat passes and feeding buzzes.

Methods

Surveys commenced one half hour after sunset and ended one half hour before sunrise. Survey stations were established 500 m apart along linear features where safe night travel was possible. Surveys were only completed during appropriate weather conditions (e.g., wind and temperature), with weather attributes (temperature, sky condition and wind (Beaufort scale)) recorded throughout the survey.

Each survey site consisted of a five-minute listening period using a Wildlife Acoustics Echo Meter Touch 2 Pro. The detector was held with the microphone at a 45 degree angle and slowly rotated 360 degrees for the duration of the sampling period. If a bat was detected, the detector was held stationary for 15 seconds to avoid duplicate counts.

Surveys were completed three times, once in 2019, and twice in 2024 to capture variations between and within seasons.

Total detector hours were calculated for the Project area and by ecosite/vegetation cover type. Ecosite/vegetation cover type for each survey point was established by utilizing the dominate ecosite/vegetation cover type within a 50 m radius of the survey point.

Acoustic Bat Call Analysis

Data was analyzed using Wildlife Acoustics Kaleidoscope software. Echolocation call characteristics were used to identify bat species. Call characteristics used to establish species included:

- Minimum frequency.
- Maximum frequency.
- Call duration.
- Call slope.
- Call shape.

Call characteristics were compared to reference calls in literature and call libraries (WDNR 2016, WDNN 2016, Keinath 2011, Adams 2003). In addition, reference calls within Omnia's call library were used where possible.

Results

Passive acoustic bat surveys were complete across the Project area on three occasions:

- July 22 - 23, 2019.
- June 18 – 22, 2024.
- July 26 – 28, 2024.

During each survey 61 acoustic bat survey locations were surveyed for 305 minutes per survey (915 minutes total). Of the 61 survey locations established in 2019, three had to be relocated in 2024 due to access limitations (Figure 1), the relocated survey locations were in the same habitat types as the original locations. Four bat species or species groups were detected during the survey, little brown myotis (*Myotis lucifugus*), little brown myotis/northern myotis (*M. septentrionalis*), hoary bat (*Lasiurus cinereus*), and western small-footed bat (*M. ciliolabrum*).

In the July 2019 survey, bat species or species group were detected in 30% (18/61) of survey locations at a rate of 3.5 echolocation observations per hour. Feeding buzzes were detected in 3% (2/61) of survey locations at a rate of 0.4 feeding buzzes per hour.

No bat detections were recorded in the June 2024 survey. Temperatures were cooler but we cannot confirm why not bats were detected.

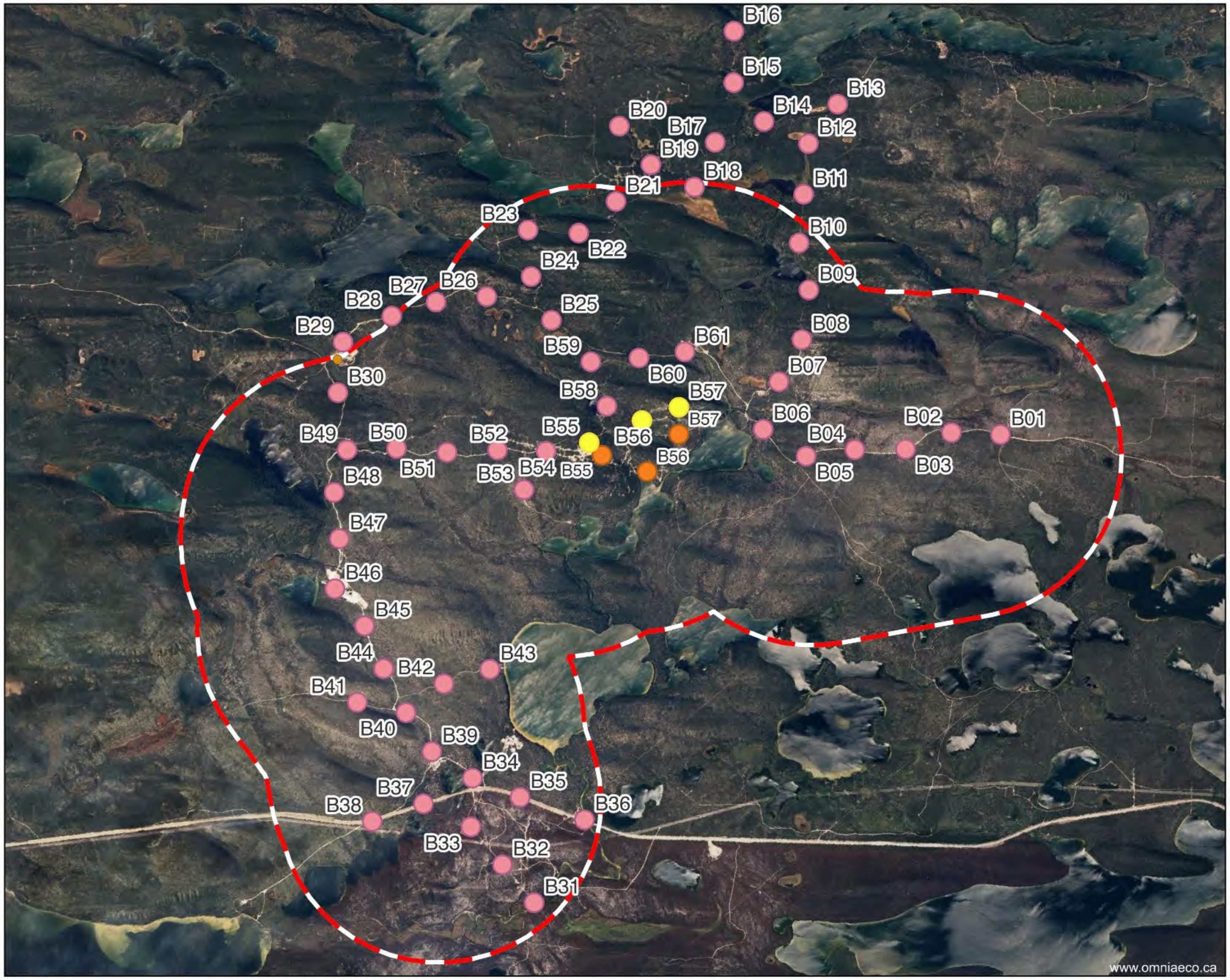
In the July 2024 survey, bat species or species group were detected in 8% (5/61) of survey locations at a rate of 3.5 echolocation observations per hour. No feeding buzzes were detected in the July 2024 survey.

Six different mapped ecosites were sampled during the passive bat acoustic surveys. The most sampled ecosites/vegetation cover types were RF2 (regenerating forest – tall shrub dominated) (2.17hrs), BS3 (jack pine/blueberry/lichen) (2.17 hrs), and anthropogenic (polygonal and linear disturbance) (0.42 hrs). Three survey locations completed in BS3 in 2019 (locations #31 to 33) were affected by the 2023 fire. For 2024, these sites are mapped as RF3 (recent burn ecosite).

In the July 2019 survey, little brown myotis passes and feeding buzzes were most detected in the BS9 (black spruce – jack pine/feathermoss) ecosite at 72 passes/hr and 60 feeding buzzes/ hr respectively. It should be noted the sample size in this ecosite was limited. The BS3 ecosite hosted little brown myotis passes (5.5/hr) and feeding buzzes (0.9/hr) second most frequently. Little brown myotis/northern myotis passes were most frequently detected in the BS3 (3.7/hr) and anthropogenic (2.4/hr) ecosites. No feeding buzzes were detected for the little brown myotis/northern myotis group.

During the July 2024 survey, hoary bat detections were noted within the RF3, RF2, and BS3 (n=3). Little brown myotis were detected in BS3 (n=2), western small-footed bat was recorded in BS3 (n=2).

These results are not a surprise as variation within and across years is not unexpected.



Legend

Local Study Area (LSA)

Bat Survey Location

2019, 2024

2024

2019

0 1 2 3 km

Kilometres

OMNIA ECOLOGICAL SERVICES

Denison Wheeler River Project	
Acoustic Bat Surveys (2019 and 2024) Denison Wheeler River Project	
DATE OCTOBER 2024 Ver.1.01	**Figure 1**
PROVIDED BY Denison Mines	PROJECTION/DATUM UTM zone 13V NAD83
PROJECT ID 2404-05	CREATED BY HS / QA / QC: MC

Denison Mines

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November 13, 2024

Nana Kwamena
Canadian Nuclear Safety Commission
Government of Canada
280 Slater Street
Ottawa, ON K1P 5S9

Dear Ms. Kwamena,

Re: Wheeler River Project Federal Indigenous Review Round 4 Follow-up Clarifications for Information Requests 114 & 174

During a November 8, 2024 discussion between the Canadian Nuclear Safety Commission (CNSC) and Denison (Kwamena - Switzer), and a subsequent discussion between the CNSC and Denison (Way-England) on November 12, 2024, the CNSC requested further information on two of Denison's Round 4 responses. Specifically, the CNSC requested Denison clarify whether the responses to Information Request (IR) 114 and 174 would alter the conclusions of the assessment. Denison confirms that the information provided in the response to these two IRs did not change the conclusions of the Environmental Impact Statement (EIS).

The enclosed memo provides further clarification in support of Denison's determination. Minor updates that have been made to the final EIS (October 2024), as part of Denison's response to the aforementioned IRs, have been noted in the memo.

Kindly,

[redacted]

Janna Switzer
Vice President, Environment Sustainability & Regulatory
Denison Mines

Cc Jessica Way (CNSC)
Brianne England (Denison)

Wheeler River Project Environmental Impact Statement (EIS)
Round 4 Information Requests (IRs) 114 and 174 consideration of conclusions
November 13, 2024

IR-114

For reference, we note that the nature of IR-114 has changed over the two-year review period. Initially the primary focus of IR-114 concerned inclusion of Metal and Diamond Mining Effluent Regulations (MDMER) parameters, the use of baseline receiving environment concentrations to derive water quality thresholds, and data and analysis for mercury / methyl mercury. The use of the copper (Cu) federal environmental quality guideline (FEQG), that is now the focus of IR-114, was raised by the federal-Indigenous review team (FIRT) in the draft Round 4 comments received by Denison in September 2024.

In response to Round 4 IR comments, the EIS technical team updated the EIS (final EIS; October 2024) as described in the following bullet points. Discussion regarding the updates is also provided for context and clarity:

- The changes requested to **Section 8 Aquatic Environment** were made. This includes corrections/revisions to table footnotes, removal of MDMER effluent limits for arsenic and total suspended solids as short-term screening criteria, and the inclusion of the Cu FEQG in the assessment. The following is noted regarding the Cu FEQG in particular as this seemed to be the most salient issue raised in the IR, specifically related to the calculation of the Cu FEQG. At baseline and reference conditions, the FEQG was calculated to be 0.0002 mg/L. When evaluating results predicted during operations, the FEQG was calculated in consideration to the toxicity modifying influence of the effluent – that is, the FEQG was calculated using the BLM model in consideration of the effluent-induced hardness in the receiver and the value of 0.00098 mg/L was used. As noted in the Round 4 response to this IR, Denison and its SMEs believe it is relevant to consider all aspects of the receiving environment and this includes induced hardness since the scenario being evaluated only occurs during periods of effluent discharge. This approach is used in other jurisdictions (e.g., water licences in northern Canada issued through local water boards) and therefore the concept of utilizing induced toxicity modifiers, like hardness, that would be associated with the receiving environment is not unique.

  With the above in mind, the results show no exceedances of the adjust Cu water quality guideline as defined by the BLM derived FEQG in the operations phase during periods of effluent discharge. In consideration of this there is no rationale on which to change the conclusion of the EIS. Text has been added to the EIS documentation (see below regarding Appendix 10-A) that considers the FEQG reflecting baseline and reference conditions from a sensitivity analysis perspective which Denison and its SMEs believe is an appropriate treatment of the information. The sensitivity acknowledges the perceived increased risk to aquatic biota at the lower, baseline FEQG since the predicted copper concentration is greater than the FEQG; however, this sensitivity analysis does not require a change to the overall conclusions of the EIS.

- Additionally, the following is noted:
  - The Surface Water Quality valued component (VC) is an intermediate VC, where a change in an intermediate VC has the potential to result in an effect on a receptor VC and receptor VCs are generally biological or integrated assessment endpoints. Significance determination is not completed on intermediate VCs, but integrated into the residual effect evaluation, residual effect characterization, and significance determination for related receptor VCs.
  - If a water quality guideline is exceeded, this does not directly correspond to an effect on receptor VCs or a significant effect on a receptor VC. A close review of Section 8 residual effect analysis was conducted. This included a review of the ratings for residual effect characteristics: direction, magnitude, geographic extent, duration, frequency, reversibility, context, and likelihood for aquatic environment VCs. The information contained in the revised draft EIS was acceptable, and it was determined that no updates to the assessment conclusions were required with the inclusion of the Cu FEQG. While some additional risk to sensitive receptors is possible, the overall integrity of the VC populations within the aquatic regional study area is unlikely to be changed.
  - The assessment is conservative on many fronts, and one of the central issues with copper is that the analytical lab's detection limit for surface water sample was at the background FEQG of 0.0002 mg/L. Additional surface water sampling with a lower detection limit was initiated in 2024 and will provide a more accurate value for baseline copper concentrations. Denison's commitment to collect more water samples prior to construction and incorporate new water quality data into Denison's application for a licence to operate, along with updated effluent quality data, in outlined in commitment 8-48. The conceptual environmental sampling plan for aquatic environment VCs included in the EIS is at the appropriate level of detail needed at the environmental assessment (EA) stage and does not need to be updated because of this IR.
- **Appendix 8-E Constituent Concentrations and Mixing Zone Assessment Report** has been updated to be consistent with the revisions to Section 8 described above, e.g., updating table footnotes, removing MDMER effluent limits as short-term screening criteria for arsenic and total suspended solids, and including the copper FEQG as appropriate.
- **Appendix 10-A Environmental Risk Assessment** a new section *6.2.4 Copper Aquatic Toxicity Reference Values* was added to Appendix 10-A, Section 6.2 Sensitivity Analysis. The content of this new section is effectively the information provided to the CNSC in Attachment IR-114 Round 4.

IR-174

For reference the following is noted with respect to the chronology and evolution of IR-174 for context. This IR was “not accepted” in the draft, Round 4 IRs provided to Denison in September; however, in the October 2024 version of the Round 4 IRs, this IR was deemed to be "under discussion.”

Despite this change in status, Denison nevertheless included a detailed response to IR-174 in the October 18, 2024, IR response package to address the specific comments contained in the draft IR-174 Round 4.

As part of Denison’s response to this Round 4 IR, clarification on data provided in the baseline bat detection map legend was provided and this was updated in the final EIS (October 2024) in Figure 2.9 of Appendix 9-F, methodology for future pre-construction baseline bat survey was provided, and commitment 9-37 was updated as requested.

The results of bat surveys (acoustic) completed in 2024 were provided to the CNSC (OMNIA memo dated October 29, 2024). Four bat species or species groups were detected during the surveys: little brown myotis (*Myotis lucifugus*), northern myotis (*M. septentrionalis*), hoary bat (*Lasiurus cinereus*), and western small-footed bat (*M. ciliolabrum*). Hoary bat and western small-footed bats were not detected during the 2019 acoustic survey.

The detection of different or additional bat species has no implications on the EIS baseline report (Appendix 9-B). The baseline report is an inventory of species detected during the focused surveys completed to support the EIS and reflects the information gathered to the date of publication; the OMNIA memo included with the IR response is now part of the EIS record and therefore the record includes documentation of all species encountered. The assessment and conclusions surrounding bat species in Appendix 9-D are unchanged in consideration of the results of the 2024 acoustic surveys and the reasoning for this is discussed below.

The assessment provided for bat species focussed on bat species at risk (SAR) including northern myotis and little brown myotis. The assessment is provided in Appendix 9-D and follows an accepted habitat-based assessment. The information provided in Appendix 9-D includes a summary of the life history requirements, the expected Project effects, proposed mitigation measures (including project design measures, general mitigations for wildlife SAR, and species-specific measures for bat species), and anticipated residual effects on those species. Since the hoary and western small-footed bats occupy the same ecological niche and have similar life histories to northern myotis and little brown myotis, the information provided in Appendix 9-D applies equally to them (and all bat species with similar life histories and niche requirements), including the conclusions of the assessment. With that in mind, Denison and its SMEs do not have a rationale to alter the EIS conclusions in this regard.

The above rationale is consistent with typical EA practice. The EIS was not designed to include an assessment of every species that has been detected at a given Project site, nor is such an assessment necessary considering the EA methodology used for the EIS. Scoping is completed to focus the assessment on key VCs, and this is considered EA best practice. This approach is outlined in within the EIS documentation, including Section 5 Approach and Methodology of the Assessment and Section 9 Terrestrial Environment.

November 19, 2024

Wheeler River Project Environmental Impact Statement Review

Denison's Response to the CNSC's November 14, 2024 comment Round 5 IR-114

CNSC Round 5 IR-114 comment

1. Update EA commitment 8-47 to include a linkage to IR-114 to ensure that additional sampling for alkalinity and nitrate will be conducted prior to construction activities as supporting information for IR-114, as indicated by Denison in their Round 4 responses.
2. Provide an updated Table 8.2-13 for review incorporating the correct short- and long-term benchmark values of 0.00011 mg/L and 0.00004 mg/L respectively, for Cadmium.
3. Provide an update to the ERA risk conclusions to remove reference to utilizing an "induced hardness" scenario calculating a copper FEQG with effluent concentrations of hardness (i.e. 250 mg/L) rather than the maximum predicted receiving environment concentrations of hardness (i.e. 9 mg/L as per EIS Table 8.2-10) as rationale for risk to receptors.
4. Confirm, in light of this new information, with appropriate justification, whether the EA predictions and conclusions remain valid, and whether the proposed mitigation measures remain adequate.
5. Make a commitment to assess and minimize copper concentrations in effluent through the BATEA assessment during licensing.

Denison's response – to be considered in conjunction with the IR-114 responses provided to the CNSC on October 18, 2024 and November 13, 2024

1. *Note: commitment 8-47 was a commitment related to wetlands*. Commitment 8-48 has been updated in commitments register version 4 as shown here in track changes:

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
			methylmercury, and other relevant COPCs such as lead, arsenic, and cadmium as part of the constituents monitored in fish throughout all project phases.				
8-45	Water Quality / Project Description	1	Denison is committed to investigating BATEA and working with the province and CNSC to ensure discharge concentrations of all constituents including uranium are protective of the aquatic environment.	IR-18	All phases	Engineering Design; EMS; EA Follow-up Program	Regulatory Requirement
8-46	Wetlands / Fish Habitat	1	To further supplement existing information that exists for the LSA wetlands, Denison is committed to undertaking wetland surveys including the collection of water quality, sediment quality, benthic invertebrates and fish and fish habitat surveys prior to the construction to provide an updated baseline for assessing the success of mitigation measures and to assess potential effects of the project on wetlands. These locations will then be further considered as part of the EMP for continued monitoring for these media and biota.	IR-101, Appendix 8-F	All phases	Engineering Design; EMS; EA Follow-up Program	FUP Requirement
8-47	Wetlands/Fish Habitat	1	Wherever possible, wetlands will be avoided through Project design and instituting proper buffers.	IR-101, Section 8.3.5, Appendix 8-F	All phases	Engineering Design	Regulatory Requirement
8-48	Water Quality	4~~2~~	Denison is in agreement that regular water quality data collection should be instituted and commits to beginning such periodic sampling prior to construction to provide a more robust dataset and following the CCME Guidance Manual for Optimizing Water Quality Monitoring Program Design (2015). Sampling will be conducted monthly during the open water period and twice under ice and will include analysis for alkalinity and nitrate. Any new water quality data will be integrated into Denison's application for a licence to operate, along with updated effluent quality data.	IR-107, IR-114	Prior to Construction	EA Follow-up	FUP Commitment
			Denison has committed to a pre-operational EEM study and will conduct that study in accordance with				

2. Excerpt of Final EIS (October 2024) Table 8.2-13 for the CNSC's review of cadmium screening criteria:

Table 8.2-13: Maximum Concentration of Surface Water Constituents of Potential Concern in Surface Water

Constituent	Unit	Kratchkowsky Lake (LA-7)	Whitefish Lake North (LA-6)	Whitefish Lake Middle (LA-5 North)	Whitefish Lake South (LA-5 South)	McGowan Lake (LA-1)	Icelander River	Russell Lake Inlet	Short-term Benchmark			Long-term Benchmark		
									Value	Reference	Notes	Value	Reference	Notes
Alkalinity	mg/L	NE	NE	12.4	12.4	NE	NE	NE						
Aluminum	mg/L	0.01766	0.01616	0.01835	0.02226	0.01500	0.01499	0.01614				0.1	SEQG/ CCME	(1)
Ammonia (as N)	mg/L	0.01463	0.01463	0.05232	0.05215	0.03978	0.0395	0.03368				5.74	SEQG /CCME	(2)
Un-ionized Ammonia	mg/L	0.0000086	0.0000086	0.000030 9	0.000030 8	0.0000235	0.0000233	0.0000199				0.019	SEQG/ CCME	
Arsenic	mg/L	0.00012	0.00011	0.00015	0.00015	0.00013	0.00013	0.00012				0.005	SEQG/ CCME	
Cadmium	mg/L	0.000024	0.000023	0.00004	0.000039	0.000033	0.000033	0.00003	0.00011	CCME	(3)	0.00004	SEQG/ CCME	

(3) Cadmium criteria based on water hardness of >0 to <5.3 mg/L (Site-specific background hardness is 5.26 mg/L [95th percentile of LA-5 and LA-6]).

3. and 4.

Baseline conditions for the Wheeler River include a background hardness of 5.26 mg/L, DOC of 2.24 mg/L, and pH of 6.61 (95th percentile of LA-5 and LA-6). Using ECCC's Biotic Ligand Model for copper, the calculated HC_5 is below 0.0002 mg/L, however, 0.0002 mg/L is considered by the FEQG to be the lowest concentration routinely measured and therefore replaces the calculated HC_5 value for this water chemistry. Therefore, at baseline conditions the FEQG is 0.0002 mg/L. Table 3-1, Table 3-3, and Table 3-5 of the ERA (Appendix 10-A) were updated to include the copper FEQG of 0.0002 mg/L as the screening criterion.

As identified in Section 5.3.1.1 of the ERA (Appendix 10-A), toxicity reference values (TRVs) for copper were obtained from the USEPA Ecotoxicology Database (ECOTOX) for aquatic organisms. The selected TRVs were 20% Effect Concentrations (i.e., EC_{20} values), which are concentrations at which only 20% of the test organisms respond. The TRVs are shown in Table IR-114-1 below. Where the TRVs derived from ECOTOX were lower than the CCME guideline the CCME guideline was selected.

Table IR-114-1: Copper Toxicity Reference Values Used for Aquatic Organisms in the ERA

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Copper	Forage fish	0.002	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=237)	ECOTOX
	Predator fish	0.003	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=89)	ECOTOX
	Zooplankton	*0.002*	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=117)	ECOTOX; CCME
	Benthic invertebrates	*0.002*	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=264)	ECOTOX; CCME
	Phytoplankton	0.0092	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=101)	ECOTOX
	Aquatic plants	0.038	mg/L	5th percentile of estimated chronic EC_{20} distribution (n=28)	ECOTOX

As requested in IR-114, the TRVs have been re-evaluated using the FEQG and the BLM. The BLM was run based on baseline site-specific conditions. The test species and concentrations identified as used to generate the BLM were evaluated to develop TRVs for the applicable biotic groups. The most restrictive effect concentration for each biotic group was identified. The test endpoint was either an EC_{10} or an IC_{10}. Based on the protocol identified in Table 5-11 of the ERA, the EC_{10} (or IC_{10}) was multiplied by 2 to obtain an EC_{20}, which was then utilized as the TRV. A summary of the TRVs for baseline conditions is identified in Table IR-114-2.

Considering that while the facility is in operation it is expected that hardness in the receiving environment will increase to approximately 9 mg/L and pH will increase to approximately 7, the BLM was re-run under updated site conditions and the TRVs were re-evaluated based on the test species and concentrations used to generate the BLM. The copper TRVs under site conditions are presented in Table IR-114-3.

Table IR-114-2: Copper Toxicity Reference Values from Baseline Conditions BLM

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Copper	Forage fish	0.0052	mg/L	Fathead minnow, growth (IC_{10} = 0.0026 mg/L)	FEQG BLM
	Predator fish	0.0008	mg/L	White sturgeon, growth (EC_{10} = 0.0004 mg/L)	FEQG BLM
	Zooplankton	0.0009	mg/L	Daphnia magna, reproduction (EC_{10} = 0.0004 mg/L)	FEQG BLM
	Benthic invertebrates	0.0004	mg/L	Pond snail, growth (EC_{10} = 0.0002 mg/L)	FEQG BLM
	Phytoplankton	0.0091	mg/L	Rotifer, intrinsic (EC_{10} = 0.0046 mg/L)	FEQG BLM
	Aquatic plants	0.0212	mg/L	Duckweed, root length (EC_{10} = 0.01 mg/L)	FEQG BLM

Notes:

BLM based on hardness of 5.26 mg/L, DOC of 2.24 mg/L, pH of 6.61, temperature of 13°C.
TRV is an EC_{20}, adjusted from an EC_{10} or IC_{10}.

Table IR-114-3: Copper Toxicity Reference Values from Site Conditions BLM

COPC	Biotic Group	TRV	Unit	Rationale	Data Source
Copper	Forage fish	0.01	mg/L	Fathead minnow, growth (IC_{10} = 0.005 mg/L)	FEQG BLM
	Predator fish	0.002	mg/L	White sturgeon, growth (EC_{10} = 0.001 mg/L)	FEQG BLM
	Zooplankton	0.002	mg/L	Daphnia magna, reproduction (EC_{10} = 0.001 mg/L)	FEQG BLM
	Benthic invertebrates	0.001	mg/L	Pond snail, growth (EC_{10} = 0.0005 mg/L)	FEQG BLM
	Phytoplankton	0.017	mg/L	Rotifer, intrinsic (EC_{10} = 0.009 mg/L)	FEQG BLM
	Aquatic plants	0.015	mg/L	Duckweed, root length (EC_{10} = 0.008 mg/L)	FEQG BLM

Notes:
BLM based on hardness of 9 mg/L, DOC of 2.24 mg/L, pH of 7, temperature of 13°C.
TRV is an EC_{20}, adjusted from an EC_{10} or IC_{10}.

The hazard quotients (HQs) for aquatic organisms were re-evaluated using both sets of TRVs, baseline conditions and site conditions during operation where hardness and pH are increased (Table IR-114-4). Consistent with Section 5.4.1 of the ERA (Appendix 10-A) an HQ less than or equal to 1 suggests low risk to the ecological receptor, and an HQ above 1 needs further investigation to determine if adverse effects are possible. Conservatively using baseline conditions, HQs for all aquatic organisms are less than 1 with the exception of predator fish in Whitefish Lake, and benthic invertebrates at all locations where HQs are slightly above 1. As such, further consideration was given to changes in site conditions when the facility is in operation. Using more realistic site conditions for hardness and pH, HQs for all aquatic organisms are less than 1 at all downstream locations, indicating no adverse effects to aquatic organisms from facility related copper. It is relevant to consider all aspects of the receiving environment and this includes induced hardness and pH since the scenario being evaluated only occurs during periods of effluent discharge. This approach is used in other jurisdictions (e.g., water licences in northern Canada issued through local water boards) and therefore the concept of induced hardness is not unique.

The copper predictions in the ERA are considered conservative based on the following assumptions:

- Baseline concentrations of copper are predominantly below the detection limit, indicating that baseline concentrations of copper are likely overestimated in the ERA.
- The effluent predictions in the ERA are based on available information from test studies at the time the ERA was prepared. Denison will be refining the effluent quality through the BATEA assessment and licensing process.
- Based on the effluent quality and quantity released to Whitefish Lake, the maximum copper concentration in Whitefish Lake and downstream waterbodies was evaluated as part of the HQ. This is a conservative assumption.
- Once the facility is operational, site conditions will change which includes increased hardness and pH; therefore, the predicated HQs under baseline conditions are considered conservative and overestimate risk.

Denison is in the process of collecting additional baseline water quality data which will be used in future ERA iterations to reconsider the baseline copper concentration in the Wheeler River. The ERA is a living document that will continue to be updated at defined intervals and will integrate new data when it is available. Denison has also committed to an ongoing environmental monitoring program which will be used to determine if there are any adverse effects to aquatic organisms from copper and other constituents of potential concern.

Table IR-114-4: Re-Evaluated Hazard Quotients for Copper in Aquatic Organisms

Location	Maximum Copper Concentration in Water (mg/L)	Hazard Quotients (unitless) – Baseline Conditions						Hazard Quotients (unitless) – Site Operation Conditions					
		Forage Fish	Predator Fish	Zooplankton	Benthic Invertebrate	Phyto-plankton	Aquatic Plants	Forage Fish	Predator Fish	Zooplankton	Benthic Invertebrate	Phytoplankton	Aquatic Plants
Kratchkowsky Lake (reference) [1]	6.22E-04	0.12	0.80	0.70	**1.49**	0.07	0.03	0.12	0.80	0.70	**1.49**	0.07	0.03
Whitefish Lake North	6.20E-04	0.12	0.80	0.70	**1.49**	0.07	0.03	0.06	0.34	0.30	0.63	0.04	0.04
Whitefish Lake Middle	8.22E-04	0.16	**1.06**	0.93	**1.97**	0.09	0.04	0.08	0.46	0.40	0.84	0.05	0.05
Whitefish Lake South	8.17E-04	0.16	**1.05**	0.92	**1.96**	0.09	0.04	0.08	0.45	0.40	0.83	0.05	0.05
McGowan Lake	7.50E-04	0.14	0.97	0.85	**1.80**	0.08	0.04	0.07	0.42	0.37	0.76	0.04	0.05
Icelander River	7.49E-04	0.14	0.97	0.84	**1.80**	0.08	0.04	0.07	0.42	0.37	0.76	0.04	0.05
Russell Lake Inlet	7.17E-04	0.14	0.92	0.81	**1.72**	0.08	0.03	0.14	0.92	0.81	0.73	0.08	0.03

Note:
Bold and shaded value indicates hazard quotient greater than 1.
[1] Kratchkowsky Lake is a reference lake located upstream of the effluent discharge point, and as such, the site operation conditions were the same as baseline conditions.

In the Aquatic Environment section of the EIS (Section 8), the effects assessment is completed for aquatic VCs. To address the CNSC's concerns and to recognize the Cu FEQG in consideration of hardness of 9 mg/L, pH of 7, and DOC of 2.24 the BLM is 0.0005 mg/L and the following updates have been made:

- Section 8.2 Water Quality – long-term copper guideline presented is FEQG 0.0002 mg/L under background conditions in the nearfield model and 0.0005 mg/L under expected conditions of hardness 9 mg/L, pH of 7, and DOC of 2.24 in regional surface water quality results and discussion.
- Section 8.3 Fish and Fish Habitat – with the inclusion of Cu FEQG under expected conditions of hardness 9 mg/L, pH of 7, and DOC of 2.24 and some exceedances of this guideline in water quality section, the assessment for benthic invertebrates recognizes this slight increased risk by updating the magnitude for the characteristics ratings in relation to water quality from low to moderate.
- Section 8.5 Fish Health - with the inclusion of Cu FEQG under expected conditions of hardness 9 mg/L, pH of 7, and DOC of 2.24 and some exceedances of this guideline in water quality section, the assessment for fish health recognizes this slight increased risk by updating the magnitude for the characteristics ratings in relation to water quality from low to moderate.

Overall, we have updated Section 8 to recognize that while some additional risk to sensitive receptors is possible in consideration of the Cu FEQG without hardness mediation, the overall conclusions are unchanged. The residual effects of the Project are not expected to result in a change to the viability and persistence of aquatic VCs and associated KIs and were, therefore, predicted to be not significant.

The ERA was conservative in a number of ways in relation to copper, including:

- baseline concentrations of copper in water are predominantly below the detection limit (<0.0002 mg/L), indicating that baseline concentrations of copper are likely overestimated in the ERA.
- The IMPACT model predicts how constituents travel through the environment and concentrations of constituents change as a result of interactions with natural flows and lake sediments. The Kds applied in the model have largely over predicted the baseline sediment copper concentrations throughout the lakes demonstrating that the model and model inputs are conservative.
- in the EIS, copper concentrations in effluent represented an upper bound; Denison is confident the actual effluent quality will be within the range of what was assessed and specifically, lower than what was used in the EIS, and the maximum copper concentration in Whitefish Lake and downstream waterbodies was evaluated as part of the HQ.

Monitoring programs will be implemented to assess the environmental performance of the Project relative to the predictive assessment that has been completed in support of the EA process. Such monitoring is needed since there is always some level of uncertainty associated with EA predictions. Effluent, water, and sediment sampling will be completed to verify the accuracy of the effects and effectiveness of proposed mitigation measures. Copper is included in planned monitoring as it is a deleterious substance under MDMER and must be monitored in effluent per MDMER Schedule 4 and is included in trace metal analysis for water and sediment samples. As such, there are no changes needed to the monitoring proposed in the EIS.

As part of commitment 8-48, Denison is collecting baseline water quality data which includes a lower detection limit for metals including copper. Any new water quality data will be integrated into Denison's application for a licence to operate, along with updated effluent quality data. The following, recent information is provided as background context for the CNSC's review of this IR response:

- Initial 2024 results in Whitefish Lake show that copper is typically less than the new, lower detection limit of 0.00007 mg/L.
- We also note that information provided by Denison to the CNSC (November 1, 2024 Nagel to Gorzkowski) shows that copper in effluent is expected to be 0.0042 mg/L which is 5 times lower than the copper concentration in effluent used in the EIS (0.022 mg/L).

5. A new commitment (8-53) has been added to commitment register version 4 as shown here in track changes:

Denison Mines

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
8-53	Water Quality	4	Denison will assess and minimize copper concentrations in effluent through the BATEA assessment during licensing	IR-114 (Nov 2024)	Prior to Operation	EMS; EA Follow-up	Regulatory Requirement

Denison Mines

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November 22, 2024

Jessica Way
Environmental Review Specialist
Canadian Nuclear Safety Commission
Via email: Jessica.way@cnsc-ccsn.gc.ca

Re: Submission of the Final Environmental Impact Statement for the Denison Mines Corp Wheeler River Uranium Mine under the *Canadian Environmental Assessment Act, 2012*

Dear Jessica Way:

As you are aware, the environmental assessment for the Denison Mines Corp (Denison) Wheeler River Uranium Project (the Project) was initiated in 2019, with submission of the draft environmental impact statement in October 2022.

On November 21, 2024, the Canadian Nuclear Safety Commission (CNSC) provided notice that Denison had resolved all information requests from the Federal-Indigenous Review Team, concluding the technical review for the Project under the *Canadian Environmental Assessment Act, 2012*. The notice allows Denison to submit the final environmental impact statement (EIS) for CNSC review and acceptance.

Denison is pleased to provide the final EIS to CNSC, which is enclosed with this letter. Denison confirms that all requested revisions and updates to the EIS resulting from the technical review were completed in a comprehensive and detail-oriented manner.

Along with the final EIS, the following files are included for CNSC review and acceptance:

1. Commitments Register Version 4,
2. Indigenous Engagement Report (updated to October 31, 2024), and
3. Public Comments Table.

Should you have further questions about this, please do not hesitate to contact me at bengland@denisonmines.com.

Sincerely,

Brianne England
Regulatory Manager

Cc: David Cates, Janna Switzer, Carolanne Inglis-McQuay (Denison)
Nana Kwamena, Rain Noakes, Ryan Froess (CNSC)
Candace Piper, Jeff Dereniwski (Saskatchewan Ministry of Environment)

Wheeler River Project

Public Notice: Acceptance of Final EIS for the Wheeler River Project

December 24, 2024: The Canadian Nuclear Safety Commission (CNSC) has accepted the final Environmental Impact Statement (EIS) for the proposed Wheeler River Project, submitted by Denison Mines Ltd. (Denison). This acceptance follows a comprehensive EIS technical review process by the Federal Indigenous Review Team (FIRT), including consultations with Indigenous Nations and communities and members of the public. CNSC staff will now proceed with the preparation of the *Canadian Environmental Assessment Act, 2012* Environmental Assessment (EA) Report, which will be made available, along with a Commission Member Document, for review by Indigenous Nations and communities and the public prior to a public Commission hearing.

The following documents have now been posted:

- Letter: CNSC to Denison - Wheeler Project - Acceptance of the Final EIS and Supporting Documents
- Final environmental Impact Statement
- Combined Final EIS Appendices
- Commitments Register Version 5 - Wheeler River Final EIS Submission

With these conclusions, along with the sufficient licence application, CNSC staff will notify CNSC Commission Registrar of this acceptance, who will proceed with scheduling public hearing dates. Further details regarding how to participate will be provided once the Commission Secretariat has announced the hearing dates. In early January, notifications will be sent to Indigenous Nations and communities with detailed next steps in the consultation process.

Document reference number: 201

Date modified: 2024-12-24

e-Doc 7421144

December 24, 2024

Brianne England
Regulatory Manager
Denison Mines Corp.
bengland@denisonmines.com

Subject: Wheeler River Project– Acceptance of the Final EIS and Supporting Documents

Dear Ms. England,

On December 24, 2024, CNSC staff completed their review of Denison's submission of the final Environmental Impact Statement (EIS) for the proposed Wheeler River Project. CNSC staff have determined that the information provided in Denison's submission is complete and, as such, the final EIS has been deemed acceptable. CNSC staff will proceed with the preparation of the *Canadian Environmental Assessment Act, 2012* Environmental Assessment Report, which will be made available for review by Indigenous Nations and communities and the public prior to a public Commission hearing.

The Final EIS will soon be posted to the Canadian Impact Assessment Registry. This will include this conclusion letter and Denison's responses to comments from Indigenous Nations and communities and members of the public, the updated Indigenous Engagement Report (IER), and all other supporting documents. CNSC has also provided responses to comments directed to the regulator and will post these responses in the new year, as these are shared with commenters.

With these conclusions, along with the sufficient licence application, CNSC staff will notify CNSC Commission Registrar of this acceptance, who will proceed with scheduling public hearing dates. Further details regarding how to participate will be provided once the Commission Secretariat has announced the hearing dates.

CNSC reminds Denison that when the next version of the IER is submitted for the Commission Hearing, *Appendix A Key Engagement with Indigenous Nations and communities* is expected to be fully updated within two months of the submission date.

Sincerely,

-Original Signed By-

Jessica Way
Environmental Review Officer
Environmental Review Division

c.c.: CNSC: D. Beaton, L. Sigouin, N. Kwamena, N. Frigault, P. Burton, A. Levine, K. Gorzkowski, B. Duhaime, R. Froess, R. Noakes
Denison: K. Himbeault, J. Switzer, C. Inglis-McQuay, R. Nagel

Wheeler River Project

Public Notice: Participant funding for Denison's Wheeler River Project

This participant funding opportunity is open from February 3 to April 4, 2025. For details on how to apply, please see the original posting here: Participant funding for Denison's Wheeler River Project

Participant funding notice

The Canadian Nuclear Safety Commission (CNSC) is offering participant funding to assist Indigenous Nations and communities, members of the public and interested parties in reviewing the environmental assessment (EA) and licence application for Denison's Wheeler River Project and in participating in a future Commission hearing process. This is the second opportunity to apply for participant funding for the Wheeler River Project. The Commission has not yet announced any details, such as date or location, for a hearing on Denison's application. For more information on the earlier Wheeler River funding opportunity, please see the previous participant funding notice.

Denison is proposing to develop an *in situ* recovery uranium mining and processing operation located in the Athabasca Basin in northern Saskatchewan, approximately 600 km north of the city of Saskatoon, 4 km west of Highway 914, and midway between Cameco Corporation's Key Lake Mill and McArthur River Mine. The proposed Wheeler River mine would produce up to 12 million pounds of uranium concentrate (U_3O_8) annually for 15 years. Under the Nuclear Safety and Control Act, Denison's proposal requires CNSC authorization, which must include an EA decision under the *Canadian Environmental Assessment Act, 2012* affirming that the proposed activities will not cause significant adverse environmental effects, followed by a licensing decision.

For further details on Denison's proposal and the EA process, please see the Canadian Impact Assessment Registry. The date and location of associated , as well as information on how the public will be invited to participate in them, will be announced at a later date in a notice of public hearing.

Up to **$250,000** in participant funding will be **disbursed among all** successful applicants. Funding will be awarded for the review of documentation, including the EA report and CNSC staff's and Denison's Commission member documents, and for participation in associated and yet-to-be-announced public Commission hearings, where applicants will be given the opportunity to provide new, distinctive and valuable information through informed and topic-specific interventions to the Commission.

Document reference number: 204

Date modified: 2025-02-03

Wheeler River Project

Public Notice: Notice of Public hearing

March 6, 2025 - On February 27, 2025, the Canadian Nuclear Safety Commission (CNSC) announced hearing dates for a public hearing on Denison Mines Corporation's licence application to prepare a site for and construct its Wheeler River mine and mill project. The hearing will also consider the Environmental Assessment, under the *Canadian Environmental Assessment Act,* 2012.

Hearing details:

Part 1:

- Date: October 8, 2025
- Place: To be determined (National Capital Region and/or virtually via zoom)

- Time: As set by the agenda to be published prior to the hearing date Date

Part 2:

- Date: Week of December 8, 2025
- Place: To be determined (Saskatoon)
- Time: As set by the agenda to be published prior to the hearing date

More information can be found in the CNSC's public notice here: https://api.cnsc-ccsn.gc.ca/dms/digital-medias/Notice-of-Public-Hearing-and-Participant-Funding-2025-H-09.pdf/object

Document reference number: 205

Date modified: 2025-03-06

Notice of Public Hearing and Participant Funding

February 27, 2025   Ref. 2025-H-09

CNSC to conduct public hearing on Denison Mines Corporation's licence application to prepare a site for and construct its Wheeler River mine and mill project

The Canadian Nuclear Safety Commission (CNSC) will hold a public hearing to consider an application from Denison Mines Corp. (Denison) for a licence to prepare a site for and construct its Wheeler River mine and mill project. Denison is proposing to develop an *in situ* recovery uranium mining and processing operation located in the Athabasca Basin in northern Saskatchewan, approximately 600 km north of the city of Saskatoon. The proposed project is located within Treaty 10 territory, the homeland of the Métis, and within the traditional territories of the Dene, Cree, and Métis peoples. The property consists of 19 mineral claims totaling 11,720 hectares.

Purpose and scope of hearing

Pursuant to section 24 of the Nuclear Safety and Control Act, a licence issued by the Commission is required for the proposed site preparation and construction of the project. The proposed project is subject to an environmental assessment (EA) under the Canadian Environmental Assessment Act, 2012 (CEAA 2012). Although the Impact Assessment Act came into force in August 2019, replacing CEAA 2012, it includes provisions to allow ongoing projects with EAs initiated under CEAA 2012 to continue under their existing EA processes. As a prerequisite to the licensing decision, the Commission must also make an EA decision to determine whether the proposed project is likely to cause significant adverse environmental effects.

Hearing details

Date (Part 1):	**October 8, 2025**
Place:	To be determined (National Capital Region and/or virtually via zoom)
Time:	As set by the agenda to be published prior to the hearing date
Date (Part 2):	**Week of December 8, 2025**
Place:	To be determined (Saskatoon)
Time:	As set by the agenda to be published prior to the hearing date

The public hearing will be webcast live and available on the CNSC website at cnsc-ccsn.gc.ca. Additional details about the public hearing will be issued at a later date.

During Part 1 of the hearing, the Commission will consider oral and written submissions, related to Denison's application, from Denison and CNSC staff. During Part 2 of the hearing, the Commission will consider oral and written interventions from Indigenous Nations and communities, members of the public and other interested parties.

Denison's licence application is available on the CNSC website or on request to the Commission Registry. Denison's submission and CNSC staff's recommendations to be considered at the hearing will be available on the CNSC website, or on request to the Commission Registry, after August 12, 2025.

Participant funding

In advance of the public hearing, the CNSC is making available up to **$250,000** in funding through its Participant Funding Program. The purpose of this funding is to assist Indigenous Nations and communities, members of the public and interested parties in reviewing CNSC staff's and Denison's submissions to the Commission, as well as in participating in the hearing process by providing topic-specific interventions to the Commission. Participant funding applications must clearly demonstrate how the proposed submission will provide the Commission with information directly related to Denison's application. Please note that the $250,000 will be disbursed among all successful applicants. The deadline for submitting a completed participant funding application form is **April 4, 2025**. More information can be found at the following website: Participant funding for Denison's Wheeler River Project

Interventions

Pursuant to rule 19 of the Canadian Nuclear Safety Commission Rules of Procedure, persons who have an interest or expertise in this matter or information that may be useful to the Commission in coming to a decision are invited to comment on Denison's application. Requests to intervene must be filed with the Commission Registry by **October 24, 2025**, using the online request form, email, or the contact information below. **The request to intervene must include the following information:**

- a written submission of the comments to be presented to the Commission
- a statement setting out whether the requester wishes to intervene by way of written submission only, or by way of written submission and oral presentation
- the requester's name, address, telephone number and email address

Oral presenters who wish to use a PowerPoint presentation are asked to submit their slide decks to the Commission Registry by **November 24, 2025**. All submissions will be available for download on the CNSC website or on request to the Commission Registry. Personal information, such as email address and telephone number, is essential for linking the submission to its author. If you wish to ensure the confidentiality of your personal information, please submit it on a separate page.

Canada

Individuals who require Indigenous language interpretation for the hearing are asked to contact the Commission Registry by **September 10, 2025**, to request interpretation services. For any request received after this date, the Commission Registry will do its best to provide interpretation services.

Obligation for providing documentary material for the record

Under rule 15 of the Canadian Nuclear Safety Commission Rules of Procedure, any documentary evidence, written submission or other material filed with the Commission shall be open to the participants and the public (subject to any confidentiality measures taken by the Commission, as described below).

In order to provide a clear record of the information that is before the Commission, all participants should submit to the Commission Registry, along with their substantive submissions, any reference materials used to support their position. Reference materials must be directly appended to the submission or filed under separate cover, as appropriate, to be considered on the record. Items cited in and/or hyperlinked from the body of the main submissions but not filed will not be considered as part of the record and will not be taken into account in the Commission's deliberations.

Confidentiality

Under rule 12 of the Canadian Nuclear Safety Commission Rules of Procedure, the Commission can decide to take measures to protect confidential information. Persons considering filing information that may be confidential should contact the Commission Registry, before their submission deadline, for information on how to request that the Commission decide on whether to take measures to protect that information and what those measures should be.

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For further information on the public Commission hearing process, or on the licensee or the facility being considered in this matter, or to request documents, contact:

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Canadian Nuclear Safety Commission
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Addressing “Purpose of” and “Alternative Means” under the Canadian Environmental Assessment Act, 2012

This document provides guidance on federal environmental assessments commenced under the former *Canadian Environmental Assessment Act, 2012*. It is retained for the completion of transitional environmental assessments commenced prior to the *Impact Assessment Act*. For more information on transitional environmental assessments, please consult the Legislation and Regulations page.

Updated: March 2015

Document Information

Disclaimer

The Operational Policy Statement: Addressing “Purpose of” and “Alternative Means” under the *Canadian Environmental Assessment Act, 2012* is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA (Canadian Environmental

Assessment Act) 2012) or any of its regulations. In the event of any inconsistency between this guide and CEAA 2012 or regulations, CEAA (Canadian Environmental Assessment Act) 2012 or regulations would prevail.

For the most up-to-date versions of CEAA 2012 and regulations, please consult the Department of Justice website.

Updates

This document may be reviewed and updated periodically. To ensure that you have the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

This document is also available in Adobe's Portable Document Format [PDF (Adobe Acrobat document) - 716 KB (kilobytes)].

Purpose

The Operational Policy Statement (OPS (Operational Policy Statement)) aims to ensure that the CEAA (Canadian Environmental Assessment Act) 2012 requirements related to the purpose of a designated project and alternative means of carrying out the designated project are met in all environmental assessments (EAs (environmental assessments)) for which the Canadian Environmental Assessment Agency (the Agency) is the responsible authority.

The OPS (Operational Policy Statement) sets out the general requirements and approach to address the purpose of a designated project and alternative means of carrying out the designated project under CEAA (Canadian Environmental Assessment Act) 2012 when the Agency is the responsible authority.

The OPS (Operational Policy Statement) informs the preparation of directives by the responsible authorities, such as the Environmental Impact Statement (EIS (Environmental Impact Statement)) Guidelines. The OPS (Operational Policy Statement) serves as core guidance to project proponents. It provides direction to Agency employees in their interactions with those engaged in federal EA (environmental assessment), such as proponents, federal authorities, other jurisdictions, Aboriginal groups and the public, throughout the EA (environmental assessment) of a designated project.

Application

In the OPS (Operational Policy Statement), "project EA (environmental assessment)" means the EA (environmental assessment) of a designated project under CEAA (Canadian Environmental Assessment Act) 2012. Throughout the OPS (Operational Policy Statement), the term "environmental effects" refers to environmental effects as described in section 5 of CEAA (Canadian Environmental Assessment Act) 2012.

The OPS (Operational Policy Statement) should be used to inform the preparation of the EIS (Environmental Impact Statement) Guidelines and EIS (Environmental Impact Statement) for a designated project. It should be used in conjunction with other Agency policy and guidance instruments.

For application under CEAA (Canadian Environmental Assessment Act) 2012, this OPS (Operational Policy Statement) replaces the Agency's OPS (Operational Policy Statement) entitled, Addressing "Need for", "Purpose of", "Alternatives to" and "Alternative Means" under the *Canadian Environmental Assessment Act*, which had been updated in 2007.

The 2007 OPS will continue to apply for project EAs (environmental assessments) initiated under the *Canadian Environmental Assessment Act* that are being completed pursuant to the transitional provisions of CEAA (Canadian Environmental Assessment Act) 2012.

Relevant Provisions of CEAA (Canadian Environmental Assessment Act) 2012

CEAA (Canadian Environmental Assessment Act) 2012 aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project. In addition, CEAA (Canadian Environmental Assessment Act) 2012 ensures that a designated project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out.

Section 19 of CEAA (Canadian Environmental Assessment Act) 2012 identifies factors to be considered in the EA (environmental assessment) of a designated project, including:

- the "purpose of" the designated project, as per paragraph 19(1)(f); and
- "alternative means" of carrying out the designated project, as per paragraph 19(1)(g).

With respect to the latter, alternative means considered in a project EA (environmental assessment) must be technically and economically feasible. The project EA (environmental assessment) must address their environmental effects as defined under section 5 of CEAA (Canadian Environmental Assessment Act) 2012 for each of these alternative means.

Section 5 of CEAA (Canadian Environmental Assessment Act) 2012 describes the environmental effects that must be considered in the implementation of the legislation, including changes to the environment and effects of changes to the environment. Paragraph 19(1)(a) clarifies that environmental effects include cumulative environmental effects and environmental effects of accidents and malfunctions.

A project EA (environmental assessment) must address other factors laid out in section 19 of CEAA (Canadian Environmental Assessment Act) 2012. For example, factors related to determining the significance of environmental effects, selecting mitigation measures and implementing a follow-up program are also considered for the one or many alternative means brought forward for decision making. Community knowledge and Aboriginal traditional knowledge may also be taken into account in the project EA (environmental assessment).

Considerations in Addressing the "Purpose of" the Designated Project

The purpose of the designated project is defined as the rationale or reasons for which the designated project would be carried out from the proponent's perspective. It conveys what the proponent intends to achieve by carrying out the designated project. It is often described concisely in terms of:

- the problems that the project is intended to address (for example, resolving a supply gap);
- the opportunities that the project is designed to seize (for example, achieving growth potential);
- the manner in which the project relates or contributes to broader private or public sector policies, plans or programs (for example, contribution to an energy efficiency plan); and/or,
- any other objectives of the proponent in carrying out the project (for example, increasing the productivity of a business line).

The information regarding the purpose of the designated project should be sufficient to provide context for public and technical comment periods during the project EA (environmental assessment), and ultimately to allow the decision maker to understand the purpose of the designated project. Should a Governor in Council decision subsequently be required, it may also help inform whether significant adverse environmental effects would be justified in the circumstances.

Considerations in Addressing "Alternative Means" of the Designated Project

"Alternative means" are the various technically and economically feasible ways under consideration by the proponent that would allow a designated project to be carried out. Identified by the proponent, the alternative means include options for locations, development and/or implementation methods, routes, designs, technologies, mitigation measures, etc. Alternative means may also relate to the construction, operation, expansion, decommissioning and abandonment of a physical work.

The alternative means should be considered by the proponent as early as possible in the planning of a designated project, even before the beginning of the EA (environmental assessment) process by a responsible authority. For projects where the Agency may be the responsible authority, the Agency recognizes that projects may be in the early planning stages when project descriptions are being prepared. In many cases, proponents have not made final decisions concerning the placement of project infrastructure, the technologies to be employed or other options that may exist for various project components. In these situations, project proponents are strongly encouraged to describe the various options available and their associated environmental effects within the project description. This will allow the Agency to set direction in the EIS (Environmental Impact Statement) Guidelines regarding which alternative means should be addressed in the EIS (Environmental Impact Statement), where appropriate, and will avoid unnecessary delays at a later stage of the project EA (environmental assessment). Project proponents should contact the Agency for further guidance in this area prior to the submission of the project description.

Once an EA (environmental assessment) has commenced, the approach and level of effort applied to addressing alternative means is established on a project-by-project basis taking into consideration:

- the characteristics of the project;
- the environmental effects associated with the potential alternative means;
- the health or status of valued components (VCs (valued components)) that may be impacted by the alternative means;
- the potential for mitigation and the extent to which mitigation measures may address potential environmental effects; and,
- the level of concern expressed by Aboriginal groups or the public.

EA (environmental assessment) documentation must clearly explain and justify the methodologies that have been used to address alternative means. At any step during the alternative means analysis, the proponent may consider community knowledge and Aboriginal traditional knowledge.

Considering the alternative means of carrying out the designated project should include the four steps described below:

Step 1: Identify technically and economically feasible alternative means

To identify and describe the technically and economically feasible alternative means to carry out the designated project, the proponent should:

- Develop criteria to determine the technical and economic feasibility of the alternative means.
  Examples of technical criteria could include use of energy, mode of operation, performance, supporting infrastructure, schedule and risks.

Examples of economic criteria could consist of a comparison of cost estimation and forecasted revenues.

- Identify and describe the alternative means from the proponent's perspective.
  The description of the alternative means must be in sufficient detail to establish how to assess them relative to the criteria developed for determining their technical and economic feasibility, as well as to support the analysis described in Steps 2 to 4.
- Establish which of these alternative means are technically and economically feasible.
  A qualitative approach may be used to establish how the alternative means relates to the criteria, based on evidence and professional judgment. Thresholds or other quantitative decision-making tools may also be used, when available and relevant for specific criteria.
- Document the rationale for the alternative means retained for consideration in the project EA (environmental assessment).
  The rationale must provide sufficient detail for an independent reviewer to assess the criteria developed, the nature of the alternative means considered, the approach taken to assess these alternative means against the criteria, and the alternative means retained for further analysis in Step 2.

Step 2: List their potential effects on valued components

Under CEAA (Canadian Environmental Assessment Act) 2012, identification of VCs (valued components) for the project EA (environmental assessment) is made in relation to section 5 of CEAA (Canadian Environmental Assessment Act) 2012 and takes into account direction provided by the responsible authority. Analysis is then undertaken iteratively to examine which of those VCs (valued components) should be considered in addressing alternative means identified in Step 1 as technically and economically feasible.

For Step 2, the proponent should:

- Identify the key VCs (valued components) potentially affected by each alternative means.
  The end result is an understanding of what VCs (valued components) should be retained for analysis given the nature of the alternative means under consideration.
- Examine briefly the potential effects on the VCs (valued components) for each alternative means.
  The intent is to relate the alternative means under consideration with their potential effects on key VCs (valued components). A full assessment of environmental effects is not necessary at this stage.

The intent is to develop a sufficient understanding of potential environmental effects of the alternative means under consideration to inform the selection of an approach in Step 3 and subsequently, to serve in scoping the assessment of environmental effects in Step 4.

Step 3: Select the approach for the analysis of alternative means

Based on information gathered in Step 1 and Step 2, proponents are encouraged to identify a preferred means of carrying out the designated project. The preferred means then becomes the focus of the project EA (environmental assessment), and no further analysis is generally required on other alternative means considered in Step 1 or 2.

In cases where the proponent is not able to identify a preferred means, multiple alternative means can be brought forward in the project EA (environmental assessment). For efficiency, the proponent is then encouraged to identify a scenario that will become the focus of the analysis. The other alternatives would be the object of further analysis only in terms of how they differ from the scenario relative to potential effects on VCs (valued components).

Case A: Identifying a preferred means

To identify a preferred means among the alternative means of carrying out the designated project, the proponent should:

- determine and apply criteria to examine the environmental effects (identified in Step 2) of the technically and economically feasible alternative means (identified in Step 1). Examples of criteria are distance to a watercourse or minimization of loss of wildlife habitat.
- compare the alternative means on the basis of environmental effects, as well as technical and economic feasibility. Thresholds, governmental standards and public concerns may support the criteria used in the comparative analysis; and
- identify the preferred alternative means based on the relative consideration of environmental effects, and of technical and economic feasibility.

If a preferred means is selected, the analysis and the rationale for the choice should be explained from the perspective of the proponent, and be documented in the EIS (Environmental Impact Statement) in sufficient detail to provide context for public and technical comment periods during the project EA (environmental assessment), and ultimately to allow the decision maker to understand the choice.

Case B: Bringing forward multiple alternative means

The proponent can bring forward in the project EA (environmental assessment) multiple alternative means that are technically and economically feasible. The proponent is then encouraged to:

- identify one scenario on which the analysis will focus; and
- describe how the other alternative means retained for further analysis differ from this scenario.

The choice of a scenario should be informed by Steps 1 and 2, as well as the consideration of whether a preferred means can be identified in Step 3. There are many ways in which such scenario can be built.

The scenario can be selected based on practical criteria such as, likelihood that it will be implemented, efficiency in the comparative analysis of alternative means, or ease of presentation in an EIS (Environmental Impact Statement). For instance, selecting a scenario that represents the worst case of potential environmental effects would provide increased confidence that the predictions in the project EA (environmental assessment) are applicable to any of the alternative means.

Step 4: Assess the environmental effects of alternative means

In the case where a preferred means is chosen by the proponent (Step 3-a), the project EA (environmental assessment) should focus the analysis on the environmental effects of the preferred means. A concise summary documenting Steps 1 to 3 in EA (environmental assessment) documents will suffice to inform reviewers and the decision maker of other alternative means considered by the proponent.

In the case where the proponent chose to put forward multiple alternative means to carry out the designated project (Step 3-b) in the project EA (environmental assessment), the following approach is suggested:

- conduct the analysis of the environmental effects of the scenario;
- assess the environmental effects of the other alternative means on the basis of the consequences of their deviation from the scenario;
- after consideration of mitigation measures, provide a rationale for determining the significance of the environmental effects related to the scenario and to each of the other alternatives means.

For either case, the proponent must provide sufficient information to allow the decision maker to decide whether, based on the definition of environmental effects in section 5 of CEAA (Canadian Environmental Assessment Act) 2012, the designated project is likely to cause significant adverse environmental effects after implementing mitigation measures.

The final implementation of a designated project can vary somewhat from the proposal considered during the project EA (environmental assessment). In the case where multiple alternative means are brought forward, the proponent will be expected to carry out the designated project in a way that is consistent with the analysis (e.g., the proponent will implement one of the scenarios that was brought forward or within the bounds of the worst case scenario assessed during the EA (environmental assessment)). Similarly, when a preferred means is identified for analysis, variations during implementation are acceptable provided that they remain within the bounds of the analysis conducted. In both cases, proponents must comply with conditions established in the EA (environmental assessment) decision statement.

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Canadian Environmental Assessment Agency
Agence canadienne d'évaluation environnementale

Technical Guidance for Assessing Cumulative Environmental Effects under the
Canadian Environmental Assessment Act, 2012

Canadian Environmental Assessment Agency

December 2014

DRAFT

Canada

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Disclaimer

This technical guidance document is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) or its regulations. In the event of any inconsistency between this technical guidance and CEAA 2012 or its regulations, CEAA 2012 or its regulations would prevail. This document may be reviewed and updated periodically by the Agency.

Draft Version: Public Comments Invited

Environmental assessment practitioners, the public and Aboriginal groups are invited to provide comments on this draft technical guidance document. Any feedback on this document should be submitted to the Agency at CEAA.guidance-orientation.ACEE@ceaa-acee.gc.ca by **June 30, 2015**. All comments will be reviewed and considered for integration in the document for release in its finalized form. The document will be considered an 'evergreen' resource and will be subject to periodic updates as appropriate.

Publication Information

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Introduction

Context

The *Canadian Environmental Assessment Act, 2012* (CEAA 2012) aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a project, including cumulative environmental effects.

In addition, CEAA 2012 ensures that a project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the project to be carried out.

CEAA 2012 requires that each environmental assessment (EA) of a project take into account any cumulative environmental effects that are likely to result from the project in combination with the environmental effects of other physical activities that have been or will be carried out.

Throughout the guidance, the term “environmental effects” refers to environmental effects as described in section 5 of CEAA 2012 (see description and examples below). In addition, the term “cumulative effects” refers to cumulative environmental effects as mentioned in paragraph 19(1)(a) of CEAA 2012.

Under CEAA 2012, the “environmental effects” to be considered are those in areas of federal jurisdiction as described in section 5, which are:

- effects on fish and fish habitat, shellfish and their habitat, crustaceans and their habitat, marine animals and their habitat, marine plants, and migratory birds;
- effects on federal lands;
- effects that cross provincial or international boundaries;
- effects of any changes to the environment that affect Aboriginal peoples, such as their use of lands and resources for traditional purposes; and
- changes to the environment that might result from the federal decisions as well as any associated effects on health, socio-economic conditions, matters of historical, archaeological, paleontological or architectural interest, or other matters of physical or cultural heritage.

Examples of cumulative effects:

Fish & Fish Habitat: destruction of habitat of the same fish population from three different physical activities.

Aquatic Species: shoreline destruction from multiple physical activities resulting in the removal of several patches of a marine plant.

Socio-Economic Conditions: environmental effects from various operations resulting in the decline of a bivalve population on which an Aboriginal group depends as a source of income.

Current Use of Lands and Resources: impacts on use of traditional fishing grounds owing to decreased fish population which results from multiple physical activities.

Archaeology: continued disturbance of an archaeologically significant site due to construction activities associated with multiple projects.

Purpose

The Operational Policy Statement on Assessing Cumulative Environmental Effects under CEAA 2012 (OPS) clarifies CEAA 2012 requirements related to cumulative effects and provides core guidance to ensure that these requirements are met in all project EAs.

This technical guidance document provides methodological options and considerations to support the implementation of CEAA 2012 and the approach outlined in the OPS in a way that achieves high quality EA.

This document informs the preparation of directives by the Agency, such as the Environmental Impact Statement (EIS) Guidelines, and supports proponents in the development of an EIS. It also provides guidance to Agency employees in their interactions with those engaged in federal EA, such as proponents, federal authorities, other jurisdictions, Aboriginal groups, and the public.

Application

This technical guidance informs the assessment of cumulative effects undertaken as part of the EA of designated projects initiated under CEAA 2012 for which the Agency is the responsible authority. (In this document, the term “project” refers to designated projects initiated under CEAA 2012 for which the Agency is the responsible authority, and “Project EA” refers to the EA of designated projects initiated under CEAA 2012 for which the Agency is the responsible authority.)

For such a Project EA, this technical guidance replaces the 1999 guide entitled “Cumulative Effects Assessment Practitioners Guide”. The 1999 guide will continue to apply for EAs initiated under the former *Canadian Environmental Assessment Act* that are still being conducted pursuant to the transitional provisions of CEAA 2012.

This technical guidance **does not** apply to EA processes conducted by other responsible authorities.

This technical guidance should be used in conjunction with other Agency policy and guidance instruments. For an EA by a review panel, additional guidance and direction may be provided in the Terms of Reference or Joint Review Panel Agreement.

General Approach

The practice of EA calls for examining potential environmental effects of a project on valued components (VCs). In the context of CEAA 2012, VCs are selected to enable identification or analysis of environmental effects as described in section 5 of CEAA 2012. This technical guidance therefore proposes a VC-centered approach for the assessment of cumulative effects.

The OPS calls for a five-step approach for cumulative effects assessment (see Figure 1).

> **OPS Approach**
>
> *All cumulative effects assessments should include the five steps described below- scoping, analysis, mitigation, significance, and follow up.*

Figure 1: Generic approach to cumulative effects assessment

Step 1: Scoping

Defining the scope of the assessment is the first step in the assessment of cumulative effects. Scoping helps determine which VCs should be carried forward into the Step 2 analysis. This helps orient and focus the cumulative effects assessment.

Step 2: Analysis

Step 2 considers how the physical activities examined during Step 1 may affect the VCs identified for further analysis in Step 1. Step 2 addresses such VCs within spatial and temporal boundaries set for the assessment of cumulative effects during Step 1.

Step 3: Mitigation

Step 3 aims to identify technically and economically feasible measures that would mitigate adverse cumulative effects. Mitigation may include elimination, reduction or control or, where this is not possible, restitution measures such as replacement, restoration or compensation should be considered.

Step 4: Significance

Step 4 is concerned with determining the significance of any adverse environmental effects that are likely to result from a designated project in combination with other physical activities, taking into account the implementation of mitigation measures.

Step 5: Follow-up

With Step 5, a follow-up program is developed that addresses both project-specific environmental effects and cumulative effects. A follow-up program verifies the accuracy of the EA and determines the effectiveness of any mitigation measures that have been implemented.

The detailed approach to the assessment of cumulative effects is established on a case-by-case basis taking into account:

- the project-specific EIS guidelines or direction provided by the Agency;
- the requirements and core guidance set in the OPS; and
- the technical options and considerations presented in this guidance.

Timing for conducting the cumulative effects assessment

The guidance is consistent with the general practice that calls for first examining the environmental effects of the project in isolation before moving to the consideration of other physical activities. This allows practitioners to first consider mitigation measures for the project and determine if there are residual effects after these mitigation measures have been considered. Identifying such residual effects is one of the ways in which a practitioner can orient and focus the assessment of cumulative effects.

Nonetheless, practitioners may sometimes find it useful to conduct the assessment of cumulative effects at the same time as they are addressing the environmental effects of the project in isolation. As a minimum, information and data requirements for the cumulative effects assessment should be considered from the outset of the EA for planning purposes.

Scoping (Step 1) for the cumulative effects assessment can therefore be started during or after the assessment of potential environmental effects from the project in isolation. In either case, as the EA advances and additional information is gained, it may become clearer which VCs should be carried forward to Analysis (Step 2). Scoping is therefore iterative, and adjustments can be made at different points during the EA process.

Scope and Organization

Most of the guidance in this document relates to the first two steps of the approach presented in the OPS. Section 1 covers scoping and Section 2 covers analysis. To facilitate future updates of this guide, each section is organized into stand-alone guidance sheets (e.g., guidance sheet 1.0, entitled “Overview and Outcomes of Scoping”, is the first guidance sheet dealing with Step 1).

Additional technical background is provided in appendices as follows:

- Appendix 1 provides information on the source-pathway-receptor model that can be used to identify the source of an environmental change, what the source may affect (receptor), and how the source may reach the receptor (pathway).

- Appendix 2 provides examples of types of cumulative effects to support the consideration of cumulative effects on VCs.

- Appendix 3 provides a brief introduction to some of the methods that may be used in conducting Step 1 (scoping) or Step 2 (analysis).

In this technical guidance, a methodology refers to a technical approach and related considerations for use in the conduct of an EA. In addition, a methodology generally frames the implementation of various methods. A “method” is a specific tool, technique, or procedure used as part of implementing the chosen methodology.

1.0 Overview and Outcomes of Scoping

As the first step in a cumulative effects assessment, scoping serves to orient and focus subsequent steps. Its overall outcome is a list of VCs that should be carried forward into the Step 2 analysis, as well as a rationale for VCs considered in scoping that are not carried forward. Scoping documents the scientific evidence and advice, as well as feedback from the public and Aboriginal groups used to determine if further assessment is warranted.

Methodologies

Figure 2 summarizes the recommended generic approach to scoping. The information in the following paragraphs provides an overview of the methodologies that can be used for the scoping step, starting with a description of the generic approach.

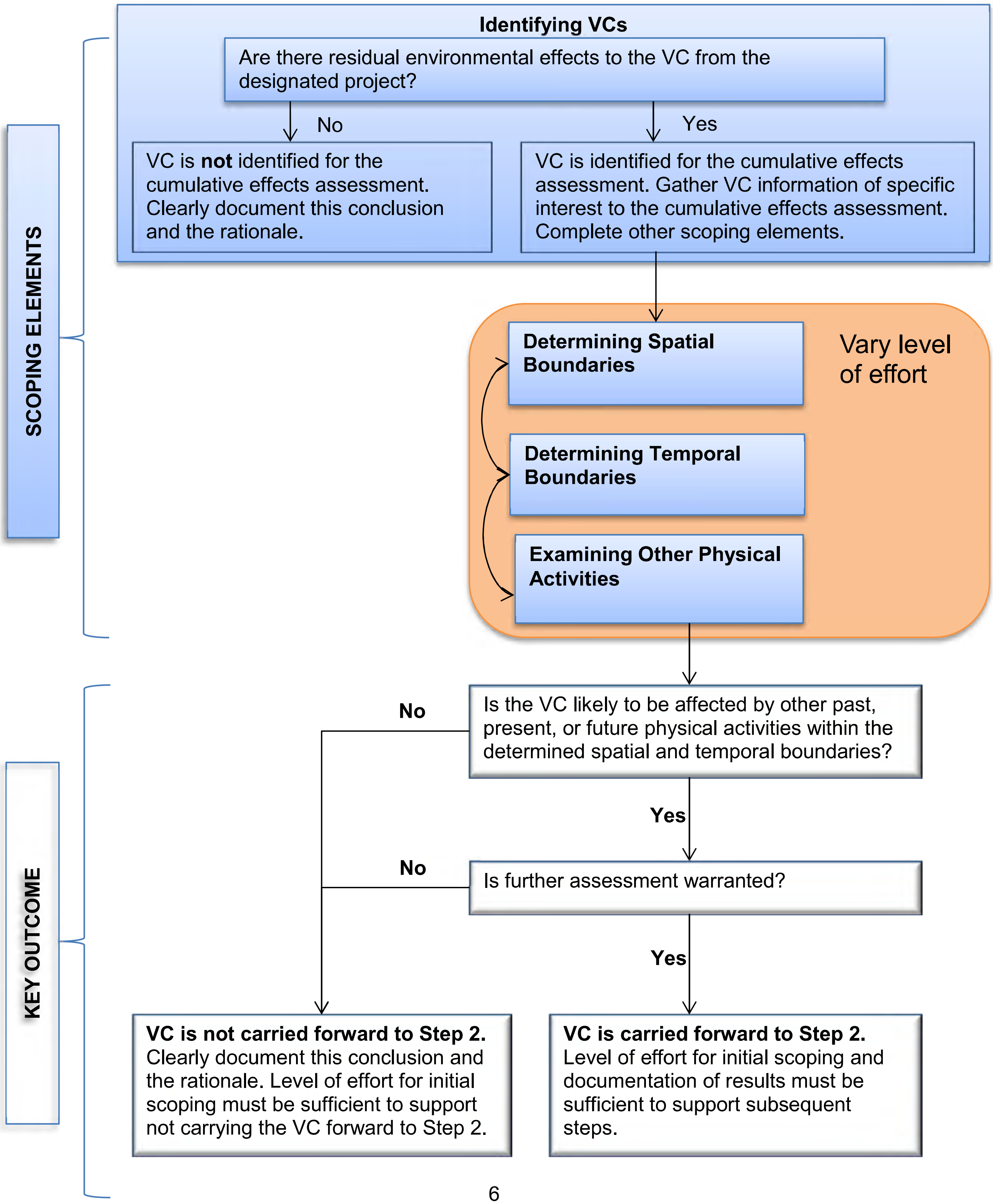
As per Figure 2, a cumulative effects assessment generally starts with addressing VCs for which residual environmental effects are predicted after consideration of mitigation measures recommended for the environmental effects of the project, regardless of whether those residual environmental effects are predicted to be significant. For each of these VCs:

- gather information on the VC of particular interest for the cumulative effects assessment (e.g., comments from the public and Aboriginal groups);
- determine the spatial boundaries within which the potential for cumulative effects will be examined and, if appropriate, analyzed;
- determine the temporal boundaries within which the potential for cumulative effects will be examined and, if appropriate, analyzed;
- identify the other physical activities that will be considered in the cumulative effects assessment; and
- identify the VCs that will be carried forward to Step 2, based on the scoping.

Scoping for the cumulative effects assessment can be started during or after the assessment of potential environmental effects from the project in isolation. With the former approach, project-specific scoping activities inform the selection of VCs by considering, concurrently, how the project and other physical activities may affect VCs. With the latter approach, the determination of which VCs to carry forward for the cumulative effects assessment can also be informed by the results of the detailed analysis of the environmental effects of the project. In either case, as the EA advances and additional information is gained, it may become clearer which VCs should be carried forward to Step 2.

The scoping elements (identifying VCs, determining spatial boundaries, determining temporal boundaries, and examining other physical activities) outlined in Figure 2 are complementary, allowing for considerations in each to inform integrated decision making on which VCs to carry forward to Step 2. VCs that are likely to be affected by other past, present, or future physical activities within set spatial and temporal boundaries should be carried forward, if further assessment is warranted.

Figure 2: Generic approach to scoping for cumulative effects assessment



Considerations

In completing the scoping step, practitioners should take into account the following considerations.

(a) Determining whether further assessment is warranted

If a VC is likely to be affected by other past, present, or future physical activities within the determined spatial and temporal boundaries, practitioners should define well-thought-out criteria that are relevant in the context of the project and apply them to each VC to determine whether further assessment is warranted. Examples of criteria where further assessment of a VC may be warranted include:

- level of concern expressed by the public, Aboriginal groups or government agencies;
- downward trend in the state (health, status or condition) of the VC;
- potential for significant cumulative effects given the understanding of risks to VCs (e.g., vulnerability of the VC, pathways of effects, level of exposure);
- uncertainty in predictions of cumulative effects; and
- potential to require mitigation measures or follow-up.

Any criteria used to determine whether further assessment is warranted should be clearly and appropriately justified.

Beyond examining the direct effects on a species (such as fish under subsection 5(1) or deer under subsection 5(2) where a federal decision affects deer), practitioners need to consider indirect effects as per section 5 of CEAA 2012 (such as Aboriginal use of lands and resources for traditional purposes). In some cases where there are no residual effects on the species, there could nevertheless be indirect effects on individuals that depend on that species in a particular locale.

Example: It may be established that a project does not change the state of a species' population, such as deer. Based on traditional knowledge and the issuance of hunting licenses, it may be well-known that the species is secure. The project may affect only a small proportion of the regional habitat, while leaving ample habitat to support the deer population. In this case, it is reasonable to document the evidence and conclude that the deer will not be carried forward for further analysis (Step 2). At the same time, however, the situation might require that the VC relating to Aboriginal hunting practices be carried forward to Step 2 because the project's effect on the deer changes those practices (e.g., site-specific locations and times of year for hunting).

Practitioners should exercise caution when identifying VCs to carry forward to Step 2. Employing criteria that are too restrictive at this step may result in more effort for practitioners at a later stage in the assessment if it is determined that further analysis is warranted. A reasonable approach should be taken to ensure the cumulative effects assessment is undertaken at an appropriate level of effort that supports defensible conclusions.

(b) Dealing with data limitations and associated uncertainties

VCs should not be omitted from being carried forward to Step 2 based on a lack of readily available data. Where data about a VC are not readily available, practitioners may use one of the following approaches, and document associated uncertainties:

- use surrogate data or model output within comparable environmental conditions;
- carry out new field surveys, if warranted, and/or collect traditional or community knowledge; or
- make inferences based on an appropriate body of knowledge (e.g., scientific and traditional knowledge about how the VC may be affected and to what extent).

Data and information for the cumulative effects assessment will often come from the analysis of environmental effects of the project, leading to identifying those VCs that have residual environmental effects.

Level of Effort for Scoping

In addition to the level-of-effort considerations outlined in the OPS, the following considerations should be taken into account for the scoping step:

- Where a VC is not carried forward to Step 2, the level of effort for scoping including the documentation of results must be sufficient to support not carrying the VC forward.
- Where a VC is carried forward to Step 2, the level of effort for scoping, including the documentation of results, must be sufficient to support subsequent steps of the cumulative effects assessment.

Additional considerations related to level of effort in scoping can be found in Subsections 1.1 to 1.4 of this document.

OPS Approach

The approach and level of effort applied to assessing cumulative environmental effects in a project EA is established on a case-by-case basis taking into consideration: the characteristics of the project; the risks associated with the potential cumulative environmental effects; the state (health, status, or condition) of valued components (VCs) that may be impacted by the cumulative environmental effects; the potential for mitigation and the extent to which mitigation measures may address potential environmental effects; and the level of concern expressed by Aboriginal groups or the public.

Outcome Documentation

Documentation of the scoping step can take the form of two lists of VCs: those that are carried forward to Step 2, and those that are not carried forward, supported by a rationale.

In addition, there should be clear, well-supported documentation of the:

1. criteria used to determine whether a VC should be carried forward to Step 2;
2. rationale for why further analysis was not warranted on any VCs, including why significant adverse environmental effects are not likely to occur; and
3. description or definition of a VC, especially if the identified VC differs from any identified in the project-specific EIS Guidelines or from those considered so far in the EA of the project.

See also other outcome documentation in Subsections 1.1 to 1.4 of this document.

1.1 Identifying Valued Components

Identification of VCs is one of four elements of the scoping step (see Figure 2). The four elements of scoping are complementary, allowing for the considerations in each to inform integrated decision-making.

VCs refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Aboriginal peoples, or the public. The value of a component not only relates to its role in the ecosystem, but also to the value people place on it. For example, it may have been identified as having scientific, social, cultural, economic, historical, archaeological, or aesthetic importance.

OPS Approach

Identification of VCs for the project EA is made in relation to section 5 of CEAA 2012 and takes into account direction provided by the Agency. Analysis is then undertaken to identify which of these VCs will be considered for the cumulative environmental effects assessment.

The cumulative environmental effects assessment should consider those VCs for which residual environmental effects are predicted after consideration of mitigation measures, regardless of whether those residual environmental effects are predicted to be significant.

Methodologies

Identification of VCs is based on the assessment of environmental effects of the project. Where residual environmental effects from the project are expected, those VCs are identified for consideration in the cumulative effects assessment.

Considerations

When identifying VCs at any point in the EA, practitioners should take into account the following considerations.

(a) Gathering data and information on VCs of interest

Data and information sources to aid in gathering VC information of specific interest to the cumulative effects assessment include, but are not limited to:

- the Project Description filed by the proponent to initiate the EA;
- scientific and science-based literature;
- legislation;
- completed or in-progress EAs;
- available mapping (e.g., historical air photos, geomorphological data, hydrological data, vegetation mapping, or topographical maps);
- government websites (e.g., for land use plans, development strategies, or open data);
- regional studies conducted under CEAA 2012;
- other regional studies (e.g., conducted by a province);
- monitoring information, status assessments, or management plans from resource management agencies;
- input from the public, Aboriginal groups, and government agencies;
- baseline studies; and

- information on wildlife species listed under the *Species at Risk Act* (e.g., recovery plans, management strategies) or other wildlife of conservation concern.

These sources can be used to understand the current state of knowledge on VCs and related issues, or to identify known regional issues of concern.

(b) Considering input from the public and Aboriginal groups

Consideration of comments from the public and Aboriginal groups, including directly affected individuals, regional and national non-governmental organizations, and public organizations (e.g., universities), may provide information of particular interest to the cumulative effects assessment. Comments may include Aboriginal traditional knowledge (ATK), community knowledge and scientific knowledge, or simply an expression of concern regarding potential cumulative effects to a particular VC. Collection and use of ATK is covered in the reference guide *Considering Aboriginal traditional knowledge in environmental assessments conducted under the* Canadian Environmental Assessment Act, 2012.

Where a cumulative effects assessment gathers information useful to understanding the historical context of past impacts to Aboriginal group's rights, practitioners should keep in mind that, in the context of consultation and accommodation, such information will also help in understanding potential impacts to Aboriginal rights.

> Example: Noise from the project could be identified by an Aboriginal group as an issue of concern relative to wildlife in the context of traditional use of lands. There may be concern that existing noise in the area due to existing physical activities may already be at a level of concern and that the project would result in cumulative effects. This concern would typically result in the "noise" VC being identified for further consideration in scoping.

(c) Characterizing VCs for Cumulative Effects Assessment

A practitioner has flexibility in how to characterize a VC by defining it either broadly or narrowly. If the VC is defined narrowly, consideration should be given to whether the result of the analysis on the narrow VC is relevant to any broader VC. While the EA of the project in isolation may look at a broadly defined VC, it may be necessary in the cumulative effects assessment to focus on a narrowly defined VC such as particular species at risk of losing critical habitats as a result of the project and other physical activities. The final choice may be affected by the available information.

> Example: A VC may be defined broadly, such as "terrestrial vegetation" (e.g. where this VC is relevant under paragraph 5(1)(*c*) or 5(2)(*a*) of CEAA 2012); more narrowly as "on-site forests"; or even more specifically as a species of particular ecological importance due to its rarity, ecological or social value, or vulnerability to the environmental effects of the project.

The state (health, status, or condition) of a species may be monitored because it is seen as a reflection of the state of the environment on a chosen scale (e.g., indicator species in state of the environment reporting). In an EA, it may be used as a surrogate to predict environmental effects on other species or another ecologically justifiable grouping. While such an EA approach is reasonable and often used, one species may have a different degree of sensitivity to disturbances than others; therefore, caution is warranted in use of indicator species.

Example: Grizzly bear, a culturally important species to Aboriginal groups in a project area, might prove to be a good VC to represent other culturally important terrestrial animal species if it is known to be vulnerable to the perturbations of projects and physical activities.

In characterizing the state of the VC, care must be taken in choosing one or more measurable variables that are directly or sufficiently indicative of the health, status, or condition of the VC. Reliance on an inadequate indicator (i.e., a measurable variable chosen to represent the state of a component) may lead to the premature exclusion of a VC from further consideration in the cumulative effects assessment.

Example: A bird, selected as a VC under paragraph 5 (1) (c) of CEAA 2012 due to its use by Aboriginal groups, may be affected by the availability and quality of its habitat. However, the status, health, and condition of the bird may also be affected by other factors. An indicator which reflects **population** abundance may yield a very different level of concern than an indicator defined in terms of **habitat**. Even though the local habitat may not yet be under pressure, a review of population data might show that the species is under pressure due to other factors, such as habitat loss in another country.

(d) Using Benchmarks

Benchmarks help define what would be considered a significant adverse environmental effect on a VC. In some cases, it may be possible to identify established or generally accepted benchmarks. These may be in the form of standards, guidelines, targets, or objectives. Benchmarks are used to:

- aid in understanding where a VC’s state (health, status, or condition) stands in relation to multiple stressors;
- provide information on relevant tangible measurements of environmental consequences for a VC; and
- provide an indication of which VCs are of regional concern (i.e., if a benchmark for a VC has been established at a regional level).

Level of Effort for Identifying VCs

Given that identifying VCs with residual environmental effects is the result of previous phases of the EA, the level of effort for this is the one adopted and justified for previous phases of the EA. Establishing the appropriate level of effort for gathering VC information of specific interest to the cumulative effects assessment should consider the criteria in the OPS (see Section 1.0 of this document for OPS level-of-effort considerations).

Outcome Documentation

The outcome of this scoping element should be clear, well-supported documentation of the:

1. list of VCs with and without residual environmental effects from the project (note that the documentation supporting this list is provided through the documentation of other phases of the EA) ; and
2. information on VCs of specific interest to the cumulative effects assessment.

1.2 Determining spatial boundaries

Determining spatial boundaries is one of four elements of the scoping step (see Figure 2). The four elements of scoping are complementary, allowing for the results of each to inform integrated decision making on scoping.

Methodologies

One of the following methodological options, or a combination of them, should be used to determine spatial boundaries. Spatial boundaries must support the consideration of cumulative effects for each VC identified for the cumulative effects assessment.

1. VC-centered spatial boundaries

Under this approach, spatial boundaries of a cumulative effects assessment are based on setting adequate spatial boundaries for each VC and considering primarily the VC's geographic range and the zone of influence (ZOI) of the project for the VC. For example, spatial boundaries for a migratory species may take into account seasonal migration paths, regardless of jurisdictional boundaries.

This option is generally recommended, as it allows for the most meaningful spatial boundaries to be drawn for the VCs identified for the cumulative effects assessment.

OPS Approach

Spatial boundaries should be identified and justified clearly, and be set taking into account direction provided by the Agency.

To consider the environmental effects of existing and future physical activities, the spatial boundaries need to encompass the potential environmental effects on the selected VC of the designated project, in combination with other physical activities that have been or will be carried out.

Example: A caribou herd that is hunted by local Aboriginal groups ranges within a 5,000 km^2 area. This full area would be the primary basis for the spatial boundary for the VC. The population is predicted to be directly affected by the residual effect (habitat loss) of the project within a 3 km radius of the project. This would occur in the southern part of the caribou population's range. The caribou herd is also being affected by transport roads and seismic lines that are being cut in the northern part of its range. Effects may include loss of habitat, decreased access to habitat due to caribou avoidance of crossing the seismic lines and increased potential for interaction with predators when crossing seismic lines. As well, in the future the herd could be affected by noise from a proposed new remote airport just outside of the herd's range. Noise from the future airport could limit the use of habitat in proximity to the airport. The spatial boundaries could be designed to allow for consideration of the cumulative effects of all of these physical activities.

In considering the caribou herd in the context of the "current use of lands and resources for traditional purposes" VC, practitioners should take into account whether an Aboriginal group has an option to access hunting opportunities in other parts of the herd's range, or if that other access is in a different group's traditional territory. If so, these factors should be considered in setting the spatial boundaries for the "current use of lands and resources" VC separately from the biophysical caribou VC.

2. Ecosystem-centered spatial boundaries

In some cases, the current understanding of an ecosystem's boundaries and processes allow practitioners to take an ecosystem-centered approach. For example, the geographic extent of the VC may be dependent on ecosystem features such as topography, climate, soils, or geology. Spatial boundaries under this approach are therefore based on knowledge of the ecosystem and where the VC fits in it. For example, ecological boundaries, such as a watershed, may define the geographic range of a VC (e.g., a population of a fish species). This option requires a good understanding of ecosystem boundaries and processes. If a sufficient knowledge base is available, the setting of VC-specific spatial boundaries is done relative to the system in which the VC occurs. For example, an aquatic species could be examined across its distribution in a watershed, thus allowing practitioners to take into account the availability of habitat and the success of recruitment processes across the watershed.

Understanding the ecological setting of a project can inform the setting of spatial boundaries. For example, ecological land classification (e.g., ecoregions) can be very helpful in the identification of spatial boundaries for VCs, particularly for VCs that occur at the landscape level. It can also be useful at a smaller scale for VCs that are an ecotype (i.e., a genetically distinct variety, population, or race of a species adapted to specific environmental conditions). In some circumstances, ecotypes are at great risk due to their rarity or loss of their habitat from other physical activities. In such circumstances, the area of distribution of an ecotype may be the area of key concern for cumulative effects assessment, and it could then be selected as the spatial boundary rather than the larger ecoregion comprising complexes of flora and fauna on which it is nested.

Because of the potential large scale and complexity of ecosystems, an ecosystem-centered approach may be best suited when regional data are available, such as through a regional study, regional EA, or ecosystem-based planning.

3. Activity-centered spatial boundaries

With this approach, spatial boundaries in a cumulative effects assessment are based on the distribution of physical activities in the vicinity of the project (e.g., mining or forest resources harvesting where they might comprise the principal land use). This approach is generally not recommended, because it may fail to encompass all environmental effects acting on the VC and may not fully consider the VC under study (e.g., the type of VC and its geographic range). However, this approach may be useful if the project is in a remote area with few interacting physical activities, and for VCs whose geographic range is limited.

4. Administrative, political, or other human-made spatial boundaries

Under this approach, administrative, political, or other human-made boundaries are established as the spatial boundaries. This may be particularly useful for socio-economic and cultural VCs. For example, spatial boundaries could be based on provincial, municipal, or statistical boundaries (e.g., census tracts), or an Aboriginal group's traditional territory for VCs such as current use of lands and resources, recreational tourism, Aboriginal health, or fisheries.

Administrative spatial boundaries can also apply to biophysical VCs. For example, wildlife information and management often occurs in defined management areas that may be useful spatial boundaries for cumulative effects assessment. Similarly, at times boundaries like ecological reserves, parks, or other protected areas may also be useful if, for example, they reflect biophysical conditions of relevance to the EA.

However, administrative, political, or other human-made boundaries are often sharp and may not take into account the spatial pattern of ecosystems, which typically consist of community gradients where attributes adjust progressively. Additionally, such boundaries may not reflect the spatial distribution of a mobile species.

Where a VC's state (health, status, or condition) is managed within administrative, political, or other human-made boundaries, the collection of data and integrated implementation of mitigation measures may be most effective if considered in the context of these boundaries. Nevertheless, the use of such boundaries must be appropriate in the context and support the assessment of cumulative effects on specific VCs.

5. Any other option

If any other option is selected, it should be fully justified in the context of the project. It must also take into account the OPS, and enable the completion of an EIS that meets the requirements of the project-specific EIS Guidelines and of an EA that meets the requirements of CEAA 2012. Discussion with Agency staff prior to implementing any other option is recommended.

Considerations

Practitioners should take into account the following considerations in determining spatial boundaries.

(a) Considering geographic scale as the EA progresses

The scale of the chosen boundary may lead to over- or under-predicting the importance of the predicted cumulative effects. With this in mind, practitioners must be aware of how cumulative effects are interpreted as the scale of boundaries change:

- Adopting a large spatial area may lead to misinterpreting the incremental cumulative effects of the project as being insignificant *relative to* everything else that is affecting the VC in the region, i.e., a small drop in a large bucket.
- Adopting a small spatial area may result in exaggerating the incremental cumulative effects of a project, i.e., a large drop in a small bucket.

An iterative approach to setting spatial boundaries should be followed. Practitioners should be prepared to adjust the spatial boundaries (for example, by covering a larger or smaller geographic extent for a VC) during the assessment process if new information suggests this is warranted.

(b) Considering the designated project's zone of influence and effects pathways

The ZOI sets a spatial limit beyond which the residual environmental effects of the designated project on a given VC are not detectable. The ZOI should be considered in setting spatial boundaries, for example, when:

- environmental effects generated by the project may be felt over a far reaching area (e.g., long-range transport of pollutants in air sheds or waterways, far-ranging wildlife); or
- exposure to environmental effects from different developments resulting in a mobile VC moving into the ZOI of other physical activities.

Setting the ZOI should be informed by the nature of pathways that result in cause-effect relationships between the project and the selected VCs (e.g., effluent from a project in a river resulting in contamination of fish tissue which is then consumed by humans and wildlife).

Example: In the case of fish that may be affected by a change in water quality, the ZOI of the project may be determined by considering how far downstream the concentration of a particular contaminant can be detected at levels greater than background levels, and what geographic range of fish populations this may affect. Effects pathways would be considered to determine how the water contaminant could affect fish and would also inform whether the ZOI extends to other fish-bearing water bodies by transport of the contaminant through groundwater or other means.

(c) Considering the influence of other physical activities

Effects pathways specify the cause-effect relationship among the project, the selected VCs and other physical activities. The selection of other physical activities to include in the cumulative effects assessment is covered in Section 1.4: *Examining physical activities that have been and will be carried out*.

Physical activities will generally not be the primary factor in establishing spatial boundaries for the cumulative effects assessment. Spatial boundaries may be set solely based on the geographic range of the VC and the ZOI of the project and other physical activities. In doing so, particular care is required for mobile or wide-ranging VCs.

Other physical activities located outside of the spatial boundary may still affect a VC within the spatial boundary. This does not mean that the spatial boundary needs to extend to include a physical activity outside the spatial boundary. The key point is that the environmental effects within the spatial boundary, whether they come from physical activities within or outside of the spatial boundary, should be considered for inclusion.

Example: A caribou herd hunted by local Aboriginal groups ranges within a 5,000 km^2 area. This full area would be the spatial boundary for the VC if the spatial boundary is set solely based on the geographic range of the VC provided that the ZOI of the project falls within the geographic range of the herd. However, the herd could be affected by noise from a proposed new remote airport just outside of the range. Noise from the future airport could limit the use of habitat within the range in proximity to the airport and should therefore be considered in the cumulative effects assessment. While this physical activity and its noise impact would then be included in the cumulative effects assessment, the VC-specific spatial boundaries would not need to be extended.

There are circumstances where the spatial boundaries may be adapted in light of examination of other physical activities, as demonstrated in the following example.

Example: A sessile aquatic species with a patchy distribution within an entire watershed is identified as a VC for the cumulative effects assessment due to the residual release of a particular contaminant by the project. Pathways of effects indicate that the ZOI for release of the contaminant from the project extends to the watershed level. Further scoping using pathways reveals that only one other physical activity would also affect this aquatic species within a small ZOI nested in the watershed. The spatial boundaries could then be adjusted to focus on effects in this small ZOI, rather than cover the entire watershed.

(d) Considering the availability and quality of spatial data

The availability and quality of the spatial data should be clearly described for each VC under study. The quality and quantity of the available spatial data, the level of effort that would be required to augment existing data, and information required to enable final EA decisions will influence whether to collect more data. The decision regarding the collection of additional data should be clearly stated and justified. If no additional data is collected, a valid reason should be given. For example, a geo-database containing detailed species information for the past 20 years would likely be adequate to identify its spatial boundaries.

Practitioners should keep the following considerations in mind:

- The ability to set spatial boundaries may be enhanced for specific VCs in a well-studied watershed, along a well-known migration path, or where relevant remote sensing imagery is available.
- VC-specific field studies can help define the spatial boundaries of some VCs for which limited or inadequate information is available. However, additional detailed studies will not necessarily be required if there is sufficient information to make a decision on whether the VC should be carried forward to Step 2.
- The study of multiple VCs at once may be particularly useful if the spatial distribution of the VCs under investigation is linked through, for example, predator-prey relationships, food webs, or natural barriers (e.g., on an island or in a mountain valley).

Level of Effort for Setting Spatial Boundaries

Spatial and temporal boundaries are set in light of other elements of scoping, including an understanding of how physical activities had, continue to, or will have an environmental effect on VCs.

The environmental effects of a physical activity on a VC must occur within the spatial and temporal boundaries set for the cumulative effects assessment (using the approaches outlined in this guidance) in order for that physical activity and its environmental effects to be considered in the cumulative effects assessment.

In addition to the overall level-of-effort considerations outlined in the OPS (see Section 1.0 of this document for OPS level-of-effort considerations), the level of effort needed to establish spatial boundaries will increase with the uncertainty regarding:

- the geographic extent of residual environmental effects from the project;
- the geographic extent of residual environmental effects of past, present, and future physical activities;
- the geographic range of the VC; and
- the quality of available spatial data.

The level of effort put into setting spatial boundaries must be sufficient to allow for full consideration of the environmental effects acting on a VC from all physical activities, and for the justification of the spatial boundaries in relation to each VC.

Outcome Documentation

The outcome of this scoping element should be clear, well-supported documentation of the:

1. methodology and considerations used in setting spatial boundaries; and
2. spatial boundaries to be used in assessing the potential adverse cumulative effects for each VC and the rationale for their boundaries.

The outcome documentation should be commensurate with the level of effort established. For example, the outcome documentation may be maps with explanatory text which rationalizes the chosen spatial boundary for each identified VC.

Information and data requirements for documenting the spatial boundaries may include maps (geographic information systems), remote sensing or aerial imagery, expert opinions, community and/or ATK, thresholds, indicators, and land-use plans.

1.3 Determining temporal boundaries

Determining temporal boundaries is one of four elements of the scoping step (see Figure 2). The four elements of scoping are complementary, allowing for the results of each to inform integrated decision-making on scoping.

OPS Approach

Temporal boundaries should be identified and justified clearly, and be set taking into account direction provided by the Agency.

Temporal boundaries for assessing a selected VC should take into account past and existing physical activities, as well as future physical activities that are certain and reasonably foreseeable. They should also take into account the degree to which the environmental effects of the physical activities overlap those predicted from the designated project.

Methodologies

Practitioners should endeavour to understand the nature of the perturbation and the persistence of potential cumulative effects in setting temporal boundaries. Time horizons for the project or selected physical activities should include timelines associated with construction, operation, and decommissioning.

One of the following methodological options, or a combination of them, should be used to determine temporal boundaries for the cumulative effects assessment. Temporal boundaries must support the consideration of cumulative effects for each VC identified for the cumulative effects assessment.

1. VC-centered temporal boundaries

Determining temporal boundaries according to each selected VC enables an examination of the unique characteristics of environmental effects on VCs and takes into account the VC's natural variation over time. This option can focus temporal boundaries to account for the duration of the residual environmental effects of the project in combination with environmental effects of other physical activities on the same VC. In establishing temporal boundaries, the identification of past, present, and future physical activities is integral to understanding the cumulative effects on the selected VCs over time.

Example: A VC-centered approach could be used for a situation associated with a hydroelectric project where there was an increase in mercury in fish consumed by an Aboriginal group. For the VC “Aboriginal Health”, a practitioner would take into account the mercury contamination associated with effluents from a pulp mill that is no longer operating and future effects from flooding to create a reservoir (which leads to conversion and circulation of mercury already present in plants and soil into the water).

In this case, the temporal boundaries would relate to the environmental effects of increased mercury in fish from the decommissioned pulp mill which may still be affecting fish body burdens. If the mill operated for 50 years and was decommissioned 25 years ago, the past temporal boundary might extend back 75 years.

The future boundary would reflect the likely duration of the presence of increased mercury in the reservoir and fish due to flooding. If mercury levels were expected to decline to levels acceptable for human consumption in some 30 years, and the pulp mill residual environmental effects were predicted to decline in the same period of time, then the future temporal boundary could then be set to 30 years from the time of flooding.

2. Ecosystem-centered temporal boundaries

Using an ecosystem-centered approach, VCs are considered in the context of the current understanding of an ecosystem state and processes. Physical activities are then considered in terms of how they affect ecosystem processes and VCs, and for how long. For example, available information on the evolution of the ecosystem over time may help identify particular events in the history of the VC that could be useful in setting temporal boundaries for the VC. The information might also reveal a trend in the state (health, status, or condition) of the VC that could help predict a suitable point for a future temporal boundary. This option is better suited to circumstances where a reasonable understanding of the ecosystem and its processes is available or can be reasonably obtained.

It may also be useful if key VCs have been strongly influenced by historical drivers or shifts in ecosystem processes – for example, with historical changes in land use (e.g., past forested ecosystems having been converted into agricultural lands).This can help in two ways: providing evidence of the time scale at which change occurs relative to the natural or human drivers, and providing evidence of past shifts in ecosystem processes to assist with predictions of potential effects. Practitioners may also find that the effects of past and existing physical activities are reflected in current ecosystem processes. In some circumstances, it may be important to also understand natural cycles within ecosystems such as predator-prey cycles, and examine the recovery of VCs in relation to the variability of natural cycles of change in ecosystems.

3. Activity-centered temporal boundaries

This option may inform the setting of temporal boundaries, but should not be used in isolation. Focusing purely on physical activities for setting temporal boundaries may create a number of issues:

- Time horizons of physical activities may not align well with consequential environmental effects on VCs (i.e., the lag time it might take a VC to respond to or recover from an environmental effect may extend beyond the phases of projects and physical activities).

- This approach may not reflect natural variation in the VC over time, or its continuing evolution in response to effects from current or past physical activities.
- Temporal boundaries could stretch too far into the past or future, requiring extra effort to support the analysis, or may require information that cannot be obtained, as uncertainty generally increases the farther into the future the temporal boundary is extended.

Nevertheless, some environmental effects will occur in close association with the phases of a project or physical activity (e.g., noise associated with operation).

4. Any other option

If any other option is selected, it should be fully justified in the context of the project. It must also take into account the OPS, and enable the completion of an EIS that meets the requirements of the project-specific EIS Guidelines and of an EA that meets the requirements of CEAA 2012. Discussion with Agency staff prior to carrying forward any other option is recommended.

Considerations

Practitioners should take into account the following considerations in setting temporal boundaries.

(a) Setting a past temporal boundary with a VC-centered approach

Baseline conditions refer to present-day conditions, prior to implementation of the project. These conditions may not be fully representative of the variations in natural conditions, due to natural variability, historical shifts, or effects from other human activity.

Setting a past temporal boundary allows for gathering of past data and information that will provide a more meaningful picture of the VC, allowing the practitioner to credibly state whether the baseline condition is representative or is at a particular point in a cycle.

This can be addressed by ensuring that the description of the baseline condition of each VC includes past information such as the VC's natural variability, drivers of change, and historical shifts. This description of the past can take various forms, such as a narrative of the evolution of the VC from the past point in time to the present, a "pre-industrial case", or a series of "past temporal snapshots" showing the evolution of the VC.

Example: In assessing the environmental effects to the "Aboriginal current use of lands and resources for traditional purposes" VC as per subparagraph 5(1)(c)(iii) of CEAA 2012, Aboriginal traditional land use (TLU) and ATK studies may be undertaken. These studies typically document historical and current Aboriginal land- and resource-use activities that can inform project planning and the development of mitigation strategies. These studies may indicate the lifetimes of study participants as the temporal boundary and/or can include anecdotal information about the cultural history and identity before industrial development took place. This information, along with other information sources (e.g., EIS of another physical activity), could be used to describe the past state of the VC and a narrative of its evolution.

The past temporal boundary would be set to a point in the past where a description of the past state of the VC is useful to understanding cumulative effects or in deciding whether further assessment of a VC is warranted. Possible points in time that could serve as boundaries are:

- when a certain land-use designation was made;
- when environmental effects on the VC first occurred;
- when land use changed (e.g., the commencement of mechanized forest resources harvesting); and
- a point in time when the VC was in a less disturbed condition, especially if the assessment includes determining to what degree past physical activities have affected the VC.

Example: Gathering baseline data reveals that, 50 years ago, a bird (the VC, as it relates to Aboriginal traditional use) habitat covered 10,000 km^2, as opposed to the present 1,000 km^2. The decrease of habitat was due to development in the area. In this case, the past temporal boundary of the VC could conceivably be set to 50 years ago. However, the availability of historical data on the population of migratory birds dating back 50 years may be severely restricted, making this an unreasonable temporal boundary. It may be necessary to rely upon more recent data (e.g., forest management plans and associated migratory bird monitoring that have been in place over the preceding 25 years) and a shorter temporal boundary. Alternatively, practitioners could use surrogate data or modelling to attempt to fill the gap in data.

Questions to consider in determining whether a description of the past state (health, status, or condition) of a VC is appropriate include:

- Does information or data indicate that another physical activity has affected the state of a VC in the past or that the VC is currently under stress?
- Do comments from the public, Aboriginal groups, or expert reviewers indicate an interest in having a description of the past state of a VC?
- Is an understanding of the incremental effects of multiple physical activities in the past necessary to understand or predict cumulative effects?
- Is the understanding of past environmental conditions for specific VCs required to contextualize cumulative effects (e.g., area of habitat lost to date, or limitations to current use of lands and resources for traditional purposes to date)?
- Would information about how past physical activities influenced the state of the VC be valuable in understanding the vulnerability of the VC to future perturbations by the project and other future physical activities?
- Would past information or data on the state of a VC support the identification of mitigation measures or the design of a follow-up program?
- Is the information reasonably attainable, including through ATK and/or surrogate data from other regions with comparable conditions?
- Will the information provide a reasonable level of certainty in predicting the future state of the VC?
- Would the information influence the determination of whether significant adverse cumulative effects would occur?

(b) Setting a future temporal boundary with a VC-centered approach

As a standard practice, boundaries should be extended long enough into the future to take into account when cumulative effects may occur. This means that boundaries should consider the planning horizon and expected life cycle of the project, as well as future certain and reasonably foreseeable physical activities that will be assessed.

Practitioners should consider the temporal dynamics of VCs in response to the environmental effects of the project and other physical activities, which can result in delays in observing environmental effects on VCs in the field. For example, there might be lag time before effects on individuals are observable (e.g., chronic exposure resulting in effects over a long period of time).

It may also take several generations before environmental effects at the population level of a species become fully apparent. A VC may also take generations to stabilize to a new state, or to recover from the perturbations of the project and/or physical activities.

The point at which the project ceases to contribute to cumulative effects may refer to a point in time when the VC is predicted to have recovered to the baseline or another acceptable target, and the state of the VC can now be considered stable relative to environmental conditions and natural variability.

Example: In a highly transformed landscape like agricultural land in the prairies, it may not be reasonable to expect conditions to return to pre-European conditions of native prairie. In such cases, the temporal boundary may be established by a return to current or pre-project or pre-disturbance conditions. For example, a project which includes a right-of-way on agricultural land in an area of former prairie would set a temporal boundary for when the right-of-way is expected to be returned to agricultural production with its inherent pre-disturbance, ecological, and land-use condition, not to pre-European conditions.

Illustrating the temporal overlap among physical activities is recommended to help identify when their environmental effects may overlap. This can be done by creating a diagram that provides the major project phases of the project on a timeline with other physical activities included in the cumulative effects assessment. However, the phases of the project need not overlap with other physical activities for cumulative effects to occur.

Information on the environmental effects of past or existing physical activities may also be of value to setting future temporal boundaries. For example:

- the environmental effects of past or existing physical activities on a specific VC may help predict the environmental effects of a project if the same or similar type of physical activity already had an environmental effect on a VC; or
- future decommissioning of an existing physical activity could affect the future condition of a specific VC.

(c) Setting a temporal boundary using various methodologies

Applying the VC-centered approach to setting temporal boundaries can be supplemented by other approaches, such as methodologies centered on an ecosystem or on physical activities. Understanding the contribution of each approach and adding supplemental information from other approaches can assist in understanding complex system interactions. A way to integrate these methodologies can be to develop scenarios.

It may be helpful to build scenarios reflecting, for example, past conditions, current status, or expected evolution with or without the project. Scenario-building is well-suited when regional data are available, for example, through a regional study, regional EA, or ecosystem-based planning, such as in the following example, in the context of a forest management plan.

Example: Historical logging or mechanized forest resource harvesting may have progressively changed the status of an ecosystem in the past. These changes were then influenced by forest management activities aimed at reversing some of the effects (initiated at T^{FM} in Figure 3).

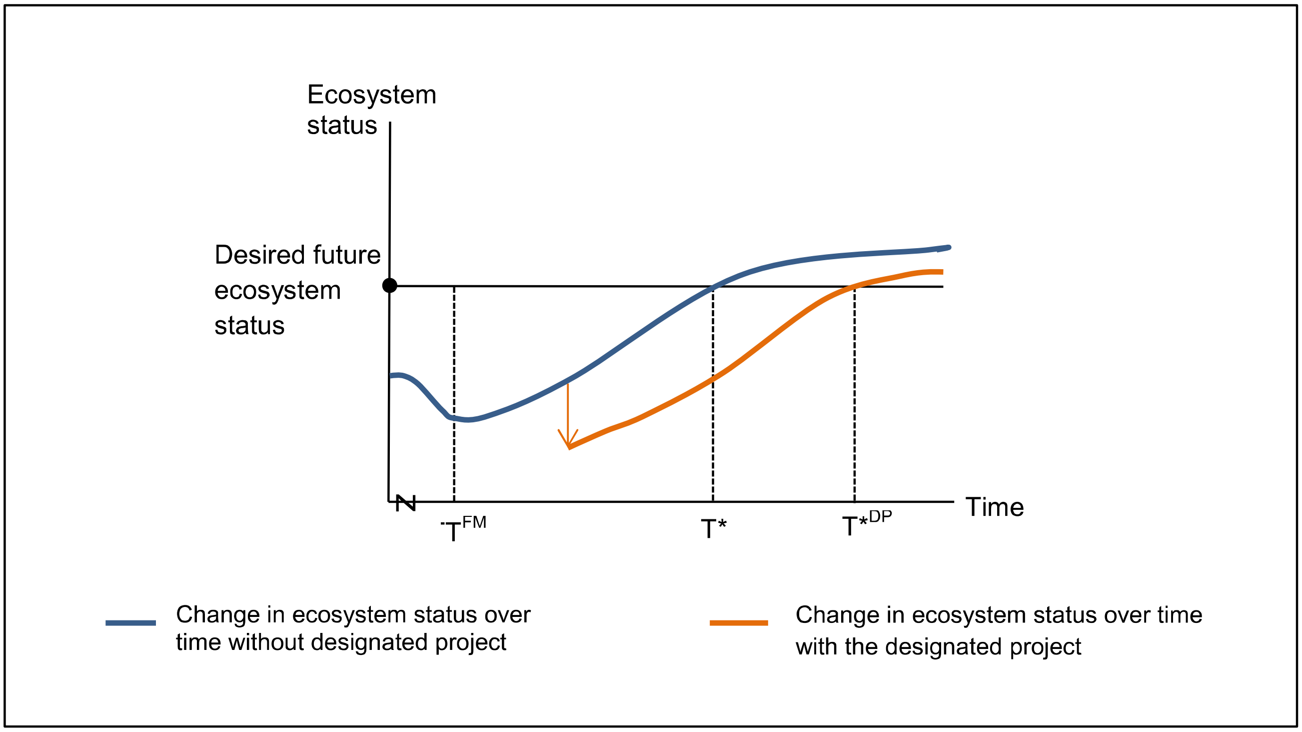
Where a project is proposed in such an area, the future duration of the environmental effects of the project, in combination with those related to forest management, can support the selection of an appropriate future temporal boundary. This boundary would be set as the point in time in the future when the ecosystem can be restored to a certain condition or status.

As shown graphically in a simplified depiction in Figure 3, the desired future ecosystem state would have been reached at T^* if the project had not been proposed. However, if the project goes ahead, the adverse environmental effects lead to a delay in when the ecosystem can reach the desired state. This occurs at T^{*DP}, and could serve as the future temporal boundary for VCs within the ecosystem.

Where data are available, the setting of past temporal boundaries can also be informed by knowledge of the ecosystem state at specific points in time.

Monitoring of the state of an ecosystem can be done over time using one or more indices (measured variable). For example, the measured variable can be associated with a key indicator species, such as a bird species known to be representative of the state of that particular forest ecosystem.

Figure 3: Future scenario



Level of Effort for Setting Temporal Boundaries

Spatial and temporal boundaries are set in light of other elements of scoping, including an understanding of how physical activities had, continue to, or will have an environmental effect on VCs.

The environmental effects of a physical activity on a VC must occur within the spatial and temporal boundaries set for the cumulative effects assessment (using the approaches outlined in this guidance) in order for that physical activity and its environmental effects to be considered in the cumulative effects assessment.

In addition to the overall level-of-effort considerations in the OPS (see Section 1.0 of this document for OPS level-of-effort considerations), the level of effort needed to establish temporal boundaries will vary with the:

- nature of the residual environmental effects, in terms of their measurability and scale or magnitude;
- time horizon of residual environmental effects of the project;
- time horizon of residual environmental effects of other past, present, and future physical activities; and
- selected temporal resolution(s) (i.e., years or decades).

Outcome Documentation

The outcome of this scoping step should be clear, well-supported documentation of:

1. the methodologies used in the determination of temporal boundaries, including descriptions and rationale for scenarios if this approach is taken;
2. the chosen past temporal boundary for the consideration of cumulative effects for each VC;
3. the future temporal boundary for the cumulative effects assessment for each VC; and
4. how the chosen temporal boundaries will adequately capture the expected cumulative effects.

The outcome documentation should be commensurate with the level of effort established. The documentation could involve a narrative description of each determined temporal boundary, or a table listing the VC with its chosen temporal boundary, accompanied by explanatory text.

1.4 Examining physical activities that have been and will be carried out

Examining physical activities that have been and will be carried out is done as part of the scoping step (see Figure 2). The four elements of scoping are complementary, allowing for the results of each to inform integrated decision-making.

Physical activities to be considered in a cumulative effects assessment are not restricted to those listed in the *Regulations Designating Physical Activities* and those designated in an order made by the Minister under subsection 14(2) of CEAA 2012.

Examples of physical activities are numerous, and include agricultural development, management of a forested area, dredging a water body, hunting, fishing, remediation of a brownfield site, construction of a pulp mill, or operation and decommissioning of a mine. Practitioners should keep in mind that predicting cumulative effects to a VC will tend to be more accurate when all sources of environmental effects to that VC have been reasonably considered.

> **OPS Approach**
>
> *The cumulative environmental effects assessment must consider other physical activities that have been carried out up to the time of the analysis, or will be carried out in the future, provided that these physical activities are likely to have an environmental effect on the same VCs that would be affected by residual environmental effects of the designated project.*

Methodologies

1. Identifying Future Physical Activities

The OPS sets the methodology to be used for identifying future physical activities, by indicating that they are to be included in the cumulative effects assessment if they are certain and should generally be included if they are reasonably foreseeable. Some doubt about whether the physical activity will proceed is acceptable. The level of certainty may not be as high as for the project itself.

> **OPS Approach**
>
> *A cumulative environmental effects assessment of a designated project must include future physical activities that are certain and should generally include physical activities that are reasonably foreseeable.*

A future physical activity would be considered certain to proceed, and would be included in a cumulative effects assessment if one or more of the following criteria are met:

- The physical activity has received approval in whole or in part, such as:
  - environmental assessment approval;
  - pre-development approval for early works, permits for exploration, or collection of baseline data; or
  - some other regulatory approval from a province.
- The physical activity is under construction.
- The site preparation is being undertaken.

A future physical activity would be considered reasonably foreseeable and should generally be included in the cumulative effects assessment if one or more of the following criteria are met:

- The intent to proceed is officially announced by a proponent to regulatory agencies. This information could be found in news media, the proponent's website or via an announcement from the proponent.
- The physical activity is under regulatory review (i.e., the application is in process). This can be known, for example, if information about the review or application is available on a government website, or an EA notice has been made public.
- The submission for regulatory review is imminent. This could be known if the collection of data has already commenced, regulatory authorities have been contacted about information requirements, or through an announcement from the proponent.
- The physical activity is identified in a development plan that is approved or for which approval is imminent (e.g., a wastewater treatment plant in a city's long term development plan).
- The physical activity supports – or is consistent with – the long-term economic or financial assumptions and engineering assumptions made for the project's planning purposes.
- A physical activity is required in order for the project to proceed (e.g., rail or port transportation facilities, or a transmission line).
- The economic feasibility of the project is contingent upon the future development.
- The completion of the project would facilitate or enable the future development.

OPS Approach

The concepts "certain" and "reasonably foreseeable" are defined as follows:

Certain: the physical activity will proceed or there is a high probability that the physical activity will proceed, e.g. the proponent has received the necessary authorizations or is in the process of obtaining those authorizations.

Reasonably Foreseeable: the physical activity is expected to proceed, e.g. the proponent has publicly disclosed its intention to seek the necessary EA or other authorizations to proceed.

The criteria in the last three preceding bullets often relate to what is described as "induced development". If the induced development is *certain* or *reasonably foreseeable*, it should be considered in the cumulative effects assessment. Examples of induced development include housing development that could arise due to the approval of the project.

2. Identifying Past and Existing Physical Activities

The following methodological options, or a combination of them, should be used to determine which past and existing physical activities to include in the cumulative effects assessment.

(a) Using direct evidence relating to past and existing physical activities with VCs

Reasonable effort should be made to identify past and existing physical activities based on direct evidence available from the historical record and other reliable sources, such as reports or ATK.

Data and information on physical activities that occurred in the distant past is often limited. The challenge generally increases as the study extends into the past. In such circumstances, the information is often anecdotal but can still provide some insight into VC response.

Example: It may be known that early settlers cleared land for agriculture in the 19th century but then gradually abandoned part of the land due to changing lifestyles, or due to other factors such as declining fertility or drought. The abandoned portion of land may have naturally regenerated to its current condition of a forest or prairie. The available information is often anecdotal, but still provides an understanding of the environmental effects of agriculture, and informs the predictions of VC response to removal of the stressors.

Data and information on existing physical activities, or those that occurred in the recent past, are much easier to find. Sources include recent EA reports and land-use planning documents.

Example: A new coal mine is proposed in a watershed where there is an existing coal mine that releases selenium in the water that could potentially lead to cumulative effects on fish and fish habitat. The environmental effects of the existing mine in relation to fish and fish habitat must be understood in order to assess the cumulative effects of the new mine in the same region. Furthermore, any other past physical activity that has affected the watershed in relation to fish and fish habitat should be included.

In some cases, information on past or existing physical activities may help identify appropriate mitigation measures. Information on existing physical activities should cover their full lifecycle, particularly if decommissioning is certain or reasonably foreseeable.

(b) Using present-day VC conditions to represent past and existing physical activities

This approach is used to address past and existing physical activities when a practitioner has only limited data and information, and needs a reliable means of making inferences about their effects on VCs. For example, it may be well-known that the current environmental conditions in a forested area exist in response to forest resource harvesting dating back to a distant past, but information on how the harvesting occurred and its impact over time may no longer be available.

OPS Approach

Present-day environmental conditions reflect the cumulative environmental effects of many past and existing physical activities.

In using this option, the practitioner first needs to consider whether the observed present-day VC conditions are indeed representative of the environmental effects of past and existing physical activities in the study area. Efforts are then focused on describing how past and existing activities may have contributed to the current state of VCs.

The practitioner should also attempt to evaluate whether the current VC condition is stable or whether it is still changing in response to past and existing physical activities. For example, an understanding of recovery stages after clear-cuts in similar environments may be helpful in determining whether the present-day VC condition is likely to remain stable or what its future state might be. This helps establish if present-day VC conditions are adequate surrogates for representing past and existing physical activities.

3. Any other option

If any other option is selected to identify past, existing, or future physical activities, it should be fully justified in the context of the project. It must also take into account the OPS, and enable the completion of an environmental impact statement that meets the requirements of the project-specific EIS Guidelines and of an EA that meets the requirements of CEAA 2012. Discussion with Agency staff prior to carrying forward any other option is recommended.

Considerations

Practitioners should take into account the following considerations in deciding which physical activities to include.

(a) Appropriate information to gather about physical activities

As a general rule, the amount of information that can be obtained for future physical activity is usually proportional to the degree of certainty about it proceeding. For a past activity, there is generally more information available for projects that occurred in the recent past.

Each physical activity that is examined should be described in adequate detail *to allow potential environmental effects to be characterized* for later assessment. Key pieces of information to note about other physical activities may include:

- location, physical size (e.g., area covered, volume of process throughput), and spatial distribution of components (i.e., site specific, randomly dispersed, travel corridors);
- components (e.g., main plant, access roads, waste disposal site) and supporting infrastructure (e.g., waste treatment, power lines);
- the expected life or period of activity (including start date), and phasing involved (e.g., exploration, construction, standard operations, later plans for upgraded or expanded operations, decommissioning, and abandonment);
- variations in seasonal operation (e.g., winter closures);
- frequency of use (for intermittent activities – e.g., helicopter use);
- transportation routes and mode of transport (e.g., roads, railways, shipping lanes);
- processes used (for industrial activity – e.g., open pit mining);
- emissions, discharges, and wastes that are likely to be released, and where;
- approvals received (e.g., permit and license conditions in effect); and
- the duration of any in-place or planned follow-up program.

Where a scenario of future development is being employed, data surrogates for key pieces of information may be established by referencing typical development characteristics.

(b) Information constraints

Information about a physical activity may not be readily available if, for example:

- proprietary technology or confidential production records are involved; or
- the design of the physical activity is too preliminary to provide enough useful information.

Information from similar physical activities at other locations (known as surrogate information) may be useful. It could be used in a case where future physical activities are reasonably foreseeable, but there is little information available.

Example: The development of a future gold mine may be considered reasonably foreseeable, but little information is available. Information on the environmental effects of a surrogate mine could be used. For example, the physical activity would probably include an open pit, mill, tailings storage facility, and water treatment facility. Caution in the use of this surrogate information would be required since the mine in question may have different geology or chemistry, processes, and tailings-management issues.

(c) Pathways and categories of environmental effects

Pathway diagrams may assist in identifying and assessing environmental effects of other physical activities on the VCs identified (see Appendix 1: Source-pathway-receptor model).

The use of broad categories to assess physical activities in a generic way may be appropriate, for example, when little detail is available beyond the type of physical activities (e.g., forest resources harvesting), or when there are too many physical activities (e.g., in an urban area or along a highway) to characterize individually. Categories may be established in recognition of the similar patterns in the environmental effects they may cause. Examples include:

- shape (e.g., linear, aerially dispersed, areal point);
- sector type (e.g., resource extraction, power generation, urban infrastructure);
- industry type (e.g., mining, forest resource harvesting, municipal infrastructure); or
- transportation type (e.g., aircraft, boats, road traffic).

This information will be most helpful when conducting the Step 2 analysis described in this document.

Level of Effort for Examining other Physical Activities

Spatial and temporal boundaries are set in light of other elements of scoping, including an understanding of how physical activities had, continue to, or will have an environmental effect on VCs.

The environmental effects of a physical activity on a VC must occur within the spatial and temporal boundaries set for the cumulative effects assessment (using the approaches outlined in this guidance) in order for that physical activity and its environmental effects to be considered in the cumulative effects assessment.

In addition to the level-of-effort considerations outlined in the OPS (see Section 1.0 of this document for OPS level-of-effort considerations), the level of effort needed to identify past, present, and future physical activities will vary with the:

- number of VCs under consideration;
- spatial boundaries selected;
- temporal boundaries selected;
- number of potential physical activities (past, present and future);
- land-use planning and/or applicable management plan information available;
- sensitivity of VCs to the perturbations of various physical activities;
- status of developments; and
- environmental and regulatory review applications for physical activities.

Outcome Documentation

The outcome of this scoping step should be clear, well-supported documentation of the:

1. methodology used in the selection of physical activities;

2. physical activities considered for inclusion which may include a map depicting the location of the physical activities in relation to the project and the VC under consideration; and

3. physical activities considered for inclusion that will not be carried forward for analyzing cumulative effects.

A table or matrix format may be useful for presenting information regarding the rationale for including each physical activity identified and the VCs that they may affect. It may also be used to categorize physical activities as past, existing, or future (certain or reasonably foreseeable). Where there is evidence that certain or reasonably foreseeable physical activities can be seen as induced development, it should be noted. Where scenarios are used to reflect future or past activities, it should also be noted.

The outcome documentation should be commensurate with the level of effort established.

Figure 4: Example of a matrix structure for outcome documentation

Past, Existing, and Future Physical Activities In a Largely Undeveloped Area	Valued Components				
	1	2	3	4	Description
Physical Activity A	✓	✓			This future physical activity is reasonably foreseeable, since it is currently under regulatory review. It has the potential of affecting VC#1 & VC#2, given the nature of the physical activity and predicted effects pathways within the spatial boundaries established for these VCs. Furthermore, such effects on VC#1 & VC#2 are likely to occur within the same timeframe as the potential effects of the project on the same VCs. The effects of Physical Activity A and those of the project therefore both fall within the established temporal boundaries for VC#1 and VC#2. The environmental effects of Physical Activity A on these two VCs will be considered further in the Step 2 analysis.
Physical Activity B	✓	✓	✓		This is a past activity that will yield useful information about potential future effects on VC#1, VC#2 and VC#3…
Physical Activity C			✓	✓	This is a certain future physical activity with potential effects on VC#3 and VC#4. In the context of the area, it can be considered induced development…
…					
Physical Activity X					This activity is not expected to affect any of the VCs identified for the cumulative effects assessment, therefore it is not included.

2.0 Overview and Outcomes of the Analysis

Step 2 of the framework is analysis of cumulative effects (see Figure 1).

This step builds on the results of scoping (Step 1) and considers how all physical activities identified during the scoping stage may affect the VCs within the spatial and temporal boundaries determined for the assessment of cumulative effects.

Step 2 analysis focuses on understanding the cumulative effects for each VC retained for further analysis.

Methodologies

Assessment of cumulative effects requires an understanding of both the estimated cumulative effects on VCs and the contribution of the project to cumulative effects.

The source-pathway-receptor model (see Appendix 1: Source-pathway-receptor model) can be used to depict the relationship between the project (as one of the sources of an environmental change) and the VC (as the receptor affected by the change).

One of the following options, or a combination of them, can be adopted as a methodological approach to analyze cumulative effects in a way that addresses the total cumulative effects on each VC and the contribution of the project to such effects.

> **OPS Approach**
>
> *The methodologies used to predict cumulative environmental effects must be clearly described. With this information, reviewers of the EIS will be able to examine how the analysis was conducted and what rationale supports the conclusions reached. Any assumptions or conclusions based on professional judgment should be clearly identified and described.*

1. Comparison using reference case(s)

Data from other areas with comparable conditions, or from a reference case, can be used to analyze or understand potential cumulative effects. Comparable conditions can include similar environments, or environments that are experiencing similar environmental effects as a result of similar physical activities. Some past physical activities may be included as a reference because they provide the best source of information for understanding past environmental conditions.

> Example: An open metal mine in an area of boreal forest where there is forest resource harvesting and TLU by Aboriginal groups could be a reference case for an open pit mine in a similar environment in a different part of the country.

The results of monitoring and follow-up of other similar physical activities that have similar receiving environments can be one source of information. This method is useful only when the reference case is comparable. The EA should include a rationale for the use of a reference case and explain its relevance, limitations, and assumptions for assessing the cumulative effects of the project.

2. Comparison using models

Predictive models can generate information that supplements available data or simulates existing and future conditions in those cases where data are limited or difficult to attain. Models can also estimate the response of a VC to cumulative effects.

Models can be qualitative (e.g., a conceptual model, typically less data-intense) or quantitative (e.g., a numerical model, typically more data-intense). The most common use of quantitative models is to predict the state of a physical condition or chemical constituent by using a computer-based application to assess various indicators or parameters such as air and water quality, species condition or response, water volume flows, airborne deposition on soils and vegetation, and habitat condition. Qualitative models can include descriptive narratives or graphic representations that illustrate the conceptual relationships between the environment and human activities.

Example: To model changes to groundwater flow directly linked to a *Navigation Protection Act* authorization under section 5 (2) of CEAA 2012, two types of models may be considered. A conceptual model would illustrate how groundwater flow may be affected by a project and other physical activities. A computer simulation of groundwater flow may predict the potential numerical quantity and quality of groundwater under a range of future conditions (e.g., future phases of the project or different mitigation measures), with or without the project.

Where models are used, it is necessary to provide the rationale for the chosen methodology, the assumptions involved in its use, and the limitations of the predicted data, including uncertainty on data interpretation, and statistical error and confidence.

3. Any other option

If any other option is selected, it should be fully justified in the context of the project. It must also take into account the OPS, and enable the completion of an EIS that meets the requirements of the project-specific EIS Guidelines and of an EA that meets the requirements of CEAA 2012. Discussion with Agency staff prior to carrying forward any other option is recommended.

Considerations

Practitioners should take into account the following considerations in conducting the analysis.

Environmental effects of other physical activities can interact with those of the project in various ways. For example, some effects may be simply additive, while others may result in effects greater than if they had occurred on their own (for more information, see Appendix 2: Types of Cumulative Effects).

Changes in the state of a VC may therefore be attributable to different changes to the environment resulting from the project and other physical activities that are acting together on the VC in various ways. In considering how various physical activities may interact to affect a VC, practitioners may find it helpful to compare the predicted future environmental state of the VC, both with and without the project.

Methodologies outline in broad terms how cumulative effects can be analyzed. For any methodology, a range of methods can be employed. For more information on types of methods that can be employed, see Appendix 3.

Level of Effort for the Analysis

In addition to the overall level-of-effort considerations outlined in the OPS (see Section 1.0 of this document for OPS level-of-effort considerations), the level of effort needed to undertake the analysis of cumulative effects will vary depending on the:

- sensitivity of the VC to the environmental effects of the project;
- likely contribution of the project to cumulative effects;
- complexity of a VC's response to multiple environmental stressors;
- state (health, status, or condition) of a VC with regard to known thresholds, standards or benchmarks;
- past or existing disturbance levels and extent of other physical activities that are or may contribute to cumulative effects on the VC; and
- selected methods used for the assessment.

Outcome Documentation

The outcome of the analysis should be a clear, well-supported documentation of the:

1. methodological approach and methods used and the rationale for their use;
2. estimated cumulative effects on VCs resulting from the project in combination with the environmental effects of other physical activities that have been or will be carried out, including the analysis conducted and rationale supporting the conclusions reached; and
3. contribution of the project to the cumulative effects, considering past, existing, and future physical activities, to facilitate the identification of appropriate mitigation.

The outcome documentation should be commensurate with the level of effort established.

2.1 Analyzing Various Types of Data and Information

Having access to data and information related to other physical activities and traditional and community knowledge is critical for conducting the Step 2 analysis.

To make decisions about which data is to be collected or generated, practitioners should have a clear understanding of how the data and information will be used in the assessment, how to establish a proper scale of analysis, and what methodologies and specific methods will be employed for their analysis.

> **OPS Approach**
>
> *Data collection and/or generation are important components of a cumulative environmental effects assessment. At times, it may be challenging to obtain or generate data to support the analysis.*

Methodologies

The methodological options presented here orient the analysis of various types of data and information frequently used in a cumulative effects assessment.

1. Using information about current and past environmental conditions

The purpose of baseline information is to develop a point of reference – before a project is developed – against which cumulative effects can be predicted and assessed. In order to analyze cumulative effects, it is essential to understand the state of the receiving environment into which a project is entering. This means that, for each selected VC subject to analysis, information should be gathered on its state within the determined spatial and temporal boundaries.

The OPS recognizes that a description of past environmental conditions can at times improve the understanding of cumulative effects for a specific VC. As such, practitioners should make reasonable efforts to understand the extent to which past and present physical activities are responsible for baseline conditions.

> **OPS Approach**
>
> *A description of past environmental conditions can at times improve the understanding of cumulative environmental effects for a specific VC.*

Baseline data can be compared to past conditions to reveal spatial or temporal patterns or trends so that predictions can be made. Information on past environmental conditions may also help establish if present-day VC conditions are likely to be stable. For example, data and information on the response of a forested area to harvesting over time may help establish if the current state has reached equilibrium and/or if the response over time corresponds to the body of knowledge on recovery stages.

Some characteristics of useful baseline information for the purpose of a cumulative effects assessment under CEAA 2012 include:

- detailed data (either qualitative or quantitative) are available for each selected VC within the spatial and temporal boundaries identified for the cumulative effects assessment;

- natural variability, drivers of change, and historical shifts for the VC are identified, if reasonably obtainable;
- trends or spatial patterns in quality, quantity, value, or use of VCs are identified where reasonably obtainable;
- the current status of the existing environment is presented in the context of relevant benchmarks; and
- data or perspectives relevant to baseline conditions include those that are obtained through community and/or ATK, where appropriate.

Models may be used to generate baseline conditions. For more information on conceptual and numerical models, see Appendix 3.

2. Using information on the environmental effects of physical activities

The focus of a cumulative effects assessment is on understanding key environmental effects on specific VCs. In achieving this understanding, it is necessary to gather information on the physical activities identified during scoping.

Pathway diagrams are useful to identify and evaluate potential cumulative effects on VCs by exploring linkages to other physical activities (see Appendix 1 for more information).

However, as a region becomes more heavily disturbed due to many actions, it may become difficult and less relevant to determine which physical activity is contributing to specific environmental effects, and to what degree. While attributing specific environmental effects to individual physical activities may not always be feasible, estimation of the cumulative effects on VCs should still be possible.

It is important to consider if past physical activities that are no longer physically present, operating, or active continue to affect an identified VC (e.g., ongoing environmental effects of an abandoned gravel pit, or a contaminant plume from a brownfield site). In some cases, the source and pathways of environmental effects may no longer be readily observable; however, they may continue to affect the state of the receptor VC.

If the state of the VC is likely to be stable, then the cumulative effects assessment can address how the baseline will be further affected by additional changes in the environment due to future activities. On the other hand, if the VC is still changing as a result of past or existing activities, then the analysis has to address two influences: how past and existing activities are expected to affect the future and how future activities will affect the future.

OPS Approach

Information on the environmental effects of past or existing physical activities may be helpful:

- *if the effects of past or existing physical activities on a specific VC will help predict the environmental effects of a designated project;*
- *if information on past or existing physical activities will assist in the identification of appropriate mitigation measures for the designated project; or*
- *if an existing physical activity will be decommissioned in the future and this decommissioning would affect the future condition of a specific VC.*

With complex interactions, the whole does not necessarily correspond to the sum of the parts. Continuing environmental changes associated with past and existing activities may result in a worsening or improvement of VC conditions. Where there is evidence that effects are not simply additive, it should be noted.

Consideration should also be given to whether an existing physical activity will be decommissioned in the future, and whether this decommissioning might affect the future condition of a specific VC.

Example: The operation of a generating station releases cooling-water effluent in a lake that results in a change in the fish population due to thermal pollution. The fish population is also affected by fishing and sewage-related pollutants from residential development on the lake's shores. All of these types of environmental effects on the fish should be included in the cumulative effects assessment.

3. Using Aboriginal traditional knowledge and community knowledge

Community knowledge and ATK available to the proponent should be incorporated into the cumulative effects assessment.

Collection and use of ATK is covered in the reference guide *Considering Aboriginal traditional knowledge in environmental assessments conducted under the* Canadian Environmental Assessment Act, 2012.

How community knowledge and ATK available to the proponent are used for the assessment of cumulative effects should be described and be a part of the selected methodological approach, without breaking obligations of confidentiality, if any, while also maintaining appropriate ethical standards. Legislated requirements associated with access to information must be considered.

OPS Approach

Community knowledge and ATK available to the proponent should be incorporated into the cumulative environmental effects assessment, in keeping with appropriate ethical standards and without breaking obligations of confidentiality, if any.

Considerations

(a) Establishing the proper scale for analysis

The assessment area for cumulative effects may be larger than required for the assessment of the project-related environmental effects to capture the greater extent of overlapping cumulative effects of other physical activities. The type of data required may change as the scale of the assessment changes.

Where cumulative effects extend over larger areas, the assessment may have to be based on satellite imagery or existing habitat surveys completed at very broad scales.

Example: Maps or photo mosaics at scales ranging from 1:250,000 to 1:50,000 are sometimes used to depict broad-level baseline environmental data for the purposes of a cumulative effects assessment (e.g., to convey available habitat). In some cases, it may be more instructive to include photos of the area (regular or panoramic views) and surrounding areas rather than maps (e.g., to depict changes in viewscape).

In other cases, practitioners may rely on various landscape-level metrics, such as linear feature density, as a predictor of the change in VC health, status, or condition, or to characterize the degree of disturbance or activity. Regardless, practitioners should select appropriate scales and tools to support meaningful evaluation.

In some cases, the scale is small and relies on field surveys.

Example: Species-at-risk studies may be relatively intensive within the proposed footprint of the project and involve on-site mapping.

(b) Selecting the appropriate analytical method

Different methods can be used to analyse the data and information (see Appendix 3). Selecting the method to be used will depend on the nature of the data and information available and generated for the cumulative effects assessment, as well as the nature of the VC and pathways of effects.

Level of Effort for the Analysis

In addition to the overall level-of-effort considerations outlined in previous sections of this document, the level of effort needed to undertake the analysis of cumulative effects will vary depending on the:

- amount of data collection or generation required to predict cumulative effects with an appropriate methodological option;
- quality/quantity of information collected about cumulative effects for each VC during the scoping process;
- quality/quantity of information available about the environmental effects of other physical activities that contribute to cumulative effects;
- amount of existing knowledge on a VC’s sensitivity to environmental effects (natural and anthropogenic); and
- amount of data judged useful for mapping.

Outcome Documentation

EA documentation must clearly explain and justify the methodologies and methods that have been used to assess cumulative effects.

Practitioners should clearly document with the following supporting information:

1. types of data and information that were gathered or generated for each VC, and why they were sought;
2. specific methods that were used to gather or generate this data and information, and why they were selected;
3. specific methods that were used to analyze this data and information, and why they were selected; and
4. the results of the analysis for each VC and how such VC-specific results were used in predicting cumulative effects (as per section 2.0).

The outcome documentation should be commensurate with the level of effort established.

2.2 Addressing Data Limitations and Uncertainty in the Analysis

Collecting and using appropriate data and information is central to the analysis of cumulative effects. A reasonable attempt to collect data and information must be demonstrated. A lack of reliable data and information will tend to make the predictions less certain, and potentially faulty.

Few – if any – cumulative effects predictions are certain. Uncertainties associated with information and methods may occur at many points in the process of analyzing cumulative effects. For example, there may be poor information about other physical activities, or conflicting reports about the effectiveness of mitigation measures. Even where the data are reliable, data interpretation could be challenging. For example, it may not be clear to what extent an effect pathway is likely to result in a change in the environment.

Practitioners must meet the requirement to assess cumulative effects in the face of data limitations and uncertainty. The EIS should present a complete picture of the potential scale of cumulative effects and the data required and used for their assessment. While there are frequent data limitations in cumulative effects assessment that cannot be fully overcome, the uncertainties that result from these limitations should be documented.

Assumptions used in modelling and other analytical methods may limit the analysis. Where possible, it should be noted whether the results are robust (i.e., not sensitive to small changes in assumptions).

OPS Approach

Potential cumulative environmental effects should be considered, as appropriate, in the analysis, even when there is little supporting data or there is predictive uncertainty.

Reviewers of the EIS should be presented with a complete picture of the potential types and scale of cumulative environmental effects. In all cases, uncertainties and assumptions underpinning an analysis should be described and information sources clearly documented.

Methodologies

Various methodologies used to address data limitations and uncertainties in a project EA are also useful in considering cumulative effects.

1. **Documenting efforts and limitations**

A reasonable attempt to collect information must be demonstrated. A lack of usable information for the analysis can have important implications to the predictive certainty of the cumulative effects assessment.

Where there is little supporting data, or where there is predictive uncertainty, the assessment of cumulative effects should still be conducted.

Limitations imposed by data and other types of uncertainty should be clearly described. This involves outlining how these limitations affected the choice of methodology and assumptions.

2. Using various sources and types of knowledge

A variety of approaches for addressing data limitations are available and have been mentioned in other parts of this technical guidance, including:

- use of ATK and community knowledge to fill data gaps;
- use of surrogate data from similar areas to estimate past environmental conditions;
- use of surrogate data from similar physical activities to predict cumulative effects;
- modelling to assess possible cumulative effects over the range of future conditions; and
- inferences based on an appropriate body of knowledge, using professional judgment.

3. Using scenario building

Scenario building may be useful to account for a range of future conditions for a VC and address uncertainty regarding the future state of a VC.

Scenario building consists of describing a set of possible alternatives that might reasonably take place leading to several possible past or future conditions. They are most helpful for studies of the mid- and long-range future and when several alternative scenarios – each one significantly different from the others – are to be considered.

Scenario building can be difficult and costly. It is often best undertaken as part of a regional approach, such as a regional study or planning exercise.

4. Using adaptive management

Adaptive management may be an appropriate strategy for helping to reduce uncertainty about the environmental effects and the effectiveness of mitigation. Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project.

However, a commitment to implementing adaptive management measures does not eliminate the need for sufficient information regarding the cumulative effects of the project, the significance of those effects, and the appropriate mitigation measures required to eliminate, reduce or control those effects.

For further information on adaptive management, see the Agency's *Operational Policy Statement: Adaptive Management Measures under the* Canadian Environmental Assessment Act, or any future updates to that document.

Considerations

Although aspects of cumulative effects cannot be known with certainty, that does not mean the EA is deficient. The practitioner must simply strive to provide the best information to support decisions about the project.

In determining whether data and information should be obtained or generated, practitioners should consider the ability, cost, and utility of the data to be collected, its intended use, and the limitations to its use in the assessment of cumulative effects.

Caution should be exercised if the degree of uncertainty is unusually large (e.g., effects are expected in the future, but it is not possible to predict whether they will improve or harm a particular VC). In these cases, predictions will be highly sensitive to the assumptions made. Relying on a particular assumption could result in a faulty conclusion. It would therefore be appropriate to present the results as a range, in line with the range of underlying assumptions.

In addition, a Step 5 follow-up program can be established to monitor the VC. This will help determine whether the mitigation measures identified in Step 3 are appropriate in the face of actual environmental effects.

Level of Effort for Uncertainties

The level of effort needed to address uncertainty will depend on:

- what decisions were made in Steps 1 and 2 concerning VCs, methodologies, methods, data collection and level of effort; and
- what is required to clearly state assumptions and data limitations throughout the EA.

Outcome Documentation

In addition to the criteria identified in previous subsections on analysis, the outcome of the analysis should be a clear, well-supported documentation of:

1. model assumptions and data limitations in the assessment of cumulative effects; and
2. the implications of these assumptions and limitations for the predictive certainty of the underpinning a cumulative effects assessment.

The outcome documentation should be commensurate with the level of effort established.

Appendix 1: Source-pathway-receptor model

This reference document provides information on the source-pathway-receptor model as background information. This model (see Figure 5) is used in EAs to identify:

The source of an environmental change (source)

The source is the activity or event that causes environmental stresses. For example, the source might be the project (i.e., a mine) or another physical activity (i.e., agriculture).

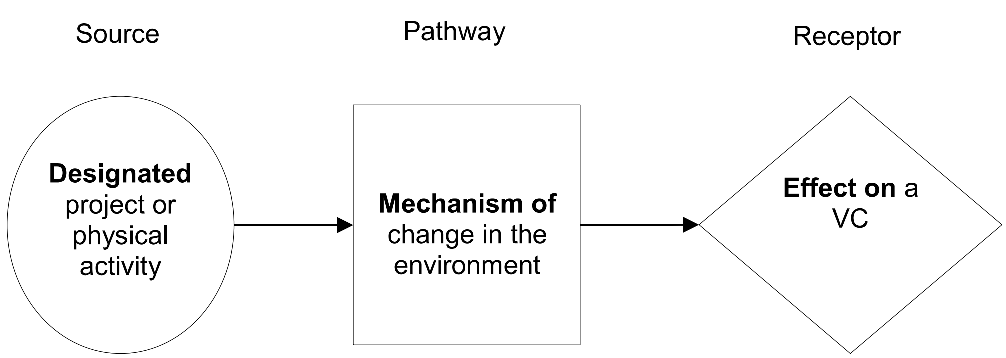
What the source may affect (receptor)

The receptor is the environmental component that is affected by the impacts of a physical activity. Since receptors differ in health and resiliency, each receptor has its own, unique sensitivity to environmental change. These receptors are the focus of the cumulative effects assessment and are typically referred to as VCs.

How the source may reach the receptor (pathway)

The pathway is the route the source takes to reach a VC. Pathways are the mechanisms through which a change in the environment occurs. Pathways can include physical or chemical transport through air, water, soil, animals, food supplies, etc. In order to consider cumulative effects, it is essential to understand these mechanisms and the state of the receiving environment within which a project takes place.

Figure 5: Source-Pathway-Receptor Model



Appendix 2: Types of cumulative effects

This reference document provides information on types of cumulative effects.

It is important to consider how cumulative effects may interact and manifest in practice in order to make sound and justifiable predictions about their significance. Key types of cumulative effects presented in this reference document include:

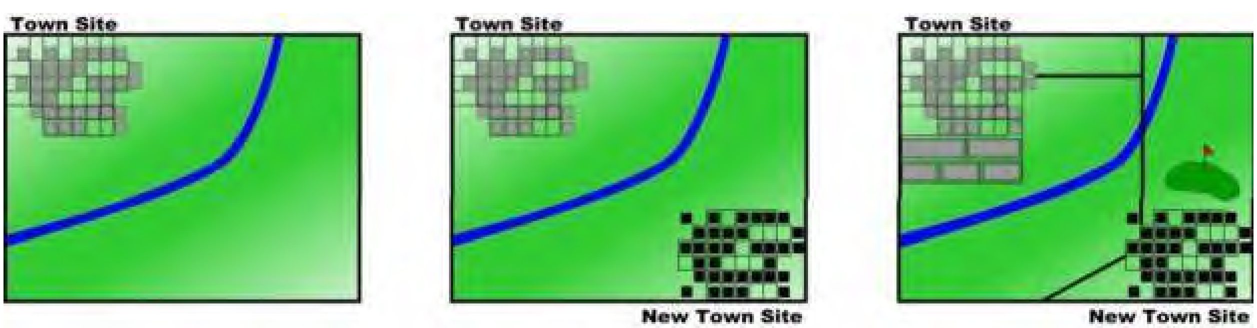
- additive;
- synergistic;
- compensatory; and
- masking.

Determining how cumulative effects occur can be a complex task, and can vary based on the VC being assessed. For example, even if the cumulative effects on habitat are additive, the ultimate effect on a species may be synergistic. Although classifying cumulative effects can be helpful to conceptualize various forms of cumulative effects, the critical point is the need to assess how the cumulative effects are acting on VCs (Duinker & Grieg 2006).

Additive cumulative effects

An additive cumulative effect is the sum of individual effects of two or more physical activities. Figure 6 demonstrates the loss of habitat increases with each new element of development (a new town, followed by new roads and a golf course).

Figure 6: Additive cumulative effects[1]



Synergistic cumulative effects

A synergistic cumulative effect occurs as a result of the interaction between two or more effects, when the resultant combination is greater or different than the simple addition of the effects. Consider the example described in the following text and shown in Figure 7 (adapted from Greig, L.A. et al, 2003).

[1] Source: Gartner Lee Ltd. 2006. *Cumulative Effects Assessment "Tips" Document*

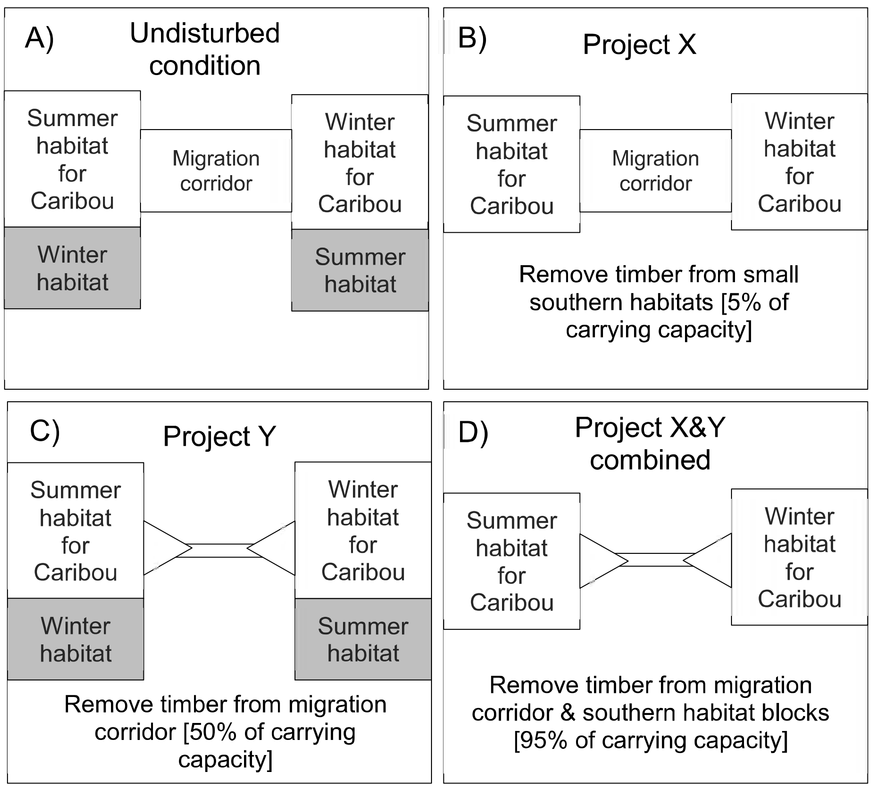
Panel A: Caribou habitat is divided in two large blocks joined by a migration corridor. Each block has contiguous winter and summer habitats, but their proportions are unequal and reversed in the two blocks.

Panel B: Harvest of timber is assumed to remove the small southern areas of winter and summer habitats with relatively little effect on carrying capacity for the migratory caribou herd.

Panel C: Harvest of timber in the migration corridor is assumed to almost completely block migration. Animals stranded in one or the other large habitat block need to find life requisites for the entire year in that block by utilizing the smaller habitat blocks, and the carrying capacity is substantially reduced.

Panel D: The synergistic cumulative effects of both projects combined is expected to reduce the caribou carrying capacity of the total area much more than the sum of the carrying capacity reductions of the two actions when taken independent of each other.

Figure 7: Synergistic cumulative effects[2]



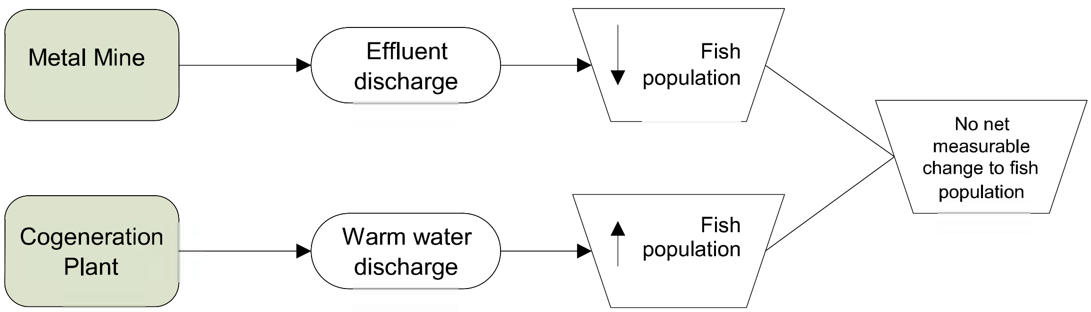
2 Source: Greig, L.A. et al, 2003

Compensatory cumulative effects

Compensatory cumulative effects are effects from two or more physical activities that "offset" each other.

For example, as illustrated in Figure 8, a metal mine project might cause a decrease in a specific fish population due to effluent discharges, while a cogeneration plant might enable an increase in this same population through its warm water discharges. These effects may offset each other and, accordingly, the cumulative effects on this fish population may not be measureable.

Figure 8: Compensatory cumulative effects[3]



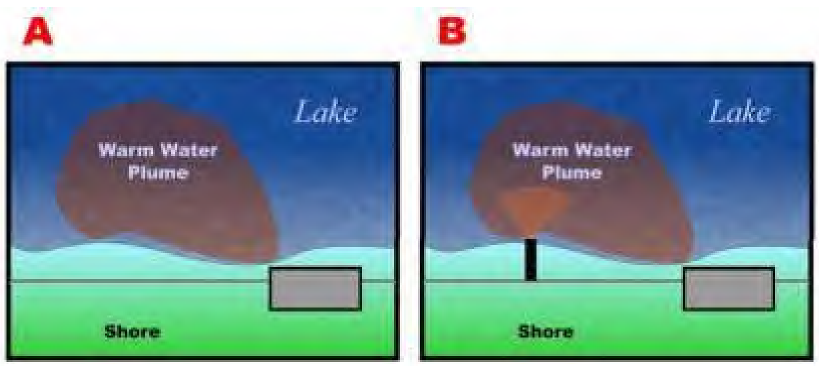
[3] Source: Adapted from Gartner Lee Ltd. 2006. *Cumulative Effects Assessment "Tips" Document*

Masking Cumulative Effects

The effects of one project might mask the effects of another in the field. For example, as illustrated in Figure 9, the warm water plume associated with a generating station (shown under “A” in Figure 9) may be of such magnitude that the effects of a small plume associated with another project (introduced as shown under “B” in Figure 9) would not be detected. If the generating station were to stop its physical activities, then the effect of the other project would become visible.

It is therefore possible that the effects of an earlier project could mask the effects of a new project. In this case, it is reasonable to conclude that the new project is not likely to result in environmental effects. This conclusion is correct as long as the effect of the earlier project continues. Once this earlier project is terminated, the effect from the new project would become evident. If masking of cumulative effects is predicted, a follow-up program may be required to ensure that mitigation measures remain effective in managing cumulative effects when the earlier project is terminated.

Figure 9: Masking Cumulative effects[4]



References

Gartner Lee Ltd. 2006. *Cumulative Effects Assessment “Tips” Document.* Prepared for the Canadian Environmental Assessment Agency.

Greig, L. A., P. N. Duinker, R. R. Everitt, and K. Pawley. (2003). Scoping for cumulative effects assessment. Prepared for Indian and Northern Affairs Canada Environment Directorate, Whitehorse, Yukon Territory. ESSA Technologies Ltd., Richmond Hill, Ontario.

Duinker, P. N., & Greig, L. A. (2006). The impotence of cumulative effects assessment in Canada: ailments and ideas for redeployment. *Environmental Management*, *37*(2), 153-161.

[4] Source: Gartner Lee Ltd. 2006. *Cumulative Effects Assessment “Tips” Document*

Appendix 3: Selecting the methods to be used

This Appendix provides a brief introduction to some of the methods that may be used in the cumulative effects assessment for Step 1 (scoping) or Step 2 (analysis).

Numerous methods are available for conducting a cumulative effects assessment, and often these are simply typical EA tools modified to better consider cumulative effects. The methods discussed in this Appendix include:

- Questionnaires and Interviews;
- Checklists and Matrices;
- Network and Systems Analysis/Diagrams;
- Indicators and Indices;
- Conceptual and Numerical Models;
- Trend Analysis; and
- Spatial Analysis.

Questionnaires and Interviews

Description

Questionnaires and interviews are a means of gathering a broad range of information from knowledgeable or interested individuals.

These methods can be used to collect information about past, present, or planned development projects, baseline data, changes in the socio-economic environment over a period of time, and opinions about where, why, and how cumulative effects may occur.

Applicability to Cumulative Effects Assessment

Interviews and questionnaires can be used to assist in the collection of baseline data and increase understanding of the environmental effects of other physical activities, the VCs affected, and possible mitigation measures. Interviews and questionnaires are most applicable to the scoping of the cumulative effects assessment.

It can be useful to interview experts during scoping and/or analysis to provide a range of expert knowledge during a cumulative effects assessment.

Checklists and Matrices

Description

A checklist is a simple method that can be used to record VCs and potential cumulative effects, but is not typically useful for analysis.

Matrices can be used to summarize and present complex information in a concise manner. Matrices are two-dimensional grids, with information arranged in rows and columns. Practitioners can enter data in the form of descriptive words, symbols, or numbers into the grid to record and organize information. Matrices range from simple interaction matrices, with project physical activities along one axis and VCs along the other, to more complex matrices that describe potential cumulative effects. Matrices can also describe mitigation and follow-up relative to specific cumulative effects.

Applicability to Cumulative Effects Assessment

Checklists are most applicable to the scoping of the cumulative effects assessment to, for example, help highlight common or likely cumulative effects among physical activities and the project under consideration.

Matrices can be used to present and organize information on the cumulative effects of a project and other physical activities on VCs. They are often used to identify the likelihood of cumulative effects on one or more VCs. They can also be used to score or rank cumulative effects. Matrices are often used in EA reports to add information such as mitigation and follow-up recommendations, and even the significance of the cumulative effects and the contribution of the project.

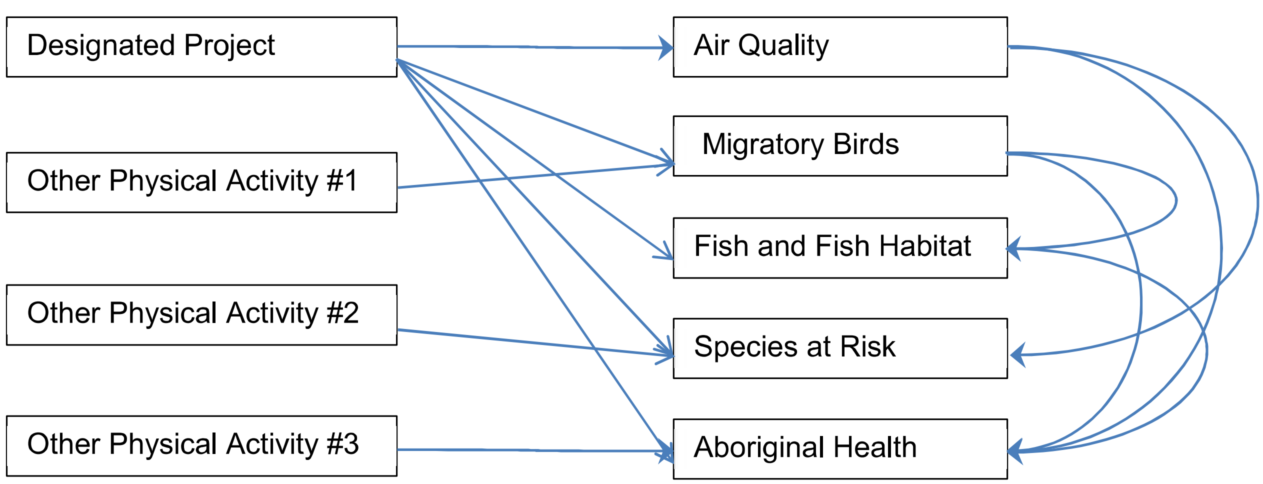
Network and Systems Analysis/Diagrams

Description

Network and systems analysis identifies the pathway of cumulative effects using a series of chains or webs between a proposed action and a VC. This method is based on the concept that there are links and interactions between individual VCs. A VC is affected not only directly by the source activity, but also indirectly through another VC. This method uses a network or system diagram, which is essentially a flow chart with connector lines between a project and/or physical activities and VCs.

An example of a network or system diagram for cumulative effects assessment is provided in Figure 10.

Figure 10: Network or system diagram of cumulative effects



Applicability to Cumulative Effects Assessment

By mapping cause-and-effect relationships among projects, other physical activities, and VCs, possible cumulative effects can be identified. Network and systems analyses are most applicable to the scoping of the cumulative effects assessment, and can be helpful to identify the pathways among a project, multiple other physical activities, and multiple VCs.

Indicators and Indices

Description

In EA, an indicator is a measurable variable and an index is an aggregation of variables. Both can represent the state (health, status, or condition) of a VC. For example, if caribou are selected as a VC, then indicators might include the total size of the herd, the density of animals in a habitat, and rates of mortality and reproduction.

An indicator or index can represent environmental effects on more than one VC. For example, habitat fragmentation can be an indicator of habitat quality for wildlife or vegetation or the use of land for traditional purposes by Aboriginal peoples.

Stress Indicators

Stress indicators are measurements that provide information about the attributes of human-caused disturbances or the surrounding environment, such as the magnitude, intensity, and frequency of physical activities, or natural phenomena that may bring about changes in environmental components. Some examples of stress indicators for which models have been developed and have been correlated to specific VC conditions include kilometres of roads per square kilometre; total cleared area; percent of area disturbed by class of activity; total area burned; and stream crossing density.

Ecological Indices

An ecological index is a numerical or descriptive categorization of a large quantity of ecological data or information involving multiple metrics. It is used to summarize and simplify information, to make it useful to decision-makers and stakeholders. Some examples of ecological indices are core habitat area, habitat patch size, index of biological integrity, and Hilsenhoff biotic index.

Social Indicators

Social indicators provide information on social VCs and facilitate comparisons over time that are well-suited for examining long-term trends in a community. Some examples of social indicators are population size and growth, equity (distribution of benefits), quality of life (self-assessed), locus of control (psychological), and cultural well-being.

Applicability to Cumulative Effects Assessment

Indicators and indices can be used during the scoping, analysis, significance, and follow-up steps of the cumulative effects assessment. For the determination of significance, indicators and indices can form the basis for establishing benchmarks. In cumulative effects assessment, indicators and indices can be useful for:

- summarizing and communicating information on the health, status, or condition of a VC, either in the present or historically;
- increasing the understanding of a VC's response to environmental effects;
- acting as a tool for evaluating VC sustainability over time;
- evaluating the effectiveness of mitigation measures and cumulative effects management strategies; and
- planning follow-up, monitoring, and adaptive management programs.

Conceptual and Numerical Models

Description

Conceptual and numerical models are methods that represent or simulate the environmental interactions among projects, VCs, and other physical activities. Models used in cumulative effects assessment can be qualitative (conceptual models) or quantitative (numerical models).

Conceptual Models

Conceptual models are generalizations of reality that provide an understanding of a more complex process or system. They represent the relationships among receptors (e.g., VCs), stressors (e.g., environmental effects), and sources of stressors (e.g., projects or other physical activities). The outputs from conceptual models are typically qualitative or descriptive narratives, or graphic representations, such as a matrix or a box-and-arrow diagram.

Conceptual models may enhance understanding of the response of VCs to environmental effects resulting from past and existing physical activities. They may also serve as a useful tool to represent the structure, functions, and hierarchical relationships of the terrestrial, aquatic, and atmospheric systems affected by physical activities.

Numerical Models

Numerical models are a set of mathematical equations developed to simulate the behaviour of a system over time. They enable the quantification of cause-and-effect relationships by representing environmental conditions. A model could focus on a particular VC (e.g., water quality), or could represent a complex natural system. Some examples of commonly used numerical models are hydrological and hydrogeological models, air and water dispersion models, and species habitat models. In order to assess changes in the environment, such as air and water quality, water volume flows, and airborne deposition on soils and vegetation, numerical models usually require computers to provide solutions using complex and iterative numerical methods.

Modeling is a powerful technique for quantifying the cause-and-effect relationships leading to cumulative effects. Once the linkages have been quantified, numerical models can be used to make predictions into the future.

Applicability to Cumulative Effects Assessment

In a cumulative effects assessment, models can be used to identify and provide:

- the characteristics and interactions between VCs, the project, and other physical activities;
- the anticipated cumulative effects of multiple physical activities or events within identified study spatial and temporal boundaries;
- linkages of processes and environmental effects across disciplinary boundaries; and
- a scientific basis for the identification of VCs and their associated indicators, the establishment of spatial and temporal boundaries, the identification of other physical activities, and the prediction of cumulative effects.

For example, the Impact Model approach involves testing the validity of a statement, similar to that made in a scientific hypothesis. Such hypotheses provide a clear basis for prediction of cumulative effects by setting out how cumulative effects are likely to arise, and the accompanying rationale for a prediction.

Trends Analysis

Description

Trends analysis assesses the health, condition, or status of VCs over time, and is commonly used to develop projections of past or future conditions. The trend is often described relative to an environmental benchmark. The objective of trends analysis is to identify a pattern – in the form of a mathematical equation – which represents the behaviour of a VC. To support trends analysis, the data can be depicted in various ways, including:

- a simple quantitative indicator of a trend, such as numbers of animals from annual surveys, to reflect changes in population levels over time;
- a series of figures illustrating changes in habitat pattern;
- video simulations from a modelling exercise, showing complex changes in geographic or aesthetic resources; and
- aerial imagery showing time-series information.

Applicability to Cumulative Effects Assessment

Trends can help practitioners identify cumulative effects issues, establish appropriate environmental baselines, or project future cumulative effects.

Spatial Analysis Using Geographic Information Systems

Description

Spatial analysis is a method for identifying the spatial distribution of effects or analyzing geographic information. Spatial analysis can be applied to a range of physical activities and environmental conditions, and is used for identifying physical effects in terms of geographical location. Geographic information systems (GIS) are the most commonly used tool in spatial analysis.

Geographic Information Systems

GIS typically involves the preparation of maps or layers of geographic information that are then superimposed on one another. The layered map can be used to provide a composite picture of the baseline environment.

With GIS it is possible to correlate measures of disturbance to physical activities and relate those disturbances to the occurrence of VCs. This is a tool for creating a model of cause-effect relationships.

Overlay Mapping

Overlays provide a technique for illustrating the geographical extent of different environmental effects. Each overlay can be a layer of information, such as a map of a single impact. When superimposed on one another, the overlaps illustrate areas where there are potential cumulative effects.

With GIS software, overlay mapping is particularly suitable for pinpointing sensitive zones where development should not occur. This can then serve as the basis for land management proposals and other mitigation measures.

Applicability to Cumulative Effects Assessment

Spatial analysis is useful for identifying where cumulative effects may occur as a result of the geographic location of the project in relation to other physical activities.

GIS is also a useful tool in cumulative effects assessment owing to its ability to store, manipulate, and display large sets of complex, geographically referenced data. It is well suited to complex spatial applications, and can be used to display the consequences of multiple actions and to support mitigation proposals for undertaking cumulative effects assessments.

Canadian Environmental Assessment Agency
Agence canadienne d'évaluation environnementale

Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the *Canadian Environmental Assessment Act, 2012*

Interim Technical Guidance

March 2018

Version 1

Canada

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Document Information

Disclaimer

Please be advised that this draft guidance piece is an interim document. The Agency is currently reviewing the Environmental Assessment process and as a result of the review, EA practice, policies and procedures may change. This draft guidance document reflects current practice under the Canadian Environmental Assessment Act, 2012 (CEAA 2012).

This Technical Guidance is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) or its regulations. In the event of an inconsistency between this document and CEAA 2012 or its regulations, CEAA 2012 or its regulations would prevail.

For the most up-to-date versions of CEAA 2012 and regulations, please consult the Department of Justice website.

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Updates

This document may be reviewed and updated periodically. To ensure that you have the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

Table of Contents

LIST OF ABBREVIATIONS AND ACRONYMS

Agency	The Canadian Environmental Assessment Agency
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
EA	Environmental Assessment
EIS	Environmental Impact Statement
Minister	Minister of the Environment
OPS	Operational Policy Statement
Project	A designated project under CEAA 2012 for which the Agency is the responsible authority
Project EA	EA of designated projects conducted under CEAA 2012 for which the Agency is the responsible authority
VC	Valued Component

INTRODUCTION

Context

The *Canadian Environmental Assessment Act, 2012* (CEAA 2012) aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a project, including cumulative environmental effects.

In addition, CEAA 2012 ensures that a project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the project to be carried out.

Throughout this guidance, the term “environmental effects” refers to environmental effects in areas of federal jurisdiction as described in section 5 of CEAA 2012, which are:

- effects on fish and fish habitat, shellfish and their habitat, crustaceans and their habitat, marine animals and their habitat, marine plants, and migratory birds;
- effects on federal lands;
- effects that cross provincial or international boundaries;
- effects of any changes to the environment that affect Aboriginal peoples, such as their use of lands and resources for traditional purposes; and
- changes to the environment that might result from federal decisions as well as any associated effects on health, socio-economic conditions, matters of historical, archaeological, paleontological or architectural interest, or other matters of physical or cultural heritage.

Please refer to Basics of Environmental Assessment and the Practitioners Glossary for Environmental Assessment of Designated Projects under the *Canadian Environmental Assessment Act, 2012* for additional information on the environmental assessment (EA) process and key terms under CEAA 2012.

Purpose

This technical guidance provides methodological options and considerations to support the implementation of CEAA 2012 and the approach outlined in the *Operational Policy Statement on Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under CEAA 2012* (OPS), in a way that achieves high quality EA.

The OPS provides core guidance on CEAA 2012 requirements related to the determination of significance for a designated project to ensure that these requirements are met in all project EAs.

This document informs the preparation of Canadian Environmental Assessment Agency (the Agency) documents such as the Environmental Impact Statement (EIS) Guidelines and the EA report. It is intended to support proponents of designated projects in the preparation of an EIS, in conjunction with other Agency policy and guidance instruments. It also provides guidance to Agency employees throughout the EA of a designated project in their interactions with those engaged in federal EAs, such as proponents, review panel members, federal authorities, other jurisdictions, Indigenous groups and the public.

This Technical Guidance is based on a collection of examples from past EAs; it is not exhaustive. This document will be reviewed periodically to integrate updated information on the best available approaches to determination of significance.

Application

This technical guidance is intended for use in the EA of a designated project when the Agency is the responsible authority or supports an EA conducted by a review panel. It should be used in conjunction with other Agency policy and guidance instruments. For an EA by a review panel, additional guidance and direction may be provided in the Terms of Reference and/or Joint Review Panel Agreement.

When the National Energy Board is the responsible authority, direction and guidance can be found in their filing manual. Applicants seeking guidance on nuclear projects should refer to the Canadian Nuclear Safety Commission's regulatory framework.

The term "project" refers to designated projects under CEAA 2012 for which the Agency is the responsible authority, and "project EA" refers to the EA of designated projects conducted under CEAA 2012 for which the Agency is the responsible authority. Environmental effects refer to those identified in section 5 of CEAA 2012, including cumulative environmental effects.

This guidance replaces the Agency's 1994 *Reference Guide: Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* and is for application under CEAA 2012. The 1994 reference guide will continue to apply for project EAs initiated under the former *Canadian Environmental Assessment Act* and are being completed under the transitional provisions of CEAA 2012.

For further guidance on the assessment of cumulative environmental effects, please see the Agency's *Operational Policy Statement Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* and *Technical Guidance on Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012.*

SUMMARY OF THE CORE GUIDANCE

Determining whether a project is likely to cause significant adverse environmental effects is central to the concept and practice of EA under CEAA 2012. Whatever adverse environmental effects are predicted and whatever methods are used to assess them, the focus of an EA under CEAA 2012 is always whether the project is likely to cause significant adverse environmental effects, after taking into account the implementation of mitigation measures.

The approach for determining significance is nested within the EA framework (see Annex 1 of the OPS).

The OPS provides the following approach for determining whether a project is **likely** to cause **significant adverse** environmental effects:

- Stage 1: Determining whether the environmental effects are adverse
- Stage 2: Determining whether the adverse environmental effects are significant
- Stage 3: Determining whether the significant adverse environmental effects are likely

The OPS provides core guidance on the three stages as well as on information requirements, documentation, and decision-making. Notably, conclusions on the significance and likelihood of environmental effects by the Agency or the review panel are presented in the EA report (or review panel report).

The OPS describes the following key criteria to be used for stage 2: determining if a residual adverse environmental effect is significant:

- Ecological and Social Context,
    - This criterion should be taken into account when considering the key criteria below in relation to a particular valued component (VC), as the context may help better characterize whether adverse effects are significant (see Technical Concepts and Considerations section);
- Magnitude;
- Geographic Extent;
- Timing;
- Frequency;
- Duration; and
- Reversibility.

Example 1: Ecological and Social Context

A proposed project would affect a burial site and a cremation site identified by an Indigenous group. The sites would be buried under mine tailings. The Indigenous group has stated that the site is of great cultural and historical importance to them. The effects are therefore deemed to be of high magnitude and permanent.

TECHNICAL CONCEPTS AND CONSIDERATIONS

The following key concepts inform the determination of significance under CEAA 2012:

- Valued components (VCs) refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Indigenous peoples or the public. The value of a component not only relates to its role in the ecosystem, but also to the value people place on it. For example, it may have been identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance. For the purposes of CEAA 2012, VCs are selected in relation to section 5 of CEAA 2012 and taking into account direction provided by the responsible authority, or in the case of an EA by review panel, by the Agency or the Minister of the Environment (the Minister).

- Mitigation measures are for the elimination, reduction or control of the adverse environmental effects of a project, and include restitution for any damage to the environment caused by those effects through replacement, restoration, compensation or any other means. Under CEAA 2012, these measures must also be technically and economically feasible.
- A residual environmental effect is an environmental effect of a project that remains, or is predicted to remain, after mitigation measures have been implemented. The determination of whether a project is likely to cause significant adverse environmental effects relates to the residual environmental effects.

Key technical considerations in determining significance include the following:

- Information and documentation;
- Addressing cumulative effects;
- Using benchmarks;
- Addressing likelihood; and
- Addressing uncertainty.

1. Information and Documentation

The Agency issues EIS Guidelines to proponents, which specify the nature, scope and extent of the information required for the preparation of the EIS. Following the review of the EIS, the Agency, the review panel or the Minister may also issue information requests to a proponent seeking additional clarification and information if necessary.

A proponent, the Agency or a review panel may make a determination of significance in the course of a project EA. Such determinations are separate from, but may inform, the decisions made by the Minister under subsection 52(1) of *CEAA 2012.*

Community knowledge and Aboriginal traditional knowledge can contribute to the determination of significance. The public and Indigenous groups can provide new information, offer a different interpretation of the facts or question the conclusions put forward by the proponent or the Agency.

The EIS will identify and define the criteria used to assign significance ratings to any predicted adverse effects and justify the methods selected to determine significance. It will contain clear and sufficient information to enable the Agency, technical and regulatory agencies, Indigenous groups and the public to review the proponent's analysis of the significance of effects. If any deficiencies are identified by the Agency, the proponent will be directed to address them.

The degree of uncertainty in outcomes of the EA should be described in the documents produced throughout the project EA as appropriate. The sources and nature of uncertainty should be clearly described to provide the basis for the stated level of confidence as well as how any identified uncertainty may affect the steps in the methodologies discussed in this document.

Example 2: Information from Indigenous Groups
Construction of a proposed project would eliminate access to sites used by a nearby Indigenous group to gather medicinal plants for traditional purposes. The plants are present at other sites within the Regional Study Area. During the EA, members of the Indigenous group noted that alternative plant sites would not be suitable because the community elders could not easily access them. The original sites were important for maintaining the practice of plant gathering for medicine and for the cultural transmission of knowledge of these sites and plants to younger members of the Indigenous group. Through the EA process, the consideration of significance was greatly informed by engagement with the affected Indigenous group.

2. Addressing cumulative effects

Determinations of significance must be made for both project-specific effects, and for any cumulative environmental effects. Both determinations of significance, documented in the EA report, will be taken into account in the Minister's decisions under subsection 52(1) of CEAA 2012.

The assessment of both project-specific and cumulative environmental effects includes the consideration of the implementation of mitigation measures. This is done prior to determining the significance of the environmental effects. Any uncertainty regarding the predicted effectiveness of proposed mitigation measures should be considered in the assessment.

The cumulative environmental effects assessment should consider all VCs for which residual environmental effects are predicted, regardless of whether those residual environmental effects are predicted to be significant.

3. Using benchmarks

Benchmarks help define what would be considered a significant adverse environmental effect on a VC. In some cases, it may be possible to identify established or generally accepted benchmarks. These may be in the form of standards, guidelines, targets, or objectives. Benchmarks are used to:

- aid in understanding whether and how much a VC's state (health, status, or condition) is affected by specific or multiple activities and stressors (Stage 1);
- provide information on potential effects levels for a VC (i.e. thresholds for negative consequences of a stressor on a VC), which can assist in the application of the criteria set for significance (Stage 2); and
- provide an indication of which VCs are of regional concern (i.e. if a benchmark for a VC has been established at a regional level), which may assist with all stages.

4. Addressing likelihood

Likelihood is defined as the probability that an event or incident, such as a significant adverse environmental effect, will occur as a result of a project. The likelihood of the predicted significant adverse environmental effects should be supported with sufficient detail, using an appropriate quantitative or qualitative approach, to understand and substantiate how conclusions were reached.

Different methodologies, such as professional judgment, reasoned argumentation, collaboration and risk assessment, (see Methodologies section) may be used to determine the likelihood of a predicted significant adverse environmental effect. The selection of the methodology used for assessing likelihood is linked, among other things, to measurability of the effect, which in turn is influenced by the nature of the VC and the nature of the environmental effect.

Where possible, practitioners should use a quantitative assessment to characterize the likelihood of occurrence. Any assumptions and limitations should be described and be transparent.

Where quantitative assessment is not possible, the probability of occurrence is often determined based on a qualitative approach using terms such as "low", "moderate" and "high" probability or "unlikely", "probable" and "very likely".

It is important that qualitative terms be defined (e.g. using a defined percentage), applied in a transparent manner and supported by explanation and discussion to avoid variability in different interpretation by reviewers.

Uncertainty often influences the prediction of the likelihood of a significant adverse environmental effect.

Example 3: Likelihood and Uncertainty

Stage 3: Determining whether the significant adverse environmental effects are likely

A proposed project could affect a herd of woodland caribou. An Indigenous group has stated that this herd is critically important to them as a source of food and for a variety of products such as snowshoe panels (current use of lands and resources for traditional purposes).

Uncertainties exist in the conclusions related to:

- the critical ecological pathways to the effects on current use;
- the effectiveness of proposed mitigation measures; and
- the interaction of various effects.

Given these scientific uncertainties and the importance placed on the availability of woodland caribou by the affected Indigenous group, a conservative approach is used. It is assumed to be 100% likely that the hunting success rate of caribou by the Indigenous groups will be significantly affected. Therefore a significant adverse effect to the current use of lands and resources for traditional purposes by the Indigenous group is likely.

5. Addressing uncertainty

Scientific uncertainty associated with information and methods may be introduced at many points in the EA process, including, for example, in the evaluation of the accuracy and availability of baseline information, accuracy of environmental effects predictions, and the expected level of effectiveness of mitigation measures.

All project EAs involve some level of uncertainty and observed results can be expected to deviate, to some degree, from predictions made in the EA. The confidence limits, confidence interval or the confidence level provides information about the range in which the true value lies within a stated degree of probability. This information can be assessed with a quantitative or qualitative approach by qualified professionals.

When data are generated, the application of statistical methods may allow for quantitative determination of confidence limits. When statistical methods are used, the nature and quality of the data used, the scientific validity of the hypotheses, and "statistical significance", have to be taken into account. Statistical significance is characterized by a low probability of error and a high confidence level. (Note that statistical significance is a different concept from that of significance of adverse environmental effects under CEAA 2012.)

As an alternate to statistical methods, professional judgment (see Methodologies section) is often applied to characterize the level of confidence of each prediction of significance and likelihood with qualitative terms such as "low", "medium" and "high". The criteria for determination of the level of confidence should be defined and documented to enable consistent interpretations by reviewers.

It may be appropriate to perform an additional risk analysis to characterize potential risks, particularly if:

- there is a high level of uncertainty in the prediction of the environmental effect;

- a significant environmental effect is possible among the range of potential effects; or
- specific adaptive management commitments would not adequately mitigate the uncertainty or potential for significant environmental effects.

The risk assessment would allow for the description of the range of likely, plausible, and possible outcomes with respect to both potential significance and likelihood.

Regardless of the approach taken to consider uncertainty (quantitative or qualitative), the sources and nature of uncertainty should be clearly described to provide the basis for the stated level of confidence as well as how any identified uncertainty may affect any of the steps in the methodologies discussed in the document.

Adaptive management may be used to address uncertainty. Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project. However, a commitment to implementing adaptive management measures does not eliminate the need for sufficient information regarding the environmental effects of the project, the significance of those environmental effects and the appropriate mitigation measures required to eliminate, reduce or control those environmental effects. Adaptive management requires appropriate predictions, monitoring and triggers for when action will be taken. For further information on adaptive management, please see the Agency's Operational Policy Statement: Adaptive Management Measures under the *Canadian Environmental Assessment Act* or any future updates of this document.

METHODOLOGIES

Several methodologies that can be used to determine whether an adverse environmental effect is significant are described in this section. A methodology generally frames the implementation of various methods.

The methodologies described below are often interrelated and can be used in combination, as appropriate, to determine whether a project is likely to cause significant adverse environmental effects. For example, professional judgment and reasoned argumentation may be used to adapt broad standards, guidelines and objectives to establish a definition or limit of significance for a specific environmental effect. Collaboration can support and inform a variety of methods.

1. Collaboration

Collaborative interactions among experts and other stakeholders can inform the consideration of significance and the scaling or defining of the key criteria. Collaboration generally involves identification of stakeholder representatives who can participate in forums that may require multiple sessions and an investment of time. These forums are typically distinct from general public participation opportunities provided by the proponent, the Agency or a review panel.

Considerations for applying this methodology include the following:

- the objectives of interactions with stakeholders (e.g., seek advice, achieve consensus) should be clear to all participants;
- the reasoning for the determination of significance must be clear for all participants to enable clear conclusions in the EIS;
- this methodology is conducive to the integration of scientific, Aboriginal and community knowledge, mutual learning, creative interpretations and problem solving; and
- this methodology is highly dependent on effective participation methods.

Consideration should be given to using multiple forms of participation (e.g., public meetings, site tours, focus groups), considering the needs and characteristics of the collaborating parties, making use of specialists with the appropriate background and experience, as well as specialists with facilitation and mediation skills.

Example 4: Collaboration

Stage 2: Determining whether the adverse environmental effects are significant

A proposed project may affect the current use of lands and resources for traditional purposes by an Indigenous group. Due to the importance of Indigenous perspectives in the understanding and interpretation of effects on this VC, a collaborative method is used to inform the consideration of significance.

Traditional knowledge holders and leaders from the potentially affected Indigenous group, as well as the proponent's technical experts in biology and archaeology, participated in a three-day workshop to discuss the evaluation of significance of adverse environmental effects. The objectives of the workshop were clearly defined:

- share and understand the rationale behind the residual adverse environmental effects identified;
- define and discuss the key criteria (i.e., ecological and social context, magnitude, geographic extent, timing and duration, frequency, and reversibility) that are typically used to determine the significance of residual adverse environmental effects; and
- achieve consensus on the key criteria to be considered for this VC and the process that will be used to apply these key criteria.

Concerns raised at the workshop were used to inform the design of the project and application of mitigation measures. Questionnaires and interviews with members of the Indigenous group resulted in additional baseline information and greater understanding of their ranking of issues related to current use of lands and resources for traditional purposes.

2. Risk Assessment

Significance can be determined on the basis of an "acceptable level" of a specified risk, using quantitative or qualitative ecological or human health risk assessment. This methodology considers a combination of likelihood and the consequences of the adverse environmental effect.

Risk assessment may also be used to describe the range of likely, plausible, and possible outcomes with respect to both potential significance and likelihood. This may be a useful aid for addressing uncertainty.

Considerations for applying this methodology include the following:

- quantitative risk assessment is often used to determine the significance of the risks to human or ecological health from, for example, carcinogenic chemicals. Its use is restricted to agents that have predictable dose-response or exposure-effect relationships. The response, effect, or risk is often measured in terms of increased incidence of a particular health outcome per million people exposed. By using the dose-response relationship, it can be determined whether or not the dose or exposure would result in an unacceptable level of risk;
- ecological risk assessments are used to assess risks to ecosystem processes, habitats and biotic resources;
- information on who has set the risk levels and how acceptable risk levels are determined should be presented. The views of Indigenous groups should be considered regarding acceptable risk levels for environmental effects that may affect them; and
- risk assessments may use generally available and tested models, models that have been adapted to better address the circumstances of the project or models developed specifically for the project.

Example 5: Quantitative Risk Assessment

Stage 1: Determining whether the environmental effects are adverse,
Stage 2: Determining whether the adverse environmental effects are significant, and
Stage 3: Determining whether the significant adverse environmental effects are likely

The health of an Indigenous group could be affected by air emissions from a proposed project.

A quantitative risk assessment method is appropriate due to the availability of a risk assessment framework and guidance endorsed by federal regulatory agencies.

Future concentrations of air contaminants are modelled and compared to available site-specific and/or published background levels, as well as health-based environmental guidelines set by regulatory agencies.

The risks to the health of Indigenous peoples are evaluated using professional judgement and by comparison to risk levels that consider both the probability of occurrence and the consequences of an adverse environmental effect.

3. Aggregation

Qualitative or quantitative aggregation methods involve attributing a scale ranking to each key criterion and applying a decision rule to inform the determination of significance. Examples of this methodology include multi-criteria analysis and decision trees.

The influence of the key criteria on a determination of significance will vary between VCs. In most cases, reliance on a standardized ranking system or standardized decision rules across all VCs will not give adequate consideration to VC-specific circumstances. It is important to explain rankings and give a clear rationale for the determination of significance on a VC-specific basis.

Example 6: Qualitative Aggregation

Stage 2: Determining whether the adverse environmental effects are significant

A proposed project may affect air quality on a nearby national park (federal lands) and also across a provincial boundary. A method based on qualitative aggregation and professional judgement is appropriate in this case, because the most relevant key criteria for measuring air quality are magnitude, geographic extent and frequency.

Thresholds for magnitude of air quality effects, available as established standards, are best understood in relation to the geographic extent and frequency criteria. Established air quality criteria are developed to apply in the environment, which means beyond the geographic extent of the project itself. The geographic extent of the effect can be tied to the predicted magnitude. For an effect on air quality on federal lands or in another jurisdiction (i.e. transboundary) to be significant, the predicted air quality would need to exceed the relevant criteria and would need to exceed the criteria more frequently than under baseline conditions.

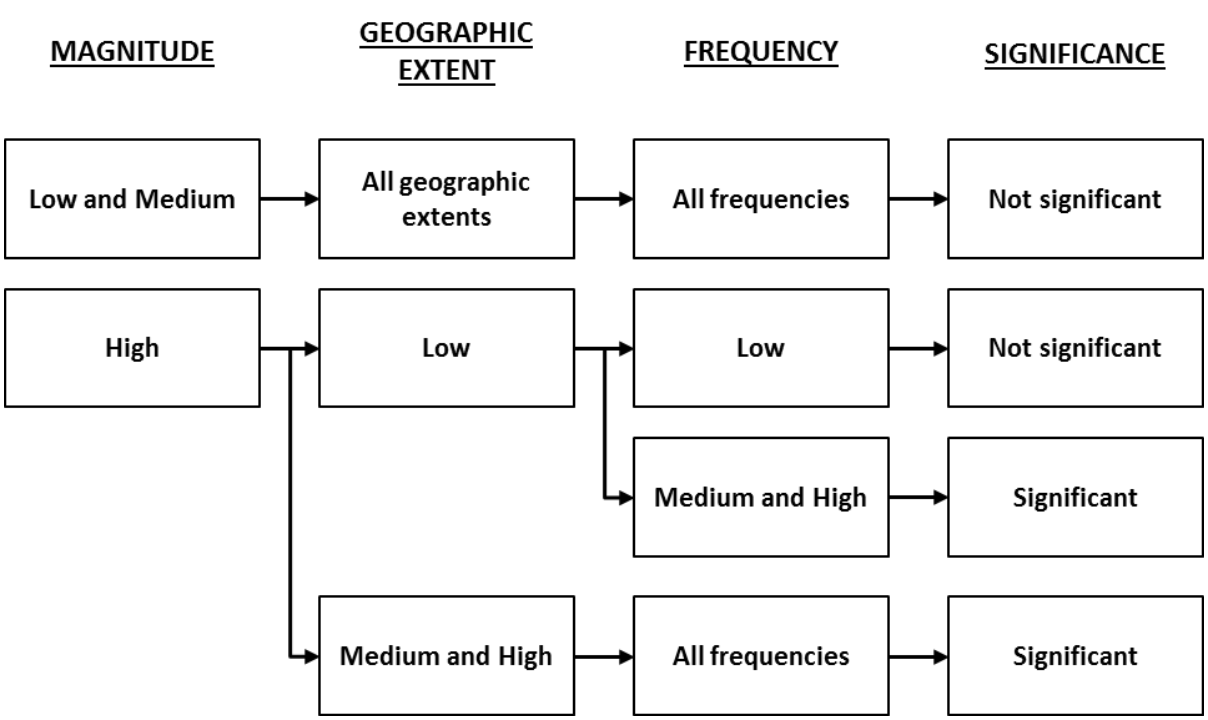
The definitions of the most relevant criteria are as follows:

- Magnitude: degree of the change in concentration of indicator compounds (airborne particulate matter, combustion by-products; and airborne metals) relative to applicable standards
- Geographic extent: the spatial area over which the effect occurs, categorized by comparison to the established study areas for the VC (e.g., Local Study Area, Regional Study Area, beyond the Regional Study Area); and,
- Frequency: how often the residual adverse environmental effect occurs within a given time period.

The decision making process for this example is outlined in Figure 1 below.

Figure 1. Example Decision Tree for Determination of Significance

Note: This diagram provides a decision tree for determination of significance (not significant or significant) based on the sequential interaction between the magnitude, geographic extent, and frequency criteria for effects (defined as low, medium or high).



Example 7: Quantitative Aggregation

Stage 2: Determining whether the adverse environmental effects are significant

A proposed project may affect fish and fish habitat as defined in the *Fisheries Act*. A quantitative aggregation method is appropriate due to the considerable variation in the importance of the key criteria to the determination of significance. Each of the key criteria is assigned effects-level definitions and related scores (see Classification and Score columns in Table 1 below) based on degree of adverse effect, e.g.:

Magnitude and Geographic Extent

- Low (Score 0): Under 20% alteration of important fish habitat in the Local Study Area
- Medium (Score 5): 20% to 40% alteration of important fish habitat in the Local Study Area
- High (Score 10): Greater than 40% alteration of important fish habitat in the Local Study Area

Magnitude and geographic extent, timing and reversibility are given greater weight in the scoring system to reflect their relative importance, i.e. any effects to these criteria could cause fundamental changes to the current state of fish populations.

In Table 1 below, the predicted effects of the project are compared to the significance key criteria using the corresponding scores. The key criteria scores are then aggregated to provide an overall determination of significance as follows:

- Negligible (not significant): 0-5
- Low (not significant): 6-10
- Moderate (not significant): 11-15
- High (significant): 16 or greater

The aggregated score of the effects is 10 corresponding to low, not significant, effects. Therefore, no significant adverse environmental effects on fish and fish habitat are anticipated as a result of the project.

Table 1. Application of Key Criteria

Note: This table illustrates the determination of significance by using quantitative aggregation, based on a comparison among the predicted effect of the project and the corresponding scores for each key criteria.

Key Criteria	Application of Key Criteria	Classification	Score
Ecological and Social Context	Species not identified as commercially or recreationally important or important to Indigenous groups.	Low	0
Magnitude and Geographic Extent	Approximately 25% of important fish habitat is likely to be altered in the Local Study Area.	Medium	5
Timing	The effect extends to sensitive periods (e.g. spawning).	Sensitive	3
Duration	The effect extends from the Construction Phase through the Closure Phase.	Long-term	2
Frequency	Conditions or phenomena causing the effect are anticipated to occur once.	Low	0
Reversibility	The effects are anticipated to be reversible following Project closure.	Reversible	0
Aggregated Score:			**10 (Low)**

4. Reasoned Argumentation

Reasoned argumentation involves presenting a clear, well-reasoned, substantiated and organized argument in support of a conclusion. A reasoned argument allows a wide audience to reasonably draw the same conclusions as the author. The argument should fully utilize relevant information, be based on a comparison of the predicted effect to a benchmark, where appropriate, and consider the most relevant key criteria.

Example 8: Reasoned Argumentation

Stage 2: Determining whether the adverse environmental effects are significant

A proposed project could affect habitat quality and quantity for a migratory bird species on federal lands, and disrupt breeding and nesting periods. Professional judgment and reasoned argumentation are used to identify benchmarks to determine what would be a significant effect for this VC. Scientific literature, species life history traits, predicted changes in measurement indicators and experience from past EAs, monitoring programs and regional studies informed this work.

A significant adverse environmental effect to this VC could be when one or more of the following population outcomes are reached:

- habitat loss or reduced habitat quality causes permanent adverse changes to survival or reproduction at the population level;
- habitat loss and fragmentation that reduces population connectivity to the point that it disrupts demographic rescue between source and sink habitats (or areas); or
- effects on abundance and distribution would be measurable at the population level and likely to decrease resilience and increase the risk to maintaining self-sustaining and ecologically effective populations.

5. Professional Judgment

Professional judgement involves developing interpretations informed by an understanding of project characteristics, predicted environmental effects, and general EA and sustainability principles, to establish a rational basis for a conclusion. The factors and logic leading to the conclusion must be clearly presented. Professional judgment should be applied by individuals that have the appropriate background and experience to make the judgment. Professional judgement is often used in combination with other methodologies (see Aggregation and Reasoned Argumentation sections above).

Considerations for applying professional judgment as the main or single methodology when determining significance include the following:

- a variety of factors should be taken into account, such as the status, size and range of a population unit, broad-scale habitat conditions, established thresholds or standards for closely related species, area-specific policies for land use and species management;
- information from a variety of sources including scientific analysis, community knowledge and Aboriginal traditional knowledge of environmental effects and their significance; and
- comparison to a benchmark should be used, where possible.

Example 9: Professional Judgement

Stage 1: Determining whether the environmental effects are adverse

After the implementation of mitigation measures, it is predicted that a project will result in the direct loss and fragmentation of migratory bird habitat on federal lands due to clearing and grubbing, watercourse alterations, and development of site access roads. Changes in habitat quality from noise, lights, people and vibrations from the project also have the potential to alter the movement and behaviour of individual birds and decrease occupancy of habitat near the project. Since no further mitigation measures are proposed, these effects are deemed residual adverse environmental effects and are advanced for consideration of significance.

Example 10: Professional Judgement

Stage 3: Determining whether the significant adverse environmental effects are likely

The migratory behaviour of marine mammals could be affected by the cumulative effects on habitat quality from a proposed project in combination with the environmental effects of other physical activities that have been or will be carried out. However, the likelihood is considered low given the distances over which the various physical activities are taking place, as well as the localized nature of potential project effects.

Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site or Thing

This document provides guidance on federal environmental assessments commenced under the former *Canadian Environmental Assessment Act, 2012*. It is retained for the completion of transitional environmental assessments commenced prior to the *Impact Assessment Act*. For more information on transitional environmental assessments, please consult the Legislation and Regulations page.

Updated: March 2015

Document Information

Disclaimer

This technical guidance is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA (Canadian Environmental Assessment Act) 2012) or any of its regulations. In the event of any inconsistency between this guide and CEAA (Canadian Environmental Assessment Act) 2012 or regulations, CEAA (Canadian Environmental Assessment Act) 2012 or regulations would prevail.

For the most up-to-date versions of CEAA (Canadian Environmental Assessment Act) 2012 and regulations, please consult the Department of Justice website.

Updates

This document may be reviewed and updated periodically by the Canadian Environmental Assessment Agency (the Agency). For the most up-to-date version, please consult the Policy and Guidance page of the Agency website.

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Ce document a été publié en français sous le titre : *Orientations techniques pour l'évaluation du patrimoine naturel et culturel ou d'une construction, d'un emplacement ou d'une chose d'importance sur le plan historique, archéologique, paléontologique ou architectural en vertu de la Loi canadienne sur l'évaluation environnementale (2012)*.

Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca

This document is also available in Adobe's Portable Document Format [PDF (Adobe Acrobat document) - 1.1 MB (megabytes)].

Purpose

This technical guidance document supports the implementation of CEAA (Canadian Environmental Assessment Act) 2012 provisions related to the effects of any changes to the environment on physical and cultural heritage or on any structure, site or thing that is of historical, archaeological, paleontological or architectural significance. It provides preliminary guidance on how to conduct the assessment when the Canadian Environmental Assessment Agency (the Agency) is the responsible authority.

The technical guidance informs the preparation of directives by the Agency, such as the Environmental Impact Statement (EIS (Environmental Impact Statement)) Guidelines, and serves as core guidance to project proponents. It also provides direction to Agency employees throughout the environmental assessment (EA (environmental assessment)) of a designated project in their interactions with those engaged in federal EA (environmental assessment), such as proponents, federal authorities, other jurisdictions, review panel members, Aboriginal groups and the public.

In combination with the EIS (Environmental Impact Statement) Guidelines, the technical guidance aims to ensure that CEAA (Canadian Environmental Assessment Act) 2012 requirements related to physical and cultural heritage or to any structure, site or thing that is of historical, archaeological, paleontological or architectural significance are met in order to achieve a high quality EA (environmental assessment) of a designated project.

Application

The technical guidance is intended for use in the EA (environmental assessment) of a designated project for which the Agency is the responsible authority.

In the technical guidance, "project EA (environmental assessment)" refers to the EA (environmental assessment) of a designated project under CEAA (Canadian Environmental Assessment Act) 2012.

Throughout the technical guidance, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA (Canadian Environmental Assessment Act) 2012. As well, “physical and cultural heritage” is hereafter referred to as heritage, and “any structure, site or thing that is of historical, archaeological, paleontological or architectural significance” is referred to as any structure, site or thing.

The technical guidance should be used to inform the preparation of the EIS (Environmental Impact Statement) Guidelines and the EIS (Environmental Impact Statement) for a designated project. It should be used in conjunction with other Agency policy and guidance instruments. For an EA (environmental assessment) by a review panel, additional guidance and direction may be provided in the Terms of Reference or Joint Review Panel Agreement.

For application under CEAA (Canadian Environmental Assessment Act) 2012, this guidance replaces the Agency’s 1996 guide entitled, *Reference Guide on Physical and Cultural Heritage Resources*. The 1996 guide will continue to be applicable for project EA (environmental assessment)s initiated under the former *Canadian Environmental Assessment Act* that are still being conducted pursuant to the transitional provisions of CEAA (Canadian Environmental Assessment Act) 2012.

Relevant Provisions of CEAA (Canadian Environmental Assessment Act) 2012

CEAA (Canadian Environmental Assessment Act) 2012 aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project, including cumulative environmental effects. In addition, CEAA (Canadian Environmental Assessment Act) 2012 ensures that a designated project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out. Sections of CEAA (Canadian Environmental Assessment Act) 2012 that are most relevant to assessing the effects of any changes to the environment on heritage or any structure, site or thing can be found in Appendix 1.

This technical guidance addresses 5(1)(c)(ii) “physical and cultural heritage” and 5(1)(c)(iv) “any structure, site or thing that is of historical, archeological, paleontological or architectural significance”. It also addresses 5(2)(b)(ii) “physical and cultural heritage” and 5(2)(b)(iii) “any structure, site or thing that is of historical, archeological, paleontological or architectural significance”.

Subsection 19(1) of CEAA (Canadian Environmental Assessment Act) 2012 clarifies that environmental effects include cumulative environmental effects and environmental effects of accidents and malfunctions. This subsection also stipulates the factors that are to be taken into account for a project EA (environmental assessment). For example, factors related to determining the significance of environmental effects, selecting mitigation measures and implementing a follow-up program also apply. The assessment may also take into account community and Aboriginal traditional knowledge, as per subsection 19(3).

Considerations in Examining Heritage or Any Structure, Site or Thing

Understanding Heritage or Any Structure, Site or Thing

A land or resource (e.g. (for example), an artifact, object or place) that is considered as heritage or any structure, site or thing is distinguished from other lands and resources by the value placed on it. The value of heritage or any structure, site or thing originates from its:

- Association with one or more important aspects of human history or culture;
- Historical, archaeological, paleontological or architectural significance; and
- Association with a particular group's practices, traditions or customs.

Practices, traditions and customs are generally defined as follows:

Practice:
a way of doing something that is common, habitual or expected;

Tradition:
a custom, opinion or belief handed down primarily orally or by practice; and

Custom:
a particular, established way of behaving.

Heritage or any structure, site or thing may be movable (e.g. (for example), tools) or immovable (e.g. (for example), cultural landscape), above (e.g. (for example), historic building) or below ground (e.g. (for example), burial ground), and on land (e.g. (for example), Quebec City's walls and fortifications) or in water (e.g. (for example), shipwreck). The features of these resources may be natural (e.g. (for example), Waterton-Glacier International Peace Park) or fabricated (e.g. (for example), pottery), or a combination of both (e.g. (for example), culturally modified trees). Additional examples of heritage or any structure, site or thing can be found in Appendix 2.

Heritage is an inclusive term that is associated with important aspects of human history and culture. Contemporary perceptions of heritage tend to be broad and encompass various social, economic, political, environmental, scientific, natural and cultural dimensions. In addition, the concept of cultural landscapes is often used to describe any geographical area that has been modified, influenced, or given special cultural meaning by people (more information on cultural landscapes can be found in Appendix 2).

A specific land or resource that has heritage value will most likely also be considered a structure, site or thing that is of historical, archaeological, paleontological or architectural significance. For Aboriginal groups, lands and resources identified as heritage or any structure, site or thing may also fit under current use of lands and resources for traditional purposes, identified under 5(1)(c)(iii). Spiritual and cultural practices of Aboriginal Groups' are often integrally linked to specific locations and surrounding landscape features, as well as objects of social significance.

Approach to Examining Heritage or Any Structure, Site or Thing in an EA (environmental assessment)

A project EA (environmental assessment) first examines any changes to the environment that may be caused by a designated project, and then subsequently considers how these changes to the environment may affect heritage or any structure, site or thing.

A project EA (environmental assessment) considers the effects of any change to the environment on heritage or any structure, site or thing with respect to Aboriginal peoples. The EA (environmental assessment) also considers the effects of any changes to the environment on heritage or any structure, site or thing that are directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function (i.e., a federal decision).

The practice of EA (environmental assessment) calls for examining potential environmental effects of the designated project on valued components (VCs (valued components)) and considering mitigation measures. Mitigation measures are taken into account prior to determining the significance of adverse environmental effects for the EA (environmental assessment) decisions and for the implementation of the follow-up program.

The approach and level of effort applied to assessing effects of any changes to the environment on heritage or any structure, site or thing in a project EA (environmental assessment) are established on a case-by-case basis taking into consideration:

- The characteristics of the designated project;
- The potential environmental effects;
- The intactness and context of VCs (valued components) that may be impacted by the environmental effects;

- The potential for mitigation and the extent to which mitigation measures may address potential environmental effects; and
- The level of concern expressed by Aboriginal groups or the public.

Assessment of environmental effects should include the five steps described below. Appendix 3 provides a reference sheet summarizing the five steps.

The steps are iterative; circumstances commonly arise during the course of an assessment that requires these steps to be revisited. EA (environmental assessment) documentation must clearly explain and justify the methodologies that have been used to assess the effects of any changes to the environment on heritage or any structure, site or thing.

Different types of heritage, structure, site or thing can fall under the authorities of municipal, provincial/territorial or federal governments and sometimes under several of these authorities. Information from other governments may be used to inform federal EA (environmental assessment)s.

Step 1. Scoping

Scoping is an iterative process. Initial scoping for the project EA (environmental assessment) is made in relation to section 5 of CEAA (Canadian Environmental Assessment Act) 2012 and takes into account direction provided by the Agency (e.g. (for example), in the EIS (Environmental Impact Statement) Guidelines). As the project EA (environmental assessment) advances, information gained, such as evidence on potential or confirmed heritage or any structure, site or thing, may help clarify what needs to be considered and to what extent.

Initial scoping should cover the following aspects: identifying VCs (valued components), listing potential effects and determining spatial and temporal boundaries.

Identifying valued components

Identifying VCs (valued components) involves making an inventory of potential lands and resources and establishing their importance as heritage or as a structure, site or thing. This may be assessed through a combination of consultation, desk-based research and a site survey or inspection, potentially with test excavations. Desk-based research may involve identifying major historical themes and activities through historical research and a review of topographical and historical mapping.

Possible sources of information to assist in identifying places where heritage or any structure site or thing that are valued may be present are:

- lists of national parks, national historic sites, national marine conservation areas, national urban parks and national historic canals;
- Commemorative Integrity Statement (for national historic sites);
- Cultural Resource Value Statement (for national parks, national marine conservation areas and national urban parks);
- federal and provincial registers of archaeological sites;
- Canadian Register of Historic Places;
- Federal Heritage Buildings Review Office;
- Directory of Federal Heritage Designations;
- federal and provincial government departments responsible for heritage issues;
- Aboriginal peoples;
- academic and research institutions;
- professional societies and organizations;
- federal, provincial and municipal archives and libraries;

- museums;
- photographs and maps;
- land use plans;
- local citizens, associations, and municipal government departments involved in the area of heritage conservation and protection; and
- International Council on Monuments and Sites Canada.

Some lands and resources will be easy to identify as heritage or any structure, site or thing for they are already recognized by one or more jurisdictions (e.g. (for example), federal, provincial, territorial, municipal or Aboriginal jurisdictions). However, some lands and resources may not be formally recognized or documented. As such, these lands and resources may need to be evaluated first to understand their importance as heritage or as a structure, site or thing.

Stakeholders, professional experts, Aboriginal groups, the public, government and non-government organizations can be important sources of information in identifying and evaluating these lands and resources. In evaluating the importance of potential heritage or any structure, site or thing, considerations may include the following:

- Context: A land or resource may not appear significant on its own. However, considering its historical and physical context, thematic representativeness and information content (such as richness, cultural and ethnic significance) may provide great insight into its value. Relevant background information may include historical events. Key characteristics of the area may also provide insight into the value of the lands and resources.
- Intactness: The degree of intactness of the land or resource is evaluated, including the level to which it has been disturbed or is preserved. Such an evaluation requires data on the previous condition

of the land or resource, which may not always be available or documented.

- Evidence: Some types of sites, such as archaeological sites, are not visible. It is therefore important to confirm the presence of these sites in order to assess any impacts on them. For example, the sacred grounds of Aboriginal peoples may have no evidence of physical activity, but may be associated with the creation of legends, ceremonial functions, personal vision quests, puberty rites, etc.
- Places: Aboriginal spiritual and cultural practices are often integrally linked to specific locations and landscape features. Environmental effects resulting from a designated project may impact these places, which may in turn limit the ability of Aboriginal peoples to engage in their spiritual and cultural practices.

Examples of questions that should be considered in identifying VCs (valued components) include:

- Are there any lands and resources that are recognized to have archaeological, historical, paleontological, architectural, scientific, engineering, natural or cultural value within the study area?
- Has any exploratory work been previously undertaken to identify resources such as archaeological sites or artifacts in the study area?
- What lands and resources are valued by a group or community?

During initial scoping, a VC (valued component) may be identified at a broad level (e.g. (for example), paleontological resources) or at a more specific level (e.g. (for example), fossils). The consideration of the effects of the project will generally involve an examination of the specific features of the VC (valued component).

Listing potential effects

The term “environmental effect”, defined in Section 5 of CEAA (Canadian Environmental Assessment Act) 2012, addresses heritage or any structure, site or thing from two perspectives:

- With respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on heritage or any structure, site or thing (e.g. (for example), disturbance to rock art); and
- Effects of any changes to the environment on heritage or any structure, site or thing (other than those mentioned in the previous bullet) that are directly linked or necessarily incidental to a federal decision (e.g. (for example), disturbance to a designated heritage lighthouse).

The following questions could be considered in listing potential effects on heritage or any structure, site or thing:

- What are the changes to the environment that may be caused by a designated project?
- How will these changes to the environment affect heritage or any structure, site or thing?
- Are there cumulative effects that will affect the identified heritage or any structure, site or thing?
- What are the public concerns associated with the potential effects?

Determining spatial and temporal boundaries

The spatial and temporal boundaries are set to allow for analysis of potential environmental effects, selection of mitigation measures and determination of significance. In the case of heritage or any structure, site or thing, setting these boundaries takes into account the nature of the VC (valued component) and the changes to the environment that may affect the VC (valued component).

In addition, the spatial and temporal boundaries may change when assessing potential cumulative environmental effects. For additional information on establishing boundaries associated with cumulative environmental effects, please refer to the *Operational Policy Statement on Assessing Cumulative Environmental Effects* under CEAA (Canadian Environmental Assessment Act) 2012.

Overall, the boundaries of an assessment should be large enough to encompass the potential effects of any changes to the environment on heritage or any structure, site or thing, including cumulative effects. In many cases, it is appropriate to consult with Aboriginal groups and the public in making this determination.

Step 2. Analysis

The objective of the analysis phase is to describe how the potential changes to the environment caused by a designated project may affect heritage or any structure, site or thing. Where a VC (valued component) is selected for more than one paragraph or subsection of section 5, the analysis is done only once. Building on the information gathered for the initial scoping, this phase of the assessment should include:

- A description of the nature and current condition of the heritage or any structure, site or thing;
- Assessment of the potential effects the project may likely cause to heritage or any structure, site or thing;
- Consideration of potential cumulative effects; and
- An analysis of the results of consultations held with the public and Aboriginal groups.

Important characteristics of these VCs (valued components) may include the type of construction materials, the location of the land or resource, etc. A VC (valued component) may already be affected by stressors caused by past and current activities. For example, adverse effects of acid rain may have already led to deterioration of a historic building. The designated project may lead to further changes in the environment or cumulative effects that may result in adverse environmental effects on the VCs (valued components). Examples of adverse effects on heritage or any structure, site or thing resulting from a change in the environment could include:

Examples of adverse effects on heritage or any structure, site or thing resulting from a change in the environment

Change in the Environment	Effects on Lands and Resources
Land disturbance and transformation of natural landscapes (e.g. (for example), soil compaction, dredging, digging, filling, clearing, etc.)	• Damage, disturbance or destruction in a conservation area. • Damage, disturbance or destruction of archaeological remains or sites, or spiritual sites.
Effects of underground construction	• Deterioration of an architectural or historic building or monument caused by vibration.
Demolition or construction of buildings or other structures	• Destruction of heritage buildings or archaeological sites. • Disturbance of the setting of heritage buildings, structures or sites.

The methodologies used to predict environmental effects must be clearly described. With this information, reviewers will be able to examine the analysis and the rationale supporting the conclusions reached. Any assumptions or conclusions based on professional judgment should be clearly identified and described.

Data collection and/or generation are important components of an analysis of environmental effects. At times, it may be challenging to obtain or generate data to support the analysis. Potential environmental effects should be considered, as appropriate, in the analysis even when there is little supporting data or there is predictive uncertainty. Reviewers of the EIS (Environmental Impact Statement) should be presented with a complete picture of the potential types and scale of environmental effects. In all cases, uncertainties and assumptions underpinning an analysis should be described and information sources clearly documented.

Scientific data and other evidence supporting an assessment of environmental effects can often be supplemented in various ways, including the use of data from other areas with comparable conditions.

Aboriginal traditional knowledge may provide important information on an Aboriginal group’s connection to heritage or any structure, site or thing on a given landscape. Community knowledge and Aboriginal traditional knowledge available to the proponent should be incorporated into the assessment, in keeping with appropriate ethical standards and without breaking any applicable obligations of confidentiality.

Step 3. Mitigation

Technically and economically feasible measures must be identified that would mitigate any significant adverse environmental effects. Mitigation of environmental effects can take two forms:

- Elimination, reduction or control of a designated project's environmental effects is preferred.
- Where this is not possible, restitution for any damage to the environment caused by the environmental effect should be considered, e.g. (for example), replacement, restoration, compensation.

Both forms of mitigation can be considered in the decisions on whether a designated project is likely to cause significant adverse environmental effects.

A range of measures may be deployed to mitigate the effects of any changes to the environment on heritage or any structure, site or thing, including:

- Re-siting of the project to avoid sensitive areas such as significant sites or areas known to contain cultural artifacts, significant cultural landscapes, etc.;
- Changing the project design or construction techniques and technologies to reduce effects of the project on lands and resources;
- Implementing site protection such as stabilization practices, fences, etc.;
- Conducting professional rescue archaeology, also known as preservation of record, to salvage archaeological resources (in part or entirely) and their contextual information prior to undertaking physical activities associated with the designated project;
- Changing site maintenance practices causing damage to physical structures, e.g. (for example) eliminating use of road salt; and
- Cleaning up contaminated heritage buildings.

Effects on heritage or any structure, site or thing can be reversible (temporary) or irreversible (permanent). Given the nature of these VCs (valued components), the selection of mitigation measures often needs to address the possibility of irreversible effects (e.g. (for example), demolition of artifacts during construction activities).

Step 4. Significance

An EA (environmental assessment) must consider the significance of any adverse environmental effects that are likely to result from a designated project after taking into account the implementation of any mitigation measures.

Significance predictions in relation to the effects of any changes to the environment on heritage or any structure, site or thing should be clearly presented and rationalized against defined criteria consistent with the Agency's reference guide *Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* (November 1994), or any future updates made to this document.

Step 5. Follow-up

Follow-up programs should address project-specific environmental effects and cumulative environmental effects. The objectives of a follow-up program are to verify the accuracy of the EA (environmental assessment) and determine the effectiveness of any mitigation measures that have been implemented.

To help determine if follow-up is required in relation to heritage or any structure, site or thing, additional guidance is available through the Operational Policy Statement published by the Agency on *Follow up Programs under the Canadian Environmental Assessment Act* (December 2011), or any future updates to this document.

Table of Contents: Appendices

Appendix 1: Reference sheet - Relevant Provisions of CEAA (Canadian

Environmental Assessment Act) 2012

Environmental Effects

5. (1) For the purposes of this Act, the environmental effects that are to be taken into account in relation to an act or thing, a physical activity, a designated project or a project are:

a. a change that may be caused to the following components of the environment that are within the legislative authority of Parliament:
   i. fish as defined in section 2 of the *Fisheries Act* and fish habitat as defined in subsection 34(1) of that Act,
   ii. aquatic species as defined in subsection 2(1) of the *Species at Risk Act*,
   iii. migratory birds as defined in subsection 2(1) of the *Migratory Birds Convention Act, 1994*, and
   iv. any other component of the environment that is set out in Schedule 2;
b. a change that may be caused to the environment that would occur
   i. on federal lands,
   ii. in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or
   iii. outside Canada; and
c. with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on
   i. health and socio-economic conditions,
   ii. physical and cultural heritage,

   iii. the current use of lands and resources for traditional purposes, or
   iv. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Exercise of power or performance of duty or function by federal authority

(2) However, if the carrying out of the physical activity, the designated project or the project requires a federal authority to exercise a power or perform a duty or function conferred on it under any Act of Parliament other than this Act, the following environmental effects are also to be taken into account:

a. a change, other than those referred to in paragraphs (1)(a) and (b), that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the project; and
b. an effect, other than those referred to in paragraph (1)(c), of any change referred to in paragraph (a) on
   i. health and socio-economic conditions,
   ii. physical and cultural heritage, or
   iii. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Schedule 2

(3) The Governor in Council may, by order, amend Schedule 2 to add or remove a component of the environment.

Factors to be Considered

Factors

19. (1) The environmental assessment of a designated project must take into account the following factors:

a. the environmental effects of the designated project, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project and any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out;
b. the significance of the effects referred to in paragraph (a);
c. comments from the public — or, with respect to a designated project that requires that a certificate be issued in accordance with an order made under section 54 of the *National Energy Board Act*, any interested party — that are received in accordance with this Act;
d. mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project;
e. the requirements of the follow-up program in respect of the designated project;
f. the purpose of the designated project;
g. alternative means of carrying out the designated project that are technically and economically feasible and the environmental effects of any such alternative means;
h. any change to the designated project that may be caused by the environment;

i. the results of any relevant study conducted by a committee established under section 73 or 74; and
j. any other matter relevant to the environmental assessment that the responsible authority, or — if the environmental assessment is referred to a review panel — the Minister, requires to be taken into account.

Scope of factors

(2) The scope of the factors to be taken into account under paragraphs (1)(a), (b), (d), (e), (g), (h) and (j) is determined by

a. the responsible authority; or
b. the Minister, if the environmental assessment is referred to a review panel.

Community knowledge and Aboriginal traditional knowledge

(3) The environmental assessment of a designated project may take into account community knowledge and Aboriginal traditional knowledge.

Environmental Assessment Decision

Decisions of decision maker

52. (1) For the purposes of sections 27, 36, 47 and 51, the decision-maker referred to in those sections must decide if, taking into account the implementation of any mitigation measures that the decision-maker considers appropriate, the designated project

a. is likely to cause significant adverse environmental effects referred to in subsection 5(1); and
b. is likely to cause significant adverse environmental effects referred to in subsection 5(2).

Referral if significant adverse environmental effects

(2) If the decision maker decides that the designated project is likely to cause significant adverse environmental effects referred to in subsection 5(1) or (2), the decision maker must refer to the Governor in Council the matter of whether those effects are justified in the circumstances.

Referral through Minister

(3) If the decision-maker is a responsible authority referred to in any of paragraphs 15(a) to (c), the referral to the Governor in Council is made through the Minister responsible before Parliament for the responsible authority.

Governor in Council's decision

(4) When a matter has been referred to the Governor in Council, the Governor in Council may decide

a. that the significant adverse environmental effects that the designated project is likely to cause are justified in the circumstances; or
b. that the significant adverse environmental effects that the designated project is likely to cause are not justified in the circumstances.

Appendix 2: Reference Sheet - Federal Involvement

Key Federal Roles

Jurisdiction over heritage is shared among levels of government. Heritage sites may be specifically designated as protected sites or may be subject to a blanket system of protection either by legislation or by policy at the federal, provincial, territorial or municipal level. In other cases, valuable heritage sites may not yet be known to government authorities (e.g. (for example), archaeological sites). Various mandates, objectives and intents of existing legislation and policies found at different levels of government should be considered when assessing heritage.

At the federal level, there are many parties involved in protecting heritage assets, notably:

- Parks Canada (PC (Parks Canada)) is responsible for managing national parks, national historic sites, national marine conservation areas, national urban parks, United Nations Educational, Scientific and Cultural Organization World Heritage Sites; and other protected heritage areas and heritage protection programs. In addition, Parks

Canada also supports the designation work of the Historic Sites and Monuments Board of Canada.

- The Department of Canadian Heritage is responsible for developing policies governing certain aspects of cultural heritage (e.g. (for example), video, literature, art, etc.), including policies related to conserving, exporting and importing cultural property. Agencies within the Canadian Heritage portfolio, including national museums and affiliated museums, and Library and Archives Canada, also have specific mandates for the protection of federal heritage.
- The Treasury Board of Canada Secretariat (TBS (Treasury Board of Canada Secretariat)) provides departments with direction on managing federal moveable heritage assets such as art, archaeological artifacts, and everyday objects that possess heritage value through the *Policy on Management of Material* and its associated *Guide to the Management of Moveable Heritage Assets, 2008*.
- The Federal Heritage Building Review Office (FHBRO (Federal Heritage Building Review Office)) advises custodian departments on their obligations regarding heritage buildings under the TSB *Policy on Management of Real Property*.
- Canada’s Historic Places (CHP (Canada’s Historic Places)), a federal, provincial and territorial initiative, maintains the Canadian Register of Historic Places (CRHP (Canadian Register of Historic Places)), which provides information about all historic places recognized for their heritage value at the local, provincial, territorial and national levels throughout Canada. As well, federal, provincial and territorial collaboration has led to the development of the *Standards and Guidelines for the Conservation of Historic Places in Canada*, 2010, which provides guidance to conserve four types of cultural resources (e.g. (for example), cultural landscapes, archaeological sites, buildings and engineering works).

- The Geological Survey of Canada provides expert advice for the identification and analysis of paleontological resources in Canada. As well, national collections of various specimens of vertebrate and plant fossils are maintained in their facilities.

Canada has also acceded and accepted some conventions from the United Nations Educational, Scientific and Cultural Organization (UNESCO (United Nations Educational, Scientific and Cultural Organization)). This means that Canada has made a commitment to uphold and implement these conventions. These conventions include:

- *Convention concerning the Protection of World Cultural and Natural Heritage, 1972*
  United Nations Educational, Scientific and Cultural Organization (UNESCO (United Nations Educational, Scientific and Cultural Organization)). Convention concerning the Protection of World Cultural and Natural Heritage. 1972. (Online). Available at: http://whc.unesco.org/en/conventiontext [July 24, 2013].
- *Convention on Wetlands of International Importance, especially Waterfowl Habitat, 1971*
  United Nations Educational, Scientific and Cultural Organization (UNESCO (United Nations Educational, Scientific and Cultural Organization)). Convention on Wetlands of International Importance, especially Waterfowl Habitat. 1971. (Online). Available at: http://www.ramsar.org/cda/en/ramsar-documents-texts-convention-on/main/ramsar/1-31-38%5E20671_4000_0 [September 18, 2013].

Key Federal Definitions and Descriptions

The Office of Auditor General (OAG (Office of Auditor General)) of Canada defines heritage as the "evidence of human experience that holds value to a particular group and is also a means of promoting and reinforcing cultural identity” (OAG (Office of Auditor General), 2003). PC (Parks Canada) defines a cultural resource as “a human work or a place which gives evidence of human activity or has spiritual or cultural meaning, and which has been determined to have historic value” (PC (Parks Canada), 2013).

PC (Parks Canada) defines heritage value as “the aesthetic, historic, scientific, cultural, social or spiritual importance or significancefor past, present or future generations” (PC (Parks Canada), 2013). This definition is included in the *Standards and Guidelines for the Conservation of Historical Places in Canada*, a document that has been adopted by a number of federal, provincial, territorial and municipal authorities. The term “significance” refers to the value placed on the resource and should not be confused with determining significance of effects in an EA (environmental assessment) context.

The heritage value of a resource is embodied in tangible and/or intangible character-defining elements. These elements include the materials, forms, location, spatial configurations, uses and cultural associations or meanings that embody the heritage value of a cultural resource, which must be retained to preserve that value (PC (Parks Canada), 2013).

Examples of Resources with Heritage Value:

- The Mackenzie King Estate has historical value because it was Prime Minister William Lyon Mackenzie King’s residence.
- The National Battlefield Park (Plains of Abraham) in Quebec City has historic value as the site of a number of battles between the English and the French for Canada in the eighteenth century.
- The Grand Lake in Algonquin Provincial Park has become an important site of national pride because of the famous painting by Tom Thompson, who inspired the formation of the Group of Seven.

The Government of Canada's policies and programs generally divide physical and cultural heritage resources into three types:

- Built heritage resource: CHP (Canada's Historic Places) provides various categories of built heritage, including cultural landscapes, archaeological sites, buildings, and engineering works (CHP (Canada's Historic Places), 2010).
- Moveable heritage resource: TBS (Treasury Board of Canada Secretariat) defines moveable heritage as objects that have tangible evidence of human experience, such as artifacts, archives, printed material, cultural products, architectural heritage, and archaeology (TBS (Treasury Board of Canada Secretariat), 2008).
- Natural heritage resource: The *Convention Concerning the Protection of World Cultural and Natural Heritage, 1972* defines natural heritage as "natural features consisting of physical and biological formations or groups of such formations, which are of outstanding universal value from the aesthetic or scientific point of view; geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation; and natural sites or precisely delineated natural areas of outstanding universal value from the point of view of science, conservation or natural beauty" (UNESCO (United Nations Educational, Scientific and Cultural Organization), 1972).

There may be other types of physical and cultural heritage resources that are not listed above.

Example of Resources by Type:

- Built Heritage
  - Halifax Citadel in Nova Scotia;
  - Bethune-Thompson House in Ontario;

  - Quebec City’s walls and fortifications, Quebec;
  - Parliament Buildings in Ottawa, Ontario;
  - Archaeological sites along the Chilkoot Trail in British Columbia;
  - Wanuskewin Heritage Park in Saskatchewan;
  - Urban cultural landscape of Lunenburg, Nova Scotia;
  - Shipwreck sites in Red Bay, Labrador; and
  - Monumental poles (formerly referred to as "Totem poles") in Gwaii Haanas National Park, British Columbia.
- Moveable Heritage
  - Archaeological objects (e.g. (for example), arrow heads, harpoons, tools, agricultural implements, pipes, pottery, etc.);
  - Religious or sacred objects made or used by Aboriginal groups;
  - Archival and printed materials; and
  - Fossils.
- Natural Heritage
  - Fathom Five National Marine Park of Canada;
  - Canadian Rocky Mountain Parks;
  - Waterton Glacier International Peace Park;
  - Gros Morne National Park; and
  - Percé Rock in Gaspé.

PC (Parks Canada) defines cultural landscapes as “any geographical area that has been modified, influenced, or given special cultural meaning by people, and that has been formally recognized for its heritage value. Cultural landscapes are often dynamic, living entities that continually change because of natural and human-influenced social, economic and cultural processes” (Canada’s Historic Places. 2010). A widely accepted framework used in the *Standards and Guidelines for the Conservation of Historic Places in Canada* places cultural landscapes into three categories: designed; organically evolved (vernacular); and associative:

- Designed cultural landscapes were intentionally created by human beings;
- Organically evolved cultural landscapes developed in response to social, economic, administrative or religious forces interacting with the natural environment. They fall into two sub-categories: Relict landscapes in which an evolutionary process came to an end. Its significant distinguishing features are, however, still visible in material form. Continuing landscapes in which the evolutionary process is still in progress. They exhibit significant material evidence of their evolution over time; and
- Associative cultural landscapes are distinguished by the power of their spiritual, artistic or cultural associations, rather than their surviving material evidence.

Key Federal Policies and Guidance

In addition to CEAA (Canadian Environmental Assessment Act) 2012, there are other vehicles to assist in the protection of heritage or any structure, site or thing. These consist of federal, provincial, territorial and municipal policies, guidance and/or legislation. Protection is also supported by international conventions mentioned above.

Some examples of other federal policies and guidance include:

- *Cultural Resource Management Policy, 2013* (PC (Parks Canada)): The policy sets out the objective to manage cultural resources administered by Parks Canada in accordance with the following principles: Understanding Heritage Value, Sustainable Conservation and Benefits to Canadians.
- *Guidelines for the Management of Archaeological Resources, 2005* (PC (Parks Canada)): These Guidelines present Parks Canada's approach to archaeological resource management as a component of cultural

resource management using the principles and practices of the Cultural Resource Management Policy. Archaeology on federal lands and lands underwater is within the jurisdiction of the Minister responsible for the Parks Canada Agency.

- *Policy on Management of Materiel, 2006* (TBS (Treasury Board of Canada Secretariat)): The objective of this policy is to ensure that materiel is managed by departments in a sustainable and financially responsible manner that supports the cost-effective and efficient delivery of government programs. It also sets out the requirements for Federal Heritage Buildings.
- *Guide to the Management of Moveable Heritage Assets, 2008* (TBS (Treasury Board of Canada Secretariat)): The guide provides departments with direction on managing federal moveable heritage assets such as art, archaeological artifacts, and everyday objects that possess heritage value. The guide stipulates that these assets are to be identified, their heritage value is to be assessed, and a record is to be kept that contains accurate information about their nature and condition.
- *Policy on Management of Real Property, 2006* (TBS (Treasury Board of Canada Secretariat)): The objective of this policy is to ensure real property is managed in a sustainable and financially responsible manner, throughout its life cycle, to support the cost-effective and efficient delivery of government programs.

Detailed information on how to access these instruments follows:

- Canada’s Historic Places. 2010. *Standards and Guidelines for the Conservation of Historic Places in Canada*. 2nd Ed. (Online). Available: http://www.historicplaces.ca/en/pages/standards-normes.aspx [July 25, 2013].

- OAG (Office of Auditor General). 2003. 2003 *November Report of the Auditor General of Canada, Chapter 6 – Protection of Cultural Heritage in the Federal Government*. Ottawa. (Online). Available: http://www.oag-bvg.gc.ca/internet/English/parl_oag_200311_06_e_12929.html [July 24, 2013] Parks Canada (PC (Parks Canada)). 2013. Cultural Resource Management Policy. Ottawa. (Online). Available: http://www.pc.gc.ca/docs/pc/poli/grc-crm/index.aspx [July 24, 2013].
- TBS (Treasury Board of Canada Secretariat). 2008. *Guide to the Management of Movable Heritage Assets*. Ottawa. (Online). Available: http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=13872&section=text [July 24, 2013].
- TBS (Treasury Board of Canada Secretariat). 2006. *Policy on Management of Materiel*. Ottawa. (Online). Available: http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?section=text&id=12062 [September 18, 2013].
- TBS (Treasury Board of Canada Secretariat). 2006. *Policy on Management of Real Property*. Ottawa. (Online). Available: http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=12042&section=text [November 12, 2013]

Appendix 3: Reference Sheet - Generic Framework

Generic step-wise framework

- **Step 1: Initial Scoping**
  - Identification of VCs (valued components), including heritage or any structure site or thing; potential environmental effects; and spatial & temporal boundaries.
- **Step 2: Analysis**

    - Data collection or generation through means such as surveys, literature reviews, on-site testing, community knowledge and Aboriginal traditional knowledge, and a clear description of methods used to predict environmental effects.
- **Step 3: Identification of Mitigation Measures**
    - Identification of technically and economically feasible measures to mitigate any significant adverse effects by reduction, elimination or control or, when these forms of mitigation are not possible, restitution measures such as replacement, restoration or compensation.
- **Step 4: Determination of Whether a Project is likely to Cause Significant Adverse Effects**
    - Clearly presented predictions based on defined criteria to support conclusions about whether a project is likely to result in significant adverse effects, taking into account mitigation measures.
- **Step 5: Follow-up**
    - Verification of the accuracy of the EA (environmental assessment) of a designated project and analysis of the effectiveness of mitigation measures.

These steps are iterative rather than linear; circumstances commonly arise during the course of an assessment that may require some steps to be revisited.

Date modified: 2023-12-05

Technical Guidance for Assessing the Current Use of Lands and Resources for Traditional Purposes under CEAA 2012

This document provides guidance on federal environmental assessments commenced under the former *Canadian Environmental Assessment Act, 2012*. It is retained for the completion of transitional environmental assessments commenced prior to the *Impact Assessment Act*. For more information on transitional environmental assessments, please consult the Legislation and Regulations page.

December 2015

Draft for public comment

Disclaimer

This technical guidance is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA (Canadian Environmental Assessment Act) 2012) or any of its regulations. In the event of any inconsistency between this technical guidance and CEAA

(Canadian Environmental Assessment Act) 2012 or its regulations, CEAA (Canadian Environmental Assessment Act) 2012 or its regulations, as the case may be, would prevail.

For the most up-to-date versions of CEAA (Canadian Environmental Assessment Act) 2012 and its regulations, please consult the Department of Justice website at: http://laws-lois.justice.gc.ca/eng/

The list of examples provided in this guidance document is not exhaustive or prescriptive but rather provides examples of the kinds of information that may be relevant and sought in an environmental assessment.

Draft Version: Public Comments Invited

Environmental assessment practitioners, the public and Aboriginal groups are invited to provide comments on this draft technical guidance document. Any feedback on this document should be submitted to the Agency at CEAA.guidance-orientation.ACEE@ceaa-acee.gc.ca by June 16th, 2016. All comments will be reviewed and considered for integration in the document for release in its finalized form. The document will be considered an ‘evergreen' resource and will be subject to periodic updates as appropriate.

Updates

This document may be reviewed and updated periodically by the Canadian Environmental Assessment Agency. For the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Ce document a été publié en français sous le titre : *Orientations techniques pour l'évaluation de l'usage courant des terres et des ressources à des fins traditionnelles en vertu de la* Loi canadienne sur l'évaluation environnementale (2012)

This document is also available in Adobe's Portable Document Format [PDF (Adobe Acrobat document) - 492 KB (kilobytes)].

Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

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Context

The *Canadian Environmental Assessment Act, 2012* (CEAA (Canadian Environmental Assessment Act) 2012) aims to protect components of the environment that are within federal legislative authority from significant adverse environmental effects caused by a designated project, including cumulative environmental effects.

In addition, CEAA (Canadian Environmental Assessment Act) 2012 ensures that a designated project is considered in a careful and precautionary manner to avoid significant adverse environmental effects, when the exercise of a power or performance of a duty or function by a federal authority under any Act of Parliament is required for the designated project to be carried out.

Throughout the technical guidance document, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA (Canadian Environmental Assessment Act) 2012. Under CEAA (Canadian Environmental Assessment Act) 2012, the “environmental effects” to be considered are those in areas of federal jurisdiction as described in section 5, and include:

- effects on fish and fish habitat, shellfish and their habitat, crustaceans and their habitat, marine animals and their habitat, marine plants, and migratory birds;
- effects on federal lands;
- effects that cross provincial or international boundaries;
- effects of any changes to the environment on Aboriginal peoples related to health and socio-economic conditions; physical and cultural heritage; current use of lands and resources for traditional purposes; or any structure, site or thing that is of historical, archeological, paleontological or architectural significance; and
- changes to the environment that might result from the federal decisions as well as any associated effects on health and socio-economic conditions, matters of historical, archaeological, paleontological or architectural interest, or other matters of physical or cultural heritage.

Purpose

This technical guidance document supports the implementation of CEAA (Canadian Environmental Assessment Act) 2012 provisions related to the effects of any changes to the environment on the current use of lands and resources for traditional purposes by Aboriginal peoples. It provides guidance on how to conduct the environmental assessment (EA (environmental assessment)) of a designated project when the Canadian

Environmental Assessment Agency (the Agency) is the responsible authority or supports an EA (environmental assessment) conducted by a review panel.

The technical guidance informs the preparation of Agency directives and key EA (environmental assessment) documents and serves as core guidance to proponents who propose the carrying out of a designated project. It also provides direction to Agency employees throughout the EA (environmental assessment) of a designated project in their interactions with those engaged in the EA (environmental assessment) process, such as proponents, federal authorities, other jurisdictions, review panel members, Aboriginal groups and the public.

In combination with Agency directives and key EA (environmental assessment) documents, the technical guidance aims to ensure that CEAA (Canadian Environmental Assessment Act) 2012 requirements related to the current use of lands and resources for traditional purposes are met in order to achieve a high quality EA (environmental assessment) of a designated project.

Application

The technical guidance is intended for use in the EA (environmental assessment) of a designated project. This technical guidance should be used in conjunction with other Agency policy and guidance instruments. For an EA (environmental assessment) by a review panel, additional guidance and direction may be provided in the Terms of Reference and/or Joint Review Panel Agreement.

In this technical guidance, the term “designated projects” refers to projects initiated under CEAA (Canadian Environmental Assessment Act) 2012, and “EA” refers to the EA (environmental assessment) of designated projects initiated under CEAA (Canadian Environmental Assessment Act) 2012 for which the Agency is the responsible authority or for an EA (environmental assessment) conducted by a review panel.

This technical guidance is applicable to designated projects which fall under sections 1-30 of the schedule in the Regulations Designating Physical Activities. (Schedule – Physical Activities)

In this technical guidance, Aboriginal refers to First Nations, Inuit and Metis.

Agency directives and key EA (environmental assessment) documents include Project Description, Environmental Impact Statement Guidelines, Environmental Impact Statement, Information Requests, and EA (environmental assessment) Report.

Relevant Provisions of CEAA (Canadian Environmental Assessment Act) 2012

This technical guidance addresses subparagraph 5(1)(c)(iii) of CEAA (Canadian Environmental Assessment Act) 2012 "with respect to aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on the current use of lands and resources for traditional purposes".

The technical guidance supports paragraph 4(1)(d) in promoting communication and cooperation with Aboriginal peoples with respect to EA (environmental assessment)s as one of the purposes of CEAA (Canadian Environmental Assessment Act) 2012.

Subsection 19(1) of CEAA (Canadian Environmental Assessment Act) 2012 identifies the factors that are to be taken into account in an EA (environmental assessment), including the significance of environmental effects, mitigation measures and the requirements of a follow-up program. This subsection also indicates the environmental effects to be taken into account in the EA (environmental assessment) include cumulative environmental effects and the environmental effects of malfunctions or accidents. In examining these factors, the EA (environmental assessment) may take into account community knowledge and Aboriginal traditional knowledge, in accordance with subsection 19(3).

Under section 52 of CEAA (Canadian Environmental Assessment Act) 2012, the Minister of the Environment must decide if, taking into account the implementation of mitigation measures the Minister considers appropriate, the designated project is likely to cause significant adverse environmental effects

When the Minister of the Environment determines that the designated project is not likely to cause significant adverse environmental effects referred to in subsections 5(1) and/or 5(2) of CEAA (Canadian Environmental Assessment Act) 2012, or if the Governor in Council determines any significant adverse environmental effects identified by the Minister are justified in the circumstances, the Minister, in accordance with section 53 of CEAA (Canadian Environmental Assessment Act) 2012, will identify, in the EA (environmental assessment) decision statement, the conditions with which the proponent must meet with respect to mitigation measures and follow-up program requirements.

Aboriginal Rights Information – Interface with Paragraph 5(1)(c)

The subject areas included in paragraph 5(1)(c) and in particular the term “current use of lands and resources” by Aboriginal peoples is often expressed by Aboriginal groups as rights, namely “aboriginal rights”, “treaty rights” and “aboriginal title”. This Guidance document is not intended to create, deny, limit or define any potential legal rights of any Aboriginal groups. Rather, this guidance document is provided to assist the public, Aboriginal groups, proponents and EA (environmental assessment) practitioners to understand the kinds of information that is to be collected and considered under paragraph 5(1)(c) and when implementing CEAA (Canadian Environmental Assessment Act) 2012.

The information gathered under paragraph 5(1)(c) may also assist other kinds of assessments needed to meet other kinds of obligations that may arise in the course of implementing CEAA (Canadian Environmental Assessment Act) 2012. For example, the information collected may overlap with the information needed to assess potential adverse impacts on Aboriginal or Treaty rights which in turn may inform any consultation or treaty implementation requirements that may arise. However, this Guidance document is not directed at informing these other kinds of assessments or obligations that may arise in relation to the implementation of CEAA (Canadian Environmental Assessment Act) 2012.

Understanding subparagraph 5(1)(c)(iii)

The current use of lands and resources for traditional purposes by Aboriginal peoples is determined on a case-by-case basis over a defined area and period of time. Under subparagraph 5(1)(c)(iii), effects from a designated project on the current use of lands and resources for traditional purposes are considered through a change in the environment.

The current use of lands and resources for traditional purposes, as well as the exercise of treaty rights, is associated with an Aboriginal group's practices, traditions or customs, which are part of an Aboriginal group's distinctive culture and fundamental to their social organization and the sustainment of present and future generations. Practices, traditions and customs are generally defined as follows:

- Practice: a way of doing something that is common, habitual or expected;
- Tradition: a custom, opinion or belief handed down primarily orally or by practice; and
- Custom: a particular, established way of behaving.

Understanding “Current use”

In the context of an EA (environmental assessment), “current use” refers to how the use of lands and resources may be affected throughout the proposed project's lifecycle (pre-construction, construction, operation, decommissioning and abandonment).

This includes uses by Aboriginal peoples that are actively being carried out at the time of the assessment and uses that are likely to occur in a reasonably foreseeable future provided that they have continuity with traditional practices, traditions or customs. Some uses may be more difficult to identify at the time of the assessment because they occur at long time intervals or with low frequency.

Furthermore, uses that may have ceased due to external factors should also be considered if they can reasonably be expected to resume once conditions change.

Examples:

The recovery plan for a species may preclude its harvesting by Aboriginal peoples within a geographic area until the species population rebounds.

Land disturbance from a previous project or natural causes such as forest fires may have affected the habitat and abundance of a bird species, resulting in a reduction of traditional hunting on that land. Remediation of the land may lead to a recovery of the bird population and enable hunting by Aboriginal peoples to resume.

The availability of information on patterns of use of lands and resources across a range of time can assist in considering "current use" in relation to a specific timeframe. An expansion or contraction of that time period may be considered as new information becomes available during the course of an EA (environmental assessment).

The following questions may assist in determining how the lands and resources are currently being used for traditional purposes by Aboriginal peoples:

- What is the frequency, duration, spatial and seasonal aspects of the use?
- Does the timing of the use correspond to the biophysical cycles of migration or growth of the resource?
- Does the timing relate to a spiritual or cultural consideration of the resource or land use?
- Are there any external factors that may have temporarily altered or halted traditional practices?
- Are Aboriginal peoples permanently or temporarily residing on the lands?

Understanding "Use"

The term "use" may refer to activities involving the harvest of resources, such as hunting, trapping, fishing, gathering of medicinal plants, berry picking, and travelling to engage in these or other kinds of activities.

In addition, use may also refer to particular connections and uses of the lands and resources related to ceremonies, customs, cultural practices, traditional governance, trade or stories. For any given Aboriginal group, use occurs over a specific geographic area; however, several groups may use portions of that same area.

The use of the lands and resources by Aboriginal peoples may have tangible values (e.g., wildlife species or traditional plants) and/or intangible values (e.g., quiet enjoyment of the landscape or sites used for teachings). Intangible values are often linked with spiritual, artistic, aesthetic and educational elements that are often associated with the identity of Aboriginal groups.

In relation to use, “occupancy” may be viewed as a distinct way of viewing an Aboriginal group's presence in an area. Occupancy may refer to a defined area that an Aboriginal group regards as its own by virtue of continuing use, habitation, naming, knowledge and control. Transmittal of legends, oral histories and ecological knowledge about places, in addition to indigenous place names and habitation sites, are often used to substantiate Aboriginal groups' claims of occupancy. The geographic boundaries of occupancy are generally smaller than those that represent use and could be shared by two or more groups.

Understanding “Lands and Resources”

The term “lands” may refer to terrestrial, riverine, lake and marine ecosystems. Land can have spiritual, economic and political significance for Aboriginal peoples. Aboriginal peoples often have a long and complex relationship with the land, which results in strongly held views about the cultural, biophysical and spiritual connectedness between the lands, waters, the peoples and their societies. Aboriginal peoples' traditional territory, both the lands occupied and those used historically, can be integral to their identity as a distinct nation.

The use of the land may be defined by the resources harvested, the activities undertaken to procure the resource and the locations where the activities have taken place. More specifically, the use of the land can be expressed in the following terms:

- subsistence practices (e.g., hunting, fishing, gathering);
- places where transmission of cultural knowledge occurs, including language, sense of self and place within the community;
- ceremonies/events (e.g., harvest feasts, solstice, annual gatherings);
- traditional routes (e.g., trails, waterways, landmarks, portages);
- sacred sites (e.g., burial grounds, cultural landscapes); and
- habitation sites.

The importance placed on the uses of the land by Aboriginal groups may vary from group to group based on the values, practices, traditions and geographic location of each group. Lands and resources may be utilized by one or more Aboriginal groups. Those groups that give prominence to certain resources (e.g., caribou) also tend to give prominence to the area where the resource is extracted (e.g., preferred harvesting area where teachings about hunting and cultural history occur).

Understanding “Traditional Purposes”

Traditional purposes typically relates to activities that are integral to a community's way of life and culture, and have continuity with historic practices, customs and traditions of the community.

Although these practices may be considered traditional and as having a strong historic link, these activities are not static. They evolve over time to reflect contemporary views, knowledge and practices. The practices, traditions and customs of Aboriginal peoples often change as a result of evolving trends occurring within society as whole (e.g., technological innovations). For example, hunting and fishing practices may have evolved from using dog sleds and canoes to snowmobiles and power boats.

For the purpose of an EA (environmental assessment), the expressions “pre-contact or post-contact with European society or colonization” are frequently used to measure the number of years, decades, generations and centuries that an Aboriginal group's current use of lands and resources for traditional purposes can be traced. Pre-contact evidence and information such as archaeological sites are frequently presented to quantify how far back the use of specific lands and resources may extend. Practices, customs and traditions that are resumed after an interruption may still be considered in the EA (environmental assessment), despite the interruption. Practices, traditions or customs do not have to be connected to a potential or established Aboriginal right, or to an area of historic occupancy, for them to be considered in an EA (environmental assessment).

The concept of “within living memory” generally refers to a period of time within a person's life and may include childhood recollections. It can be recorded using a number of qualitative research methods (e.g., map biography), often derived from interviews. These initiatives can present comprehensive information regarding the use of lands and resources by one or more groups for a given period of time (e.g., years, decades or centuries).

Linkages with other provisions of section 5

A land or resource that is part of the current use of lands and resources for traditional purposes may also fit under other provisions of section 5.

Example:

Fish and fish habitat, aquatic species, migratory birds and any other components of the environment set out in Schedule 2 fall within paragraph 5(1)(a). These components are very often part of an Aboriginal group's current use of the lands and resources for traditional purposes.

Furthermore, any one of these components under paragraph 5(1)(a), or other components not specifically listed in subsection 5(1) (e.g., caribou, deer) may be used by an Aboriginal group for more than one purpose.

Example:

Fishing and hunting might be part of an Aboriginal group's economy and therefore may also be considered as part of their health and socio-economic conditions identified under subparagraph (5)(1)(c)(iii).

In addition to being currently used for traditional purposes, a land or resource may be valued or hold value that may link it to other provisions of section 5.

Example:

Aboriginal fishing cabins, and/or the lands on which fishing activities take place, may also have heritage value and be considered as physical and cultural heritage identified under subparagraph (5)(1)(c)(ii) or any site, structure or thing of historical, archeological, paleontological or architectural significance identified under subparagraph (5)(1)(c)(iv).

Introducing the Environmental Assessment Framework

An EA (environmental assessment) examines any changes to the environment that may be caused by a designated project, and pursuant to subparagraph 5(1)(c)(iii) considers how these changes to the environment may affect the current use of lands and resources for traditional purposes with respect to Aboriginal peoples.

The approach and level of effort applied to assessing effects of any changes to the environment on the current use of lands and resources for traditional purposes in an EA (environmental assessment) are established on a case-by-case basis taking into consideration the:

- characteristics of the designated project;
- potential environmental effects;
- state (health, status or condition), nature and extent of the valued components (VC (Valued Component)s) that may be affected by a change in the environment;
- potential for mitigation and the extent to which mitigation measures may address potential environmental effects;
- potential for cumulative environmental effects; and
- level of concern expressed by Aboriginal groups.

The EA (environmental assessment) framework should include the following five steps:

- Step 1: scoping;
- Step 2: analysis;
- Step 3: mitigation;
- Step 4: significance; and
- Step 5: follow-up.

The steps are iterative; circumstances (e.g., information or analysis) commonly arise during the course of an assessment that requires one step or several steps to be revisited. EA (environmental assessment) documentation must clearly explain and justify the methodologies used to assess the effects of any changes to the environment on the current use of lands and resources for traditional purposes.

Once the potential effects of the designated project on the current use of lands and resources for traditional purposes have been identified, mitigation measures are considered. The implementation of mitigation measures is taken into account by the Minister of the Environment when determining whether a project is likely to cause significant adverse environmental effects.

Information that is gathered from Aboriginal groups by practitioners throughout the five steps needs to be assessed and presented in a manner that reflects each group's individual concerns, issues and interests in relation to the current use of lands and resources for traditional purposes.

Note that each Aboriginal group is unique and the current use of lands and resources for traditional purposes should be discussed and collected with each Aboriginal group identified in the Environmental Impact Statement (EIS (environmental impact statement)) guidelines.

Aboriginal Traditional Knowledge (ATK) should be used as sources of information during all five steps. For more information on how to integrate ATK in the assessment see *Considering Aboriginal traditional knowledge in environmental assessments conducted under the* Canadian Environmental Assessment Act, 2012.

Step 1: Scoping

Scoping is an iterative process that focuses the assessment on relevant issues and concerns and establishes the spatial and temporal boundaries of the EA (environmental assessment). Scoping should cover the following aspects:

- identifying VC (Valued Component)s;
- listing potential effects; and
- determining spatial and temporal boundaries.

Scoping for the EA (environmental assessment) is made in relation to section 5 of CEAA (Canadian Environmental Assessment Act) 2012 and takes into account direction provided by the Agency (e.g., in the EIS (environmental impact statement) Guidelines). As scoping is iterative, information gained throughout the EA (environmental assessment), such as information on potential or confirmed current use of lands and resources for traditional purposes, may help clarify what needs to be considered and to what extent.

Identifying valued components

A VC (Valued Component) represents an environmental element of an ecosystem that is identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance. The value of an ecosystem component may be determined on the basis of cultural ideals or scientific concern. For the purposes of CEAA (Canadian Environmental Assessment Act) 2012, VC (Valued Component)s are selected to assist in predicting and assessing environmental effects as described under section 5 and taking into account direction provided by the Agency or, in the case of an EA (environmental assessment) by review panel, the Minister.

Identifying VC (Valued Component)s may involve making an inventory of the current use of lands and resources for traditional purposes that may be affected by the designated project.

Examples of questions that should be considered in identifying VC (Valued Component)s include:

- Are there any lands and resources that are known to be currently used by Aboriginal peoples for traditional purposes?
- Are there any traditional activities, cultural and spiritual practices, intergenerational transfer of culture and knowledge, or traditional values taking place?
- Has any work been previously undertaken to identify lands and resources that are currently being used by Aboriginal peoples for traditional purposes, such as land use studies?
- What lands and resources are valued by an Aboriginal group?

The current use of lands and resources for traditional purposes generally consists of a combination of three elements: activities, resources and locations, as shown in Table 1.

Table 1: Elements associated with the current use of lands and resources for traditional purposes.

Elements	Examples

Elements	Examples
Activity	• Hunting • Fishing • Trapping • Berry picking • Plant gathering • Teaching • Gathering of people (e.g., for spiritual/ceremonial reasons, to share/teach skills, etc.) • Forestry
Resource	• Big game mammals: moose, deer, mountain goat, caribou, elk and muskox • Fur bearing mammals: marten, mink, beaver, otter, muskrat hare, lynx, wolverine, red and arctic fox, grizzly bear, polar bear and black bear • Other land mammals: squirrel, skunk and porcupine • Aquatic mammals: ringed seal, bearded seal, walrus, narwhal and beluga whale • Fish: lake whitefish, northern pike, sturgeon, arctic char and salmon • Waterfowl: eider, duck, Canada goose and swan • Seabirds: birds and eggs • Other birds: ruffed grouse and wild chicken • Plants, shrubs, and trees: berries, herbs, moss, medicinal plants, tobacco, bearberry, Canada yew, Lodgepole pine, Douglas fir, spruce, birch, silverberry, false dogbane bush, juniper and Saskatoon berries • Drinking/cooking water

Elements	Examples
Location	• Cabins/camps • Resource harvesting areas (e.g., plant gathering, fishing, hunting, trapline) • Trails • Ceremonial/sacred sites • Graves/burial sites • Cultural landscapes • Habitation sites

When identifying VC (Valued Component)s, it may be useful to consider that in most cases all three of these elements form an integral part of any given current use of the lands and resources by Aboriginal peoples.

Example:

A mine may have potential effects on an Aboriginal fishing site. Contamination or disturbance to the fishing site (location) could affect the fish (resource), which would in turn affect aboriginal fishing (activity).

During scoping, a VC (Valued Component) may be identified at a broad level (e.g., hunting) or at a more specific level (e.g., hunting of migratory birds). The consideration of the effects of the designated project will generally involve an examination of the specific features of the VC (Valued Component).

Gathering data and information on VC (Valued Component)s of interest

Identifying VC (Valued Component)s may be achieved through a combination of researching existing sources of information, engagement with Aboriginal groups, Traditional Land Use Studies, or other methods.

Existing sources of information

Aboriginal groups, experts, stakeholders, government and non-government organizations, as well as existing literature, can be important sources of information in identifying and evaluating lands and resources currently used by Aboriginal peoples for traditional purposes.

Possible sources of information may include the following:

- Aboriginal groups (communities and organizations)
- Aboriginal consultation records from other provincial or federal activities
- Aboriginal treaties and land claims
- existing Traditional Land Use Studies
- provincial or federal EA (environmental assessment)s conducted for other projects
- court cases and decisions
- professional societies and organizations
- academic and research institutions
- cultural environmental setting report
- registered fur management areas (traplines)
- federal, provincial and municipal archives and libraries
- federal and provincial Archaeological records
- land and marine use plans
- Canadian Registry of Historic Places
- federal and provincial government departments
- federal, provincial and territorial guidance documents and legislations
- photographs and maps
- Aboriginal Treaty and Rights Information System

Professional judgment should be exercised in evaluating the credibility, applicability and validity of any sources for the purpose of an EA (environmental assessment). The identification of VC (Valued Component)s of interest should also be informed by engaging Aboriginal groups and conducting Traditional Land Use Studies.

Engaging Aboriginal groups

Engaging all potentially affected Aboriginal groups during the scoping phase will assist practitioners in identifying VC (Valued Component)s that appropriately represent the current use of lands and resources for traditional purposes that may be affected by the designated project. Early engagement with Aboriginal groups and making effective use of ATK are strongly encouraged in order to achieve a more complete EA (environmental assessment), manage risks of costs and delays later in the process, and be aware of any issues surrounding the capacity of Aboriginal groups to participate in the EA (environmental assessment).

Information on the current use of lands and resources for traditional purposes is often conveyed through ATK. ATK is also known by other names such as Traditional Ecological Knowledge, Traditional Knowledge and Indigenous Knowledge. In general terms, ATK refers to a body of knowledge built up by a group of people through generations of living in close contact with nature. ATK is often unwritten and transmitted orally, and includes beliefs, wisdom, activities, traditions and skills derived from extended observations of the land and its creatures, weather, seasonality and other cycles, and spiritual associations. Prominent across Aboriginal beliefs is the seventh generation principle, which holds that the decisions made today should result in a sustainable world seven generations into the future.

Engagement could involve visiting communities, hosting workshops, or attending meetings to build relationships and discuss current use with Aboriginal groups. Such initiatives can increase the credibility of the EA (environmental assessment) and minimize the risk of the information being misunderstood, misinterpreted and/or taken out of context. Engaging a cross-section of the Aboriginal group, including leadership, harvesters, elders, women and youth, may help to make interactions more inclusive and the information obtained more representative of the community as a whole. Interactions with Aboriginal peoples should be in keeping with appropriate ethical standards. Confidentiality procedures can assist in avoiding any potential inadvertent disclosures (e.g., disclosure of traditional knowledge to a band member which the community restricts to its elders).

Consent forms can be used to establish agreements between practitioners and communities as to the confidentiality and intellectual property rights for information collected. These agreements provide authorization to publish relevant information in EA (environmental assessment) documents. It is important to understand the particular governance structure of each Aboriginal group so as to ensure compliance with desired protocols, and to maintain respectful working relationships.

It is important to note that all records submitted for the EA (environmental assessment) are considered part of the Canadian Environmental Assessment Registry (the Registry). The Registry consists of an *Internet site* of basic project information and *project files*, accessible to the public, which contain the records produced or obtained for the purpose of conducting an EA (environmental assessment). When requested, copies of records in the project file must be provided to the public in a timely manner. The project file does not, however, include records that would not have been released if a request had been made under the *Access to Information Act.*

Participants submitting information or documents in the EA (environmental assessment) by review panel can make a request in writing to the panel for confidentiality prior to or concurrent with the submission of the information if disclosure would cause harm to a witness or harm to the environment.

Traditional Land Use Studies

Traditional Land Use Studies seek to determine the extent of past and present use of the land for traditional purposes important to Aboriginal peoples including, but not limited to, hunting, fishing, trapping, ceremonial pursuits and the gathering of plants including berries and herbal medicines.

These studies can assist in documenting each Aboriginal group's use and habitation of the territory at any time during the groups' existence, or within living memory. They are typically completed either by the Aboriginal communities, by practitioners, collaboratively between both parties, or by a consultant hired by either the community or practitioner. Methods to complete these studies may include historical research, interviews, community meetings, geographic information systems and other mapping exercises, and field studies. These documents should be viewed as “living” and should be updated over time to reflect the changing land and resource uses of an Aboriginal group.

Traditional Land Use Studies cover the types of practices, activities, sites, and/or areas frequented by the respective groups, including:

- important travel sites and routes (e.g., trail systems, waterways, and landmarks);
- harvesting (e.g., registered traplines, resource use and harvesting areas, special-use sites such as fish camps, berry-picking areas, and medicinal plant collection areas);
- occupied areas (e.g., residential areas, meeting areas, gathering places, cabins, and campsites); and

- spiritual sites and sacred landscapes (e.g., burial sites and cultural landscapes).

Studies conducted to document land and resource use by Aboriginal peoples may be named as land use studies, traditional use studies, and traditional land use and occupancy studies. The practitioners should work with each Aboriginal group to determine what terminology and methods are most appropriate and respectful for that community.

If, instead of conducting a new Traditional Land Use Study as part of the EA (environmental assessment), the EA (environmental assessment) relies on previous studies, their original purpose should be transparent and they should reflect the views and knowledge of the Aboriginal group. It is best practice to seek the permission of Aboriginal groups prior to using existing studies and that these studies be validated in the current context. If significant time has elapsed since the study was completed, consideration should be given to conducting new research to update the previous study.

Considerations for identifying VC (Valued Component)s

In determining potential current use of lands and resources for traditional purposes that may be affected by a designated project, the following considerations may be of assistance:

- Context: A particular resource or parcel of land may not appear important on its own. However, considering the historical and physical context and information content (such as cultural significance) may provide insight into its value. For example, places that are sacred to Aboriginal peoples may show no signs of physical activity, but may be associated with the creation of legends, ceremonial functions, personal vision quests, puberty rites, etc.

- Disturbances: The degree of intactness of the lands or resources is evaluated, including the level to which they have been disturbed or are preserved. Such an evaluation requires data on the previous condition of the lands or resources, which may not always be available or documented.
- Evidence: Some types of sites, such as burial sites, are not visible. It is therefore important to take the necessary steps to identify where these sites may be present in order to avoid or mitigate any adverse effects on them. Engaging Aboriginal groups may help in locating these sites.
- Access: Aboriginal groups rely on access to lands and resources to pursue traditional uses, such as access to quality hunting areas, preferred fishing sites, established trails and ceremonial sites. The environmental effects of a designated project may result in a change in access to the area and/or changes to the resources themselves. A decrease in access for Aboriginal peoples or an increase in access for non-Aboriginal peoples (e.g., increased hunting pressures) could have a negative effect on the current use of lands and resources for traditional purposes. Consideration should be given on how land tenures (e.g., crown lands) in the area may affect access to and availability of lands and resources.
- Evolution: The current use of lands and resources for traditional purposes by Aboriginal peoples is constantly evolving over time. Traditional practices may also change over specific intervals of time, for example, when they are dependent or associated with seasons or cultural/ceremonial traditions. When considering traditional uses, “traditional” should be viewed as something that, while rooted in historical practices, remains very much a part of the contemporary culture.

Listing potential effects

Under CEAA (Canadian Environmental Assessment Act) 2012, the "environmental effects" to be considered are those described in section 5, including:

- With respect to Aboriginal peoples, an effect occurring in Canada of any change that may be caused to the environment on the current use of lands and resources for traditional purposes.

The following questions could be considered to help identify potential effects on the current use of lands and resources for traditional purposes:

- What are the changes to the environment that may be caused by a designated project?
- How will these changes to the environment affect Aboriginal groups' current use of lands and resources for traditional purposes?
- What are some of the characteristics associated with the use of lands and resources, such as the location, frequency, duration or timing of the traditional practices?
- Are there cumulative effects that will affect the identified current use of lands and resources for traditional purposes?
- What are the Aboriginal groups' concerns associated with the potential effects?

There may be a relationship between the effects on the biophysical components of the environment and the effects on the current use of lands and resources for traditional purposes. Such relationships will exist when the use is related to a particular component (e.g., fish). The assessment of a biophysical VC (Valued Component) may inform the assessment of a current use VC (Valued Component). However, effects to current use cannot always be entirely captured solely on an independent assessment of biophysical components.

Example:

Effects of the designated project may alter the migration patterns of a migratory bird that is hunted by an Aboriginal group. From a biophysical standpoint, this may have a minimal effect on the viability of the migratory bird population; however, this alteration may have a greater effect on the Aboriginal group's ability to hunt the migratory birds in a preferred area.

Therefore, assessing potential effects on current use VC (Valued Component)s could involve first identifying those which are specific to current use of lands and resources for traditional purposes (e.g., fishing) and then identifying biophysical parameters which may inform the assessment (e.g., fish and fish habitat). In some cases, the biophysical parameter will also be a VC (Valued Component) (e.g., salmon).

Determining spatial and temporal boundaries

Defining the spatial and temporal boundaries for the assessment of effects on VC (Valued Component)s establishes a frame of reference for identifying and assessing the environmental effects associated with the designated project. These boundaries are set to provide some structure for the analysis of potential environmental effects, selection of mitigation measures and determination of significance. The spatial and temporal boundaries used in the EA (environmental assessment) may vary depending on the VC (Valued Component).

Spatial boundaries will be defined taking into account the appropriate scale and spatial extent of potential environmental effects, community knowledge and ATK, current land and resource use by Aboriginal groups, ecological, technical and social and cultural considerations.

Temporal boundaries should span all phases of the designated project (e.g., construction, operation, decommissioning and abandonment). Each project phase is expressed in terms of the amount of time, in years or months, needed to complete each phase. Community knowledge and ATK should factor into decisions around temporal boundaries.

For information on establishing boundaries associated with cumulative environmental effects, please refer to the *Technical Guidance for Assessing Cumulative Environmental Effects under CEAA (Canadian Environmental Assessment Act) 2012*.

Step 2: Analysis

The objective of the analysis step is to describe how the potential changes to the environment caused by a designated project may affect the current use of lands and resources for traditional purposes. The analysis of a particular VC (Valued Component) may be applicable or used to support more than one subparagraph of section 5.

Examples:

The analysis of fish assessed under 5(1)(a)(i) can provide information relevant to the analysis on the ability of Aboriginal peoples to practice fishing under 5(1)(c)(iii).

An Aboriginal practice such as trapping may be assessed both as a current use of lands and resources for traditional purposes under 5(1)(c)(iii) and as being part of socio-economic conditions under 5(1)(c)(i).

Building on the information gathered from the scoping, this step of the assessment should include:

- A description of baseline conditions for the current use of lands and resources for traditional purposes;

- An assessment of how the potential changes to the environment caused by a designated project may affect the current use of lands and resources for traditional purposes;
- An assessment of how malfunctions or accidents related to the designated project may affect the current use of lands and resources for traditional purposes; and
- The consideration of potential cumulative effects.

Establishing baseline

Baseline conditions refer to present-day conditions, prior to implementation of the designated project. These conditions may not be fully representative of the variations in natural conditions, due to natural variability, historical shifts, or effects from other human activity.

Spatial and temporal boundaries inform the establishment of baseline environmental conditions. Baseline conditions should be provided for each VC (Valued Component) potentially affected in sufficient detail to enable the identification of how the designated project could affect the VC (Valued Component)s and an analysis of those effects. Aboriginal groups may request to be involved in the gathering of baseline information. Practitioners should indicate how input from Aboriginal groups was used in establishing the baseline conditions.

Based on the scope of the assessment, some of the baseline information that may be described and characterized includes:

- access and travel routes for conducting traditional practices;
- location of hunting camps, cabins and traplines;
- traditional uses currently practiced or practiced in recent history;
- presence of cultural or spiritual sites;
- frequency, duration or timing of traditional practices;

- geographic areas where fish, wildlife, birds, plants or other natural resources are harvested; and
- historic context about the state of the factors above.

Data collection and/or generation are important components of an analysis of environmental effects. At times, it may be challenging to obtain or generate data to support the analysis. Potential environmental effects should be considered in the analysis even when there is little supporting data or there is predictive uncertainty so that the EIS (environmental impact statement) can present the most complete picture of the potential environmental effects. In all cases, uncertainties and assumptions underpinning an analysis should be described and information sources clearly documented.

Interviews and questionnaires can be used to collect baseline data. Regardless of the methods used or the level of the Aboriginal community's involvement in the gathering of baseline information, cultural sensitivities should be taken into account.

When dealing with confidential information, some considerations to take into account include:

- sharing only information relevant to environmental effects;
- summarizing specific information into general conclusions;
- describing specific sites (e.g., harvesting and hunting locations) in a more general way so that specific locations are not revealed (e.g., highest concentration of use is within X kilometers of designated project); and
- when mapping sensitive locations, sharing information only with necessary and appropriate parties.

As indicated in table 1, activities, resources and locations are three elements that form an integral part of the current use of lands and resources for traditional purposes. When analysing potential effects, it may be useful to consider the interaction between all three elements in selecting appropriate VC (Valued Component)s and assessing potential effects of changes to the environment on these VC (Valued Component)s.

Table 2 provides examples of how changes to the environment may affect the current use of lands and resources for traditional purposes, as well as examples of measures that may be used to mitigate these effects.

Table 2: Examples of how changes to the environment may affect the current use of lands and resources for traditional purposes, as well as measures to mitigate these effects.

Change in the Environment	Potential effects on the Current Use of Lands and Resources for Traditional Purposes	Mitigation measures
Introduction of herbicides or pesticides along a transmission line.	• Reluctance to pick berries and gather food plants from areas where herbicides or pesticides have been used.	• Avoiding or minimizing the use of herbicides and pesticides near locations of plants of importance to Aboriginal groups.

Change in the Environment	Potential effects on the Current Use of Lands and Resources for Traditional Purposes	Mitigation measures
Influx of project workers in designated project area.	• Greater pressure on species used by Aboriginal groups.	• Instituting a hunting ban for employees to prevent additional hunting pressures. • Prohibiting workers and contractors from fishing in Aboriginal preferred fishing sites.
Road construction creates new rights of way, increasing access and traffic to previously remote area.	• Increased mortality of ungulates, which may affect hunting.	• Setting speed limits for vehicles that reduce the potential for vehicle-wildlife collisions.
Destruction of wetlands supporting moose and migratory birds.	• Reduced harvest of meat for food, and increased travel due to changes in moose and migratory bird abundance and distribution.	• Requiring selection and design of wetland compensation sites to take into account opportunities to provide for current use activities.

Change in the Environment	Potential effects on the Current Use of Lands and Resources for Traditional Purposes	Mitigation measures
Loss of land due to project footprint.	• Loss of ceremonial/sacred sites for transmittal of culture through teachings and storytelling.	• Adjustment of the designated project footprint (or parts of it) to avoid sensitive areas such as those which are known to be used for ceremonial purposes by Aboriginal peoples.
Decline in water quality from leaching of tailing storage facility.	• Permanent loss of area traditionally used as a source of drinking water around trails, cabins and camps.	• Maintain water quality in a given area by capturing runoff, using mitigation measures for seepage and using collection wells.
Increased noise levels due to mine operation.	• Disturbance of waterfowl hunted by Aboriginal peoples, requiring Aboriginal peoples to change their hunting practices.	• Reducing noise (e.g., helicopter and all-terrain vehicle travel) on certain parts of the land during waterfowl hunting seasons.

Change in the Environment	Potential effects on the Current Use of Lands and Resources for Traditional Purposes	Mitigation measures
Construction of a hydro-electric dam.	• Loss of access to an Aboriginal fishery.	• Developing a fish habitat compensation plan for Aboriginal fisheries that includes: fish passage restoration, enhancement of tributaries through barrier removal, riparian planting and upgrading of a hatchery.
Destruction of land.	• Loss of forage areas compromises ability to raise domesticated animals for food (livestock) and travel (horses).	• Restore the designated project site in such a way as to re-establish forage areas.
Increased marine traffic.	• Disruption of traditional navigation routes used for recreation, travel to other communities and marine harvesting.	• Adjust the timing, speed and routing of marine traffic to minimize disturbance to Aboriginal peoples.

The methodologies and methods used to predict environmental effects must be clearly described. With this information, reviewers will be able to examine the analysis and the rationale supporting the conclusions reached. Any assumptions or conclusions based on professional judgment should be clearly identified and described.

The assessment of cumulative effects on the current use of lands and resources for traditional purposes must consider how other physical activities act cumulatively to affect an Aboriginal group's ability to use the lands and resources for various purposes such as fishing, hunting and trapping, and spiritual and cultural practices.

Step 3: Mitigation

Technically and economically feasible measures that would mitigate any significant adverse environmental effects must be identified. Mitigation of environmental effects can take two forms:

- Elimination, reduction or control of a designated project's environmental effects is preferred.
- Where this is not possible, restitution for any damage to the environment caused by the environmental effects should be considered (e.g., replacement, restoration, compensation).

Consultations and ATK can help inform the appropriate and desired measures to avoid or mitigate the adverse environmental effects.

Table 2 presents examples of measures that may be used to mitigate the effects of any changes to the environment on the current use of lands and resources for traditional purposes.

The views of affected Aboriginal groups on mitigation should be considered and included in the EIS (environmental impact statement). This could assist in ensuring that the environmental effects on the current use of land and resources for traditional purposes are at an acceptable level for the community.

Engaging Aboriginal groups is particularly important when practitioners are considering alternate sites as a form of mitigation. Aboriginal peoples have strong connections to specific lands, and therefore, even if similar lands and resources are located in a nearby region, their practices may not be adaptable or readily reproduced elsewhere.

Information on past, existing and future physical activities may help identify appropriate mitigation measures for the current use of lands and resources for traditional purposes.

Step 4: Significance

An EA (environmental assessment) must consider the significance of any adverse environmental effects that are likely to result from a designated project after taking into account the implementation of any mitigation measures, including a consideration of the level of effectiveness of mitigation measures and any uncertainties associated with them.

Significance predictions in relation to the effects of any changes to the environment on the current use of lands and resources for traditional purposes should be clearly presented and rationalized against defined criteria consistent with the Agency's Operational Policy Statement *Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the* Canadian Environmental Assessment Act, 2012 (November 2015), or any future updates made to this document.

As shown in table 3, there are various considerations in the determination of the significance of potential adverse environmental effects on the current use of lands and resources for traditional purposes.

Table 3: Examples of considerations in determining significance for the current use of lands and resources for traditional purposes.

Criteria	Consideration
Magnitude	What is the amount of change in a measurable parameter relative to baseline conditions or to other targets? • What proportion of an Aboriginal group's harvest will be affected if a flock of Canada geese migratory pattern is altered or relocate due to designated project activities?
Geographic extent	What is the spatial area over which the environmental effect occurs? • Will water pollutants only affect Aboriginal fishing sites proximal to the designated project area or will they affect sites further downstream?

Criteria	Consideration
Timing, Frequency and Duration	When does the effect occur? How often will the effect occur? Will these occurrences be short or long term? • Will project-related noise disturb caribou herds so that hunting by Aboriginal peoples is affected throughout the lifecycle of the designated project? Does the noise cause caribou to move from the area consistently or persistently? Or does the noise occur rarely so that caribou hunting is only affected once in a while?
Reversibility	Will the VC (Valued Component) recover from the effect? • Are effects temporary, such as the loss of access during construction and operation to a plant gathering site (reversible) or permanent, such as the destruction of a culturally modified tree (irreversible)?

The context within which environmental effects occur should be taken into account when considering criteria in relation to the current of lands and resources for traditional purposes, as it may help better characterize whether adverse effects are significant.

Other criteria may also be considered provided that they are described and a rationale for their use is documented. The extent to which an individual criterion will influence the determination of significance will vary depending on the VC (Valued Component) under consideration, the nature of the project and its potential environmental effects, as well as the context.

As each Aboriginal group is unique, the circumstances which may cause a significant effect on the current use of lands and resources for traditional purposes should be examined on a case-by-case basis.

Example:

A wildlife species may be a steady part of one Aboriginal group's diet, while for another Aboriginal group it is used far less frequently for ceremonial purposes.

Approaches and suggestions made by Aboriginal peoples concerning how the significance of environmental effects may be determined should be considered. In addition, early discussion about significance can assist in considering potential benchmarks for significance.

Determination of significance should consider project-specific environmental effects and cumulative environmental effects. Residual effects from past, present, and future physical activities, when assessed individually, can be seen as minimal. However, when assessed together, the incremental effects may be significant. Therefore, a determination of significance should assess how the practices and uses of the lands and resources have been and will be affected cumulatively.

Step 5: Follow-up

The objectives of a follow-up program are to verify the accuracy of the EA (environmental assessment) and determine the effectiveness of any mitigation measures that have been implemented.

The results of a follow-up program can help determine the need for adaptive management to respond to unforeseen adverse effects or to change existing measures if necessary.

The design of a follow-up program should identify the current use of lands and resources for traditional purposes of concern and specific indicators that will be used to measure whether the actual environmental effects resulting from the designated project occur as predicted in the EA (environmental assessment) and that mitigation measures are effective.

Examples:

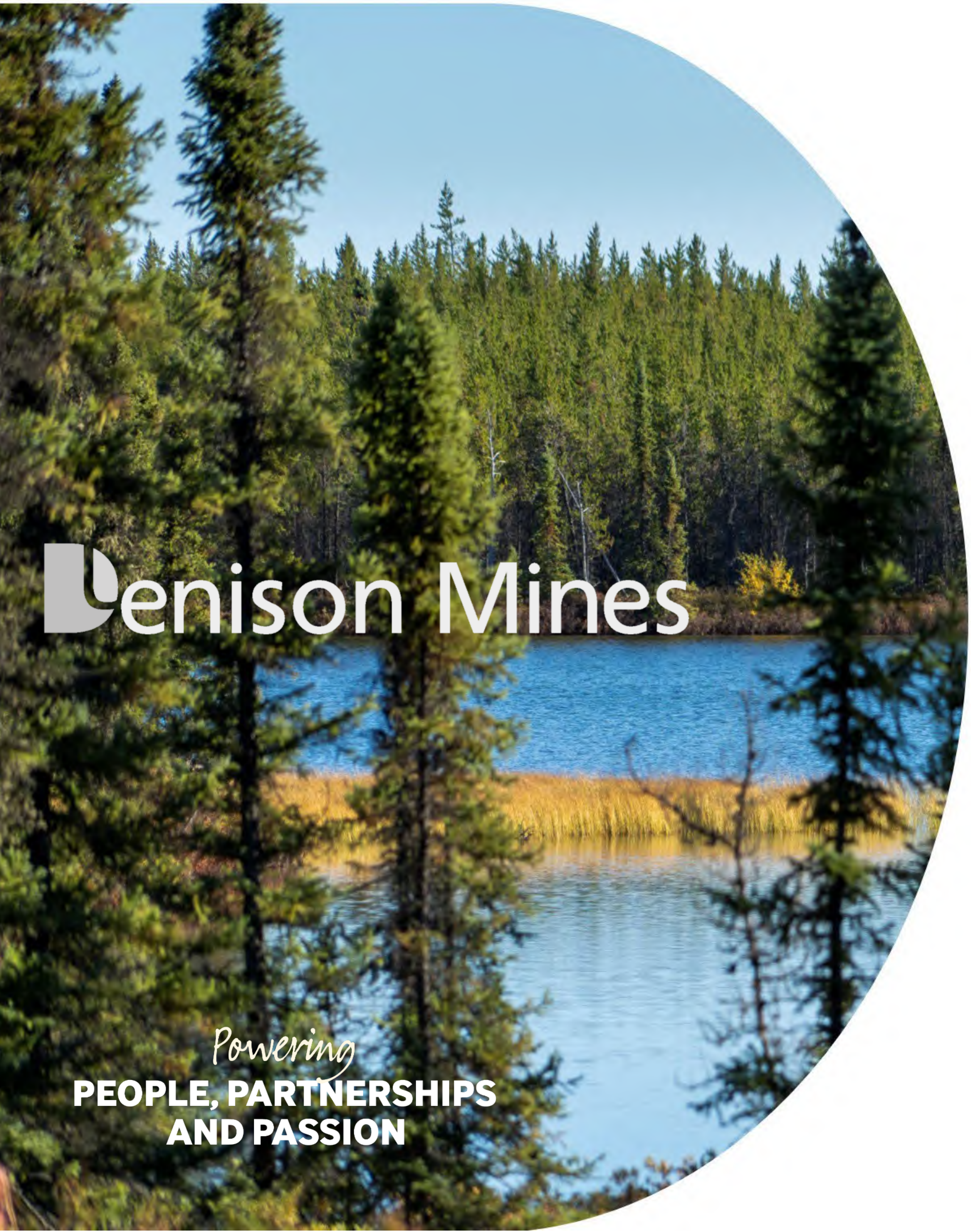
Indicators could include camp usage; wildlife presence or migration patterns, usage of hunting and navigation routes; hunting, trapping and fishing capture rates, and quantity of land and/or resources available for use for hunting, fishing or gathering.

Indicators can also be useful for planning follow-up programs for the assessment of cumulative effects.

Follow-up programs present an opportunity to make best use of the participation of Aboriginal groups on the affected territory during the implementation of the program.

To help determine the follow-up program, additional guidance is available through the Operational Policy Statement published by the Agency on *Follow-up Programs under the* Canadian Environmental Assessment Act (December 2011), or any future updates to this document.

Date modified: 2023-09-12


Denison Mines
Powering
PEOPLE, PARTNERSHIPS
AND PASSION

Denison Mines Corp.

Commitments Register

Version 5

December 2024

Revision History

Version	Date	Description of Revision
1	January 2024	Submitted to CNSC and SK EAB with the Wheeler River Project revised draft environmental impact statement (EIS).
2	July 2024	Editorial improvements to version 1 commitments. To address federal review comments on the revised draft EIS, a number of version 1 commitments were updated and new commitments were added.
3	October 2024	Updates in response to CNSC's EIS review comments received in September and October 2024.
4	November 2024	Updates in response to CNSC EIS review comments received in November 2024.

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Acronyms and Abbreviations

Term	Definition
BNDN	Birch Narrows Dene Nation
CNSC	Canadian Nuclear Safety Commission
COI	Communities of Interest
Denison	Denison Mines Corp.
ERFN	English River First Nation
EA	environmental assessment
EIS	environmental impact statement
EMS	Environmental Management System
FIRT	Federal Indigenous Review Team
GWP&MP	Groundwater Protection and Monitoring Plan
ILRU	Indigenous Land and Resource Use
IR	Information Requirement
KI	Key indicator
KML	Kineepik Métis Local #9
LLRIB	Lac La Ronge Indian Band
MN-S	Métis Nation – Saskatchewan
NVP	Northern Village of Pinehouse
OLRU	Other Land and Resource Use
QMS	Quality Management System
SK EAB	Saskatchewan Environmental Assessment Branch
PBCN	Peter Ballantyne Cree Nation
The Project	Wheeler River Project
SK MOE	Saskatchewan Ministry of Environment
TRC	Technical Review Comment
VC	Valued Component
YNLR	Ya’thi Néné Lands and Resource Office

1 Executive Summary

This commitments register is a summary of the commitments made by Denison Mines Corp. (Denison) through the joint provincial-federal environmental assessment (EA) process for the Wheeler River Project (the Project). This includes commitments made:

- in the final EIS,
- as part of the provincial and federal EIS review process, including comments received through the public review periods, and
- to the public and Indigenous Nations and communities through Denison's engagement process.

2 Commitments Register Details

The register captures the mitigation measures, follow-up program measures, and commitments that have been referenced in the EA documentation in a single location for completeness and traceability. The register has been designed to meet the requirements of Saskatchewan Ministry of Environment, Environmental Assessment Branch (SK EAB 2021) and the Canadian Nuclear Safety Commission (CNSC 2023).

Per SK EAB (2021), Denison is responsible for managing commitments made in the EIS to prevent or mitigate environmental impacts of the development and to meet specific regulatory requirements, including any terms or conditions imposed by the Minister as part of EA approval. The commitments register will be used to list and track those responsibilities and facilitate ongoing regulatory involvement. The register also includes specific commitments for monitoring. Each commitment is stated in such a manner that auditing for conformance is not subjective. Commitments must be specific, measurable, achievable and reportable. Where possible, Denison has also referred to existing guidelines or standards for evaluating whether a commitment has been met.

The Project’s commitments register is an evergreen document. It will be updated, as required, following the remainder of the regulatory review process, provincial EA approval to incorporate any conditions of the approval, CNSC public hearings, and CNSC Commission decisions. For instance, in future versions of the register a column may be added to include permit numbers as these become available.

3 Consolidated List of Commitments

In this document, commitments are defined as actions committed to a regulatory body, the public or Indigenous Nations and communities by a Denison authorized representative or accepted by an authorized Denison representative. Commitments are made in written formal submissions to the CNSC, Saskatchewan Ministry of Environment (SK MOE), or other regulatory bodies, and public stakeholders.

This section provides commitments made by Denison in a series of tables.

- **Table 3.1** outlines commitments made in the EIS, including commitments made in response to FIRT information requirements (IRs) and provincial technical review comments (TRCs). This includes commitments made related to Project design features to eliminate, reduce, or control potential Project effects on the biophysical and human environments. It does not include all Project design feature that were described in the EIS that did not have a potential influence on the environment assessment and will be described as part of Project licensing and permitting.
  - Within this table, the scope of commitment was identified broadly as being either 1) a regulatory commitment (e.g., Quality Management System [QMS] including the Environmental Management System [EMS] and plans/procedures; follow-up program; decommissioning plan; regulatory requirement) or 2) a social responsibility commitment.
- **Table 3.2** summarizes commitments made through correspondence and documentation with the public and Indigenous Nations and communities.

The detailed commitments are shown with the wording as it appears in the source reference.

The commitments register does not list regulatory requirements that Denison is legally obligated to meet.

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Table 3-1: Denison's Commitments in the Final EIS

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
2-1	n/a	1	The Project footprint and Project Area (i.e., the area of maximum physical disturbance) have been reduced to the extent practicable, to minimize habitat loss and alteration, as well as noise propagation.	2.8	All phases	EMS; Engineering Design	Regulatory commitment
2-2	n/a	1	Much of the proposed Project footprint will be developed within previously disturbed areas, including roads currently used for exploration activities, thereby minimizing additional habitat disturbance.	2.8	All phases	EMS; Engineering Design	Regulatory commitment
2-3	n/a	1	Restrict all construction activities to the approved Construction footprint.	2.8	Construction	EMS	Regulatory commitment
2-4	n/a	1	Site clearing and other works that involve disturbance of vegetation and/or soil will be completed during least-risk timing windows for wildlife and birds to avoid disturbance during sensitive time periods, whenever practicable.	2.8	All phases	EMS	Regulatory commitment
2-5	n/a	1	Cleared brush and soil will be stockpiled when possible, to be used in progressive reclamation.	2.8, 9.1.4.2.2	All phases	EMS	Regulatory commitment
2-6	n/a	1	Implement erosion and sediment controls during Construction, and throughout the life of the Project as required.	2.8	All phases	EMS; Engineering Design	Regulatory commitment
2-7	n/a	1	Ponds will be designed maintain a minimum freeboard of at least 1.0 m to allow for continued functioning during a probable maximum precipitation (PMP) event.	2.8	Construction	Engineering Design	Regulatory commitment
2-8	n/a	1	Processing plant exhaust from drying and packaging areas will be directed through a venturi scrubber prior to release outside of the building.	2.8	Operation	Engineering Design	Regulatory commitment
2-9	n/a	1	The height of the processing plant stack will be based on results of air dispersion modelling to be an appropriate height for optimal dispersion.	2.8	Construction	Engineering Design	Regulatory commitment
2-10	n/a	1	Various aspects of the processing plant design incorporate best practices for worker protection including grading floors towards sumps for spill collection, having appropriate ventilation rates, and monitoring systems in place to make sure these mitigation measures are meeting design specifications.	2.8	Construction; Operation	Engineering Design	Regulatory commitment
2-11	n/a	1	Bulk storage tanks for processing and water treatment will be located inside the processing plant, in a separate room from the processing equipment. The storage tanks will sit inside appropriately designed and sized concrete secondary containment basins. The secondary containment basin for each applicable chemical system will be physically separated from the containment basins for other chemical systems.	2.8	Construction	Engineering Design	Regulatory commitment
2-12	n/a	1	Ventilation in the pumphouses will be designed with the ALARA principle in mind to provide sufficient worker protection from potential radon and radon progeny exposure. Monitoring systems will be in place to make sure these mitigation measures are meeting design specifications.	2.8	Construction; Operation	EMS; Engineering Design	Regulatory commitment
2-13	n/a	1	Design liners and develop appropriate performance monitoring (e.g., leak detection, groundwater monitoring) based on the characteristics of the material being stored. Ponds or pads designed to temporarily or permanently store non-radioactive materials will be lined with a single geosynthetic composite liner system. This is a primary HDPE GM over a GCL. The GCL will include a low permeable layer of bentonite clay. Examples of Project components proposed to have this type of liner include: the	2.8	Construction; Operation	EMS; Engineering Design	Regulatory commitment

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
			industrial wastewater treatment plant precipitate pond, hazardous waste storage pad, and effluent monitoring and release ponds.				
2-14	n/a	1	Design liners and develop appropriate performance monitoring (e.g., leak detection, groundwater monitoring) based on the characteristics of the material being stored. Ponds or pads designed to temporarily or permanently store potentially radioactive materials will be lined with a double geosynthetic composite liner system. This is a primary HDPE GM over a GCL and a secondary HDPE GM over an additional GCL. The GCL will include a low permeable layer of bentonite clay. In between the primary and secondary liners, a leak detection and collection system will also be installed. The selected design is the most robust currently known and offers a life of several hundred years with proper installation and maintenance. Examples of Project components proposed to have this type of liner include: wellfield runoff pond, process precipitate pond, landfill leachate collection ponds, process water pond, UBS holding area, and special waste pad.	2.8	Construction; Operation	EMS; Engineering Design	Regulatory commitment
2-15	n/a	1	Fuel storage and distribution infrastructure will be constructed in accordance with applicable legislative requirements.	2.8	Construction	Engineering Design	Regulatory commitment
2-16	n/a	1	Fuels will be stored in approved, above-ground, double-walled storage tank(s) equipped with secondary containment in accordance with provincial regulations and standards.	2.8	All phases	EMS; Engineering Design	Regulatory commitment
2-17	n/a	1	Stationary and mobile equipment will be fueled with a fuel-dispensing truck.	2.8	All phases	EMS	Regulatory commitment
2-18	n/a	1	A minimum 100 m distance from any waterbody will be maintained for fuel storage, refueling activities, or equipment servicing.	2.8	All phases	EMS	Regulatory commitment
2-19	n/a	1	Hazardous substances will be managed in a safe and secure manner in line with Safety Data Sheets, permit conditions, and applicable regulations. Denison will maintain an up-to-date record of the various hazardous substances on site and will maintain Safety Data Sheets and appropriate procedures for spill management, handling, and clean up in an accessible location.	2.8	All phases	EMS	Regulatory commitment
2-20	n/a	1	Clean, non-contact runoff will be diverted around Project components where possible. Contact water, including, for example, runoff from the wellfield and around the processing plant, will be collected in various ponds and eventually routed through the IWWTP for treatment prior to release to Whitefish Lake.	2.8	All phases	EMS; Engineering Design	Regulatory commitment
2-21	n/a	1	The fresh water well(s) and surface water intake will be located, designed, installed, and operated according to applicable standards and best practices to minimize effects on the groundwater and surface water environments.	2.8	Construction; Operation; Decommissioning	EMS; Engineering Design	Regulatory commitment
2-22	n/a	2	The Project will adhere to treated effluent discharge limits as stipulated in operating approvals and by regulations and for protection of aquatic life and receptors associated with the water exposure pathway. Specifically, Denison commits to following the guidance and requirements of REGDOC-2.9.2 to develop effluent discharge targets as per operational licensing and in consultation with the CNSC.	2.8	Operation; Decommissioning	EMS	Regulatory commitment
2-23	n/a	1	Battery-powered light vehicles and mobile equipment, and an AC powered dual rotary drill for ISR wellfield development instead of a traditional diesel-powered unit will be employed where practical to reduce air emissions and noise levels and improve energy efficiency.	2.8	All phases	EMS	Social responsibility commitment

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ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
2-24	n/a	1	Project components including equipment and machinery will regularly maintained and inspected to make sure they are in good working order.	2.8	All phases	EMS	Regulatory commitment
2-25	n/a	1	Speed limits will be implemented on site roads for worker safety, to minimize generation of road dust, and to protect wildlife.	2.8	All phases	EMS	Regulatory commitment
2-26	n/a	1	Containment and control of mining solution and uranium bearing solution in the ground in general, and the mining area in particular, will use three layers of protection: 1. well design and operation – well will have secondary containment, be made of material resistant to mining solution, pressure grouted from the ore zone to surface, and tested for mechanical integrity prior to commissioning to confirm an adequate seal from surface to the well screen at the mining area. Operational monitoring of pressure and flow will provide assurance that the wells are functioning properly. 2. pumping – operation of the injection and recovery wells will be done in a way to maintain an inward hydraulic gradient to keep mining solutions no more than 50 m above the well screened area in the ore zone. Perimeter pumping wells will be installed vertically, horizontally, and laterally surrounding the mining area both inside and outside the freeze wall with the ability to capture fluids by pumping when required and recycle solutions should the primary containment system not perform as expected. 3. freeze wall – a freeze wall around the mining area, extending from the surface to the basement rock isolating the mining area from regional groundwater. The freeze wall is expected to be a minimum of 10 m thick, be installed 25 m away from the uranium deposit, and extend 30 m into the basement rock. Data from the groundwater monitoring network installed in and around the wellfield and freeze wall will make sure these mitigation measures are meeting design specifications.	2.8	Construction; Operation	EMS; Engineering Design	Regulatory commitment
2-27	n/a	1	Well casing integrity will be monitored in a rigorous fashion, thereby allowing Denison to respond to any steel casing failures in a timely manner. A network of monitoring wells installed within the freeze wall area will be equipped with pressure instrumentation for the determination of the vertical strain/stresses placed on the formation. This monitoring network is designed to detect if these strains may be approaching their acceptable levels prior to failure. The injection and recovery wells will also be equipped with continuous monitoring devices for pressure and temperature that can detect a breach in the well casing if one were to occur. This data will be transmitted to the processing plant for remote monitoring through a master control system. Through the master control system, operators will be capable of controlling pumphouse production lines remotely. Wellfield monitoring will facilitate detection of any issues with the injection and recovery wells. As a further preventative measure, annual mechanical integrity testing is conducted on the wells to ensure their containment and compliancy. Active monitoring will allow for operational shutdown if a scenario is approaching a failure mode	2.8	Operation	EMS; Engineering Design	Regulatory commitment
2-28	n/a	1	Double-walled (HDPE), or equivalent, piping will be used for the wellfield surface piping system and the piping will be freeze protected and secured to minimize movement. Surface pipelines will be designed to have secondary containment or catchment and have leak detection systems in place at key locations.	2.8	Construction; Operation	Engineering Design	Regulatory commitment

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
2-29	n/a	1	Denison is committed to conducting stringent waste characterization throughout the life of the Project. This includes physical, radiological, and chemical characterization to maintain accurate waste inventories and determine how wastes will be dispositioned through either re-use, recycling, temporary storage, or permanent disposal (on or off site). This includes clearance of material that meets unconditional release requirements and can be safely removed from site.	2.8	All phases	EMS	Regulatory commitment
2-30	n/a	1	During Operation, progressive decommissioning and reclamation activities will be completed where possible, and the progress and success of these activities will be assessed annually.	2.8, 9.3.4.2.1 9.4.4.2.1	Operation	EMS; Decommissioning Plan	Regulatory commitment
2-31	n/a	1	At Decommissioning, areas requiring additional control (potentially the industrial landfill and IWWTP precipitate pond) will be covered with an engineered impermeable liner system to limit infiltration of precipitation into the containment system.	2.8	Decommissioning	Decommissioning Plan; Engineering Design	Regulatory commitment
2-32	n/a	1	Denison's decommissioning commitment is to return the land back to the Province of Saskatchewan for unrestricted surface land use post-closure. The CDP outlines how radiological, physical, and chemical risks will be managed during Decommissioning so no unreasonable risks remain. Denison will prioritize passive versus active controls to reduce long-term risk. Additional decommissioning details will be provided in the PDP, which will submitted to regulators as part of Project licensing and permitting. Prior to executing Decommissioning activities, Denison shall prepare and submit a DDP to regulators for acceptance, which builds on the preliminary decommissioning plan.	2.8	All phases	Decommissioning Plan	Regulatory commitment
2-33	n/a	2	The Waste Management Program would include identification of waste inventory and the characteristics of the waste (radiological and hazardous non-radiological), waste segregation, waste packaging and transfer requirements, and the plan for storage or disposal of the wastes. The Waste Management Program will detail the plans for waste rock segregation based on mineralized content and acid generating potential, and also outline mitigation measures and management plans.	2.9; IR-13	All phases	EMS	Regulatory commitment
2-34	n/a	2	All fueling and de-icing activities will occur in specifically designed areas to collect any hydrocarbons and de-icing fluids. Collected waters will be characterized and brought to the Project site for treatment, shipped offsite to an approved facility or released to environment if water quality allows.	IR-12	All phases	EMS	Regulatory commitment
2-35	n/a	3	Information provided as part of the Site Water Management Plan (see FIRT IR response, Attachment IR-12, IR-12-R1A, and IR-112-R1B (Round 3 and 4)) will be incorporated into the Spill Response Plan.	IR-12	All phases	EMS	Regulatory commitment
4-1	n/a	1	Denison is committed to ongoing engagement throughout the entire Project lifespan.	4.7	All phases	Ongoing engagement	Social responsibility
4-2	n/a	1	With Denison's adoption of the Indigenous Peoples Policy in 2021, the commitment to take action towards advancing reconciliation with Indigenous peoples in Canada and the identified action plan focus areas of engagement, empowerment, environment, employment and education, reflect a commitment to implementation of the continuously evolving Reconciliation Action Program. Ongoing and meaningful engagement is one of the foundational action areas that Denison is committed to interweave the principles of reconciliation throughout all areas of operations.	3.3.1, 4.7	All phases	Ongoing engagement	Social responsibility
4-3	n/a	1	Engagement activities involving the General Public Interested Parties will continue after the submission of the EIS and completion of the EA process. Denison believes that there is considerable value in ongoing opportunities for discussion. Specific activities will be developed in discussion with interested public	4.7	All phases	Ongoing engagement	Social responsibility

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
			parties to ensure, among other things, potential effects continue to be minimized and Project benefits have opportunity to be maximized. Denison expects that opportunities to share information on Project status and receive information on issues and concerns will include activities that focus on communication (website, newsletters) and direct interaction (e.g., workshops, youth/elder sessions, meetings with community leadership, ongoing discussion with resource harvesters) would be reasonable initial activities to implement.				
4-4	n/a	1	Regulatory engagement activities following submission of the EIS can be expected to occur to review initial EA results, respond to questions and concerns that may be identified, and identify and consider regulatory or assessment areas of interest that had not been previously defined or addressed. Engagement with regulatory agencies is expected to continue throughout the lifespan of the Project to confirm regulatory requirements are adequately fulfilled.	4.7	All phases	Ongoing engagement	Social responsibility
4-5	n/a	2	Denison will incorporate or address Indigenous concerns into decommissioning plans as the plans are developed.	IR-14	All phases	Decommissioning Plan	Regulatory requirement
6-1	Air quality	1	Future measurement programs and air quality modelling for the Project will be evaluated using alternative data sets that are more recent and representative of baseline conditions in northern Saskatchewan.	6.1.3.2.7	Ongoing throughout life of mine	EMS	Regulatory requirement
6-2	Air quality	1	To confirm the residual effects of the Project on Air Quality and demonstrate compliance with provincial and federal ambient air quality standards, an adaptive air quality management program will be implemented. The air quality management program will contain various plans which will be finalized during permitting and licensing. The plans within the air quality management program will incorporate mitigation and monitoring requirements directed by provincial and federal regulators and by Indigenous groups and other Interested Parties as requested.	6.1.8	Ongoing throughout life of mine	EA follow-up program	Regulatory requirement
6-3	Air quality	1	Denison is committed to implementing strategies to reduce the likelihood and magnitude of the predicted Project-related effects on the Air Quality VC including emission controls and utilizing planning measures to counter the conditions that contribute to the predicted effects. Some mitigation measures have been incorporated into the Project plans and carried through the Air Quality assessment. These mitigation measures include the following: • applying water at least twice per day to unpaved roads and surfaces; • limiting equipment and vehicle speeds along the access road and site roads to <40 km/h; • equipping the dryer, calciner, and hygiene exhausts with scrubber systems; • making sure the dryer, calciner, and hygiene exhaust stacks are at least two times the building height to eliminate building downwash effects; • collecting and venting radon gas from wellfield operations (including test phases) through a radon surge tank equipped with a vertical stack at least 15 feet (4.5 m) above grade; • creating and implementing an Environmental Management System (EMS) to address air quality monitoring , including the application of water or chemical dust suppressants to control fugitive dust, in addition to other operational strategies to assist in dust control; • planning vehicle and equipment routes to minimize travel distances, where possible; and • employing standard operating procedures and completing regular inspections of equipment machinery to make sure it is in good working order.	6.1.5	Ongoing throughout life of mine	EA follow-up program	Regulatory requirement

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
6-4	Noise	1	An EMS will be implemented and include noise management and monitoring plans to confirm that the Project is compliant with the federal and adopted provincial guidelines during both Construction and Operation. Noise monitoring will be similar in nature to baseline monitoring that was completed in support of this assessment and will be finalized during permitting and licensing. Noise monitoring will incorporate monitoring requirements directed by provincial and federal regulators and any received input from Indigenous groups and other Interested Parties as requested.	6.2.8	Ongoing throughout life of mine	EA follow-up program	FUP commitment
6-5	Noise	1	Denison is committed to implementing strategies to reduce the likelihood and magnitude of the predicted effects include source elimination and utilizing planning measures to counter the conditions that contributed to the predicted effects. Mitigation measures to be applied during both Construction and Operation include: • not using the concrete batching plant and crusher during nighttime hours, where possible; • locating the concrete batching operation as far away from sensitive locations as possible; • directing the generator discharge openings away from sensitive locations; • making use of available on-site obstructions to control sound exposure at sensitive areas (i.e., locate sources behind buildings); and • collecting sound level measurements from the identified sources once they are operating and determining whether the actual effect is lower than that which was modelled.	6.2.5	Ongoing throughout life of mine	EA follow-up program	Regulatory requirement
6-6	GHG / Climate Change	1	Denison is committed to reassessing the GHG and climate change components of the EIS and other elements of the SACC once more detailed, site-specific data becomes available (i.e., detailed feasibility and engineering studies). This analysis is expected to include more detailed study around overall GHG emissions, carbon sinks and mitigation options, best available technologies / best environmental practices, climate resiliency, net-zero carbon planning and offsetting.	2.5	Pre-construction/ Licensing/Permitting	EA follow-up program	Regulatory requirement
7-1	Geology (Terrain morphology and stability)	1	Injection and recovery wells will be collared at surface and surveyed regularly to monitor for any changes in the collar height over time. An associated monitoring program will be developed and will include a contingency plan whose objective would be to facilitate the timely identification of, and response(s) to, potentially emerging conditions whereby routine monitoring data indicate performance is not meeting expectations.	7.5, 7.8.1, IR-66	Construction, Operation	EMS	Regulatory requirement
7-2	Groundwater (Groundwater Quality)	1	Commitment to follow-up on ongoing hydrogeological evaluations, as well as monitoring and adaptive management	7.5	All phases	GWP&MP	Regulatory requirement
7-3	Groundwater (Groundwater Quality)	1	Implementation of a groundwater monitoring well network within and surrounding the outer perimeter of the freeze wall, and a groundwater monitoring (quantity and quality) plan	7.5	Operation, Decommissioning	GWP&MP	Regulatory requirement
7-4	Groundwater (Groundwater Quality)	1	Development of contingency plans to respond to excursions	7.5	Operation, Decommissioning, Post-Decommissioning	GWP&MP	Regulatory requirement
7-5	Groundwater (Groundwater Quality)	1	Implementation of a groundwater monitoring well network and Groundwater Protection and Monitoring Plan (GWP&MP) for surface facilities	7.5	Operation	GWP&MP	Regulatory requirement
7-6	Groundwater (Groundwater Quality)	1	Remediation of mining area during Decommissioning until appropriate COPC levels (i.e., Decommissioning objectives) are achieved in the groundwater long-term	7.5	Decommissioning	GWP&MP	Regulatory requirement

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7-7	Groundwater (Groundwater Quality)	1	Implement groundwater monitoring (quantity and quality) within and exterior to the former freeze wall and along the groundwater flow path to demonstrate that groundwater conditions are aligned with those bounded by the modelling predictions, and, as such, are protective of the receiving environment	7.5	Decommissioning	GWP&MP	Regulatory requirement
7-8	Groundwater (Groundwater Quality)	1	Implement a detailed Groundwater Protection and Monitoring Plan (GWP&MP) will be provided for the Project. The GWMP will be informed by understanding of • existing groundwater conditions at the Project Area (Appendix 7-A); • the reactive transport modelling of groundwater COPCs associated with the restored mining area (Appendix 7-C); and • commitments made within the Geology and Groundwater section of the EIS.	7.8.2, Appendix 7-A, Appendix 7-C	All phases	GWP&MP	Regulatory requirement
7-9	Groundwater (Groundwater Quality)	1	The groundwater well monitoring network and sampling plan will be flexible and adapted at each stage to identify any changes in groundwater quality and quantity associated with mining activities in a timely fashion. The spatial pattern of monitoring wells (i.e., well locations and density) and the sampling schedule will reflect the spatial and temporal distribution of COPC, guided by anticipated operational conditions and by the range of constituent behaviours identified in the site-specific COPC fate and transport modelling. The monitoring system will be designed at each phase of the Project to provide adequate coverage of all hydrostratigraphic units.	7.8.2	All phases	GWP&MP	Regulatory requirement
7-10	Groundwater (Groundwater Quality)	1	Appropriate chemical and physical constituents will be monitored in groundwater, including COPCs, other major ion constituents of groundwater (e.g., total alkalinity, bicarbonate, carbonate, sodium, magnesium, potassium, calcium) and additional COPC identified in association with surface facilities: nitrogen species (i.e., ammonium, nitrate, and nitrite) and volatile organic compounds.	7.6.2.1, 7.8.2	All phases	GWP&MP	Regulatory requirement
7-11	Groundwater (Groundwater Quality)	1	Constituents to be considered as key performance indicators in groundwater are listed in the following bullets. The first three may be considered for continuous measurement. •Hydraulic response •Temperature •EC •pH •ORP •Sulphate •Uranium and Chloride	7.8.2 and IR-72	All phases	GWP&MP	Regulatory requirement
7-12	Groundwater (Groundwater Quality)	1	Groundwater will be monitored across the [surface facilities] monitoring network and samples submitted to an accredited laboratory for analysis of the full suite of COPC or for KI parameters. Sampling frequency will be at least semi annually and may be more frequent in wells surrounding specific facilities.	7.8.2.1	Operation	GWP&MP	Regulatory requirement
7-13	Groundwater (Groundwater Quality)	1	A groundwater monitoring network will be developed to monitor groundwater conditions upgradient, on the perimeter, and downgradient of the surface facilities. The groundwater monitoring network during Operation will focus on groundwater conditions within and on the outside perimeter of the freeze wall.	7.8.2.1, Table 7.4-7, 7.8.2.2.2	Construction; Operation	GWP&MP	Regulatory requirement
7-14	Groundwater (Groundwater Quality)	1	Shallow monitoring wells associated with decommissioned surface facilities will be abandoned in accordance with provincial well abandonment legislation.	7.8.2.1	Decommissioning	GWP&MP	Regulatory requirement
7-15	Groundwater (Groundwater Quality)	1	Retain monitoring wells upgradient, on the perimeter, and downgradient of [surface] facilities retained on site (a covered industrial landfill and covered wastewater treatment plant precipitates) to demonstrate chemical stability of groundwater surrounding and downgradient of these facilities after the covers have been placed.	7.8.2.1	Decommissioning/ Post-Decommissioning	GWP&MP	Regulatory requirement
7-16	Groundwater (Groundwater Quality)	1	The groundwater monitoring network for the Operation phase will be installed during Pre-Construction and Construction. Existing monitoring wells will be used as much as possible, but it is anticipated that several new wells will be installed to meet monitoring needs.	7.8.2.2.1	Pre-Construction/ Construction	GWP&MP	Regulatory requirement

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7-17	Groundwater	1	Groundwater samples will be collected at least monthly and semi-annually in the wells within the freeze wall and on the freeze wall perimeter, respectively.	7.8.2.2.2	Operation	GWP&MP	Regulatory requirement
7-18	Groundwater	1	Sampling of water quality of the water produced in the active mining area over the entire remediation process will be frequent (at least weekly) to allow the remedial approach to be adapted as required on a spatio-temporal basis. Sampling of the wells in the upper mining area and overlying Athabasca Sandstones will be seasonally during the first three years of Decommissioning and potentially more frequent during the later two years of Decommissioning to demonstrate chemical stability.	7.8.2.2.3	Decommissioning	GWP&MP	Regulatory requirement
7-19	Groundwater	1	Remediation will continue until groundwater quality in the mining area meets acceptable levels. These acceptable levels are considered to be the 'Decommissioning objectives'.	Appendix 7-C (Section 3.1.1, 4.0)	Decommissioning	GWP&MP	Regulatory requirement
7-20	Groundwater	1	Follow-up commitments related to the desilicified zone: 1. assessment of vertical hydraulic conductivity; 2. quantification of horizonal and vertical flow gradients; and 3. identification and mapping of any structures with the potential to influence groundwater flow in the DSZ, such as fractures/fault zones.	IR-73, Section 7.8.2.2.1	Pre-Construction/ Construction	GWP&MP	Regulatory requirement
7-21	Groundwater	1	Tritium concentrations in groundwater will continue to be measured as part of the routine groundwater sampling, to further evaluate the usefulness of this approach for refining the conceptual site model developed for the Wheeler River Project	IR-81, Section 7.8.2, Appendix 7-A (Appendix L and Section 4.2.2)	All phases	GWP&MP	Regulatory requirement
7-22	Groundwater	1	Metallurgical testing and further test work will support refinement of sorptive capacity and understanding of the potential for a long-term source of COPCs (including Pb) from the remediated ore zone. Information from that test work will then be used to direct testing and monitoring during the operational phase.	IR-68	Construction and Operation	Engineering Design	Regulatory requirement
7-23	Geology (Terrain morphology and stability)	1	Further detailed geomechanical studies will be carried out to reduce the uncertainties and risks in association with the stability and deformation analyses of ore zone rock matrix and its overlying rock mass formations and assess their potential impacts on the mine operation and closure.	IR-75	Construction and Operation	Engineering Design	Regulatory requirement
7-24	n/a	3	Denison will revisit and update the groundwater models as necessary, as more data becomes available through the EA follow-up monitoring program to improve confidence on the hydraulic values of the desilicified zone. Denison will take the commitment into account when developing the EA follow-up monitoring program.	IR-89	All phases	GWP&MP	Regulatory requirement
8-1	Surface Water Quantity	1	It is suggested that continued hydrologic monitoring is important to provide Project phase information to monitor predictions and support effluent discharge permitting and approvals (i.e., meet approvals for continued surface water quality levels).	8.1.8	Construction, Operation, Decommissioning	EA follow-up program	Regulatory requirement
8-2	Surface Water Quantity	1	The long-term hydrological monitoring study at the Project site has been in place since 2011. The program should remain consistent to allow for the continued establishment of long-term streamflow trends at the site through relationships to long-term operating hydrometric gauging stations in the same watershed.	8.1.8	Construction, Operation	EA follow-up program	Regulatory requirement
8-3	Surface Water Quantity	1	Monitoring should continue to include the following: • streamflow monitoring; • lake level monitoring; and • installation of stage dataloggers.	8.1.8	Construction, Operation, Decommissioning	EA follow-up program	Regulatory requirement

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8-4	Surface Water Quantity	2	Hydrological monitoring stations should continue to be surveyed at locations throughout key catchment areas.	8.1.8	Construction, Operation	EA follow-up program	Regulatory requirement
8-5	Surface Water Quality	1	Most of the collected contact water will be directed to the Process Water Pond and the Wellfield Runoff Pond, which will store water for use during ISR drilling (i.e., recycled). Other site runoff collection needs will be examined and identified as part of detailed design and permitting. Any excess water not required during the ISR process will be directed to the IWWTP.	8.2.4	Construction	EMS; Engineering Design	Regulatory requirement
8-6	Surface Water Quality	1	The IWWTP will be designed to treat contaminated water removed during the ISR process (e.g., backwash of sand filters, bleed solution), runoff collected from the waste pad, and other contact water, such as water from the wash bay and process sumps. The IWWTP will be located inside of the processing plant.	8.2.4	Construction	EMS; Engineering Design	Regulatory requirement
8-7	Surface Water Quality	1	Treated water from the IWWTP will be pumped to the three Effluent Monitoring and Release Ponds (each 3,300 m3). These ponds will be designed to hold effluent for 72 hours for testing before discharge to the environment.	8.2.4	Construction, Operation	EMS; Engineering Design	Regulatory requirement
8-8	Surface Water Quality	1	Treated water in the Effluent Monitoring and Release Ponds will be monitored prior to release to a surface waterbody. The treated effluent discharge line will be heated and have secondary containment in place.	8.2.4	Construction, Operation	EMS; Engineering Design	Regulatory requirement
8-9	Surface Water Quality	1	The exact diffuser design configuration will be optimized as required during the engineering design and permitting phase to facilitate optimal performance of the diffuser specific to site conditions. The final diffuser configuration will not change the environmental assessment conclusions of risk to aquatic receptors and that water quality will remain below guidelines.	8.2.4	Construction	EMS; Engineering Design	Regulatory requirement
8-10	Surface Water Quality; Sediment Quality and Benthic Invertebrates; Fish Health	1	To mitigate adverse effects on Surface Water Quality, Denison will implement the following mitigation measures. • Develop and implement a Surface Water Management Program that provides an integrated framework to manage water quality, including provision for water management practices for each of the primary site aspects, as well as areas of the Project site where contact water is expected. • Maximize the recycle and reuse of process water to reduce freshwater intake and release to Whitefish Lake. • Design the discharge diffuser/outfall to provide effective mixing and dilution and discharge flows that do not detrimentally affect sediments. • Develop site-specific effluent treatment to treat COPC to appropriate release limits in accordance with provincial standards and licence/permit conditions. • Discharge effluent under a scenario that will meet provincial and federal discharge criteria as identified through permitting. Scenarios may include: • discharging at a fixed rate while maintaining an appropriate minimum dilution ratio (i.e., discharge when able to meet the required dilution ratio and cease discharge during periods when unable to meet the necessary dilution ratio); • discharging under a variable waste load allocation (i.e., discharge an appropriate effluent volume based on flow in the receiver to maintain minimum dilution ratio); and • managing discharge via a hybrid of these (i.e., discharge effluent at a fixed rate to maintain the required dilution ratio, but the fixed rate can be varied on a seasonal basis based on flow).	8.2.5; 8.4.6; 8.5.5	All phases	EMS; Engineering Design	Regulatory requirement

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8-11	Surface Water Quality; Sediment Quality and Benthic Invertebrates; Fish Health	1	• Collect and monitor contact water to determine whether treatment is required prior to release to the environment to inform optimal levels of treatment. • Maintain the water management system in place during decommissioning until such time that water quality is suitable to release to the environment. • Monitor and manage effluent, including contingency for effluent treatment as may be required, so that water discharge objectives are achieved as defined by applicable provincial and federal regulatory instruments. • Design and implement an Environmental Code of Practice that defines action levels and appropriate steps to be taken to mitigate elevated concentrations of chemical and radiological constituents in treated effluent discharge to acceptable levels. • Implement Project-specific monitoring programs (e.g., effluent monitoring plan, environmental monitoring plan) that include monitoring treated effluent, surface water and sediment quality, and applying adaptive management, if necessary. • Work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system. • Develop and implement a decommissioning and reclamation plan to decommission and transfer the site to the province under the Institutional Control Program.	8.2.5; 8.4.6; 8.5.5	All phases	EMS; EA Follow-up Monitoring	Regulatory requirement
8-12	Surface Water Quality	1	The surface water quality monitoring and follow-up program will have the following objectives: • collecting and recording surface water quality to confirm that source and receiving water quality predictions are consistent with those presented in the EIS; and • monitoring to confirm the effluent and receiving water quality meet applicable regulation criteria.	8.2.8	All phases	EMS; EA Follow-up Monitoring	Regulatory requirement
8-13	Surface Water Quality	1	The monitoring and follow-up program will include measurement of water quality parameters to meet regulatory criteria (i.e., provincial discharge permits, Metal and Diamond Mining Effluent Regulations [MDMER; Government of Canada 2022] and CSA N288.4-19 (CSA Group 2019). At a minimum, this will include collection of non-radiological parameters (e.g., metals, nutrients, hardness, temperature, pH, TDS, TSS, and sulphate) and radiological parameters.	8.2.8	All phases	EMS; EA Follow-up Monitoring	Regulatory requirement
8-14	Surface Water Quality	1	Monitoring will occur within the collection ponds, specifically the Effluent Monitoring and Release Ponds and the receiving water (Whitefish Lake). Water quality monitoring in the natural environment will occur at the point of discharge (near-field) at LA-5 (Whitefish Lake South), at an upstream reference location (Whitefish Lake North [LA-6]) and at downstream locations (far-field locations). The far-field monitoring locations will be located in Whitefish Lake South (LA-5) prior to its discharge to McGowan Lake (LA-1). Constituent concentrations will be compared to the values used in the EIS and to applicable regulatory criteria or objectives.	8.2.8	All phases	EMS; EA Follow-up Monitoring	Regulatory requirement
8-15	Surface Water Quality	1	Specific monitoring and follow-up plans for the Surface Water Quality VC will be prepared to refine and finalize the approach and specific metrics following consultation with Indigenous groups, other stakeholders, and relevant federal and provincial agencies with interest in the development and implementation of this VC-specific program.	8.2.8	All phases	EA follow-up program	Regulatory requirement

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8-16	Fish and Fish Habitat	1	Measures to mitigate adverse effects on the Fish and Fish Habitat VC are consistent with those to mitigate adverse effects on the Surface Water Quantity, Surface Water Quality, Sediment Quality and Benthic Invertebrates, and Fish Health VCs. These measures are repeated in this section for completeness, with additional measures added as applicable to the Fish and Fish Habitat VC. • Avoid more sensitive habitats to the extent practicable. • Maintain existing drainage patterns with the use of culverts, where applicable. • Maintain access roads by periodically re-grading and ditching to improve water flow, reduce erosion, and manage vegetation growth. • Inspect culverts periodically. Remove accumulated material and debris upstream and downstream of the culverts to prevent erosion, flooding, habitat damage, property damage, and mobilization of sediment. • Attenuate peak discharges and augment baseflows to the environment through the use of Project water storage features (i.e., runoff, process water, contact water, monitoring/effluent ponds). • Develop and implement a Surface Water Management Program that provides an integrated framework to manage water quality and includes provision for water management practices for each of the primary site aspects, as well as areas of the site where there is contact water. • Maximize the recycle and re-use of process water to reduce freshwater intake and release to Whitefish Lake.	8.3.5	Construction, Operation	EMS; Engineering Design	Regulatory requirement
8-17	Fish and Fish Habitat	1	• Design the discharge diffuser/outfall to have the smallest footprint possible while still providing effective mixing and dilution and discharge flows that do not detrimentally affect sediments. • Adhere, as applicable, to the Interim Code of Practice: End-of-Pipe Fish Protection Screens for Small Water Intakes in Freshwater (DFO 2020a). • Adhere, as applicable, to the Interim Code of Practice for Temporary Cofferdams and Diversion Channels (DFO 2020b). • Adhere, as applicable, to the Interim Code of Practice for Temporary Stream Crossings (DFO 2020c). • Plan in-water works, undertakings, or activities to respect timing windows to protect fish and fish habitat, including their eggs, juveniles, spawning adults, the organisms upon which they feed, and the areas where they migrate. In-water works should be deferred based on the specific waterbody and known species that inhabit the waterbody (Saskatchewan Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat [DFO 2020d]). • Spring spawning species (northern Saskatchewan) – avoid work between May 1 and July 15. • Fall spawning species (northern Saskatchewan – Lake Trout present) – avoid work between September 1 and July 15). • Fall spawning species (northern Saskatchewan – Lake Trout absent) – avoid work between October 1 and July 15). • Where possible, conduct instream work during periods of low flow (e.g., summer or winter) to further reduce risk to fish.	8.3.5	Construction, Operation, Decommissioning	EMS; Engineering Design	Regulatory requirement
8-18	Fish and Fish Habitat	1	• In discussion with responsible authorities, prepare a fish salvage plan to relocate fish prior to in-water works. • Design treated effluent discharge or freshwater intake infrastructure to prevent entrainment or impingement of fish.	8.3.5	Construction, Operation, Decommissioning	EMS; Engineering Design	Regulatory requirement

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			• Implement an erosion and sediment control plan for the site to reduce potential sedimentation of waterbodies and potential lethal affects to fish, larvae, and eggs. Ensure erosion and sedimentation measures are maintained as applicable throughout the duration of the Project. • Develop site-specific effluent treatment to treat COPC to appropriate release limits in accordance with provincial standards and licence/permit conditions. • Discharge effluent under a scenario that will meet provincial and federal discharge criteria, as identified through permitting. Scenarios may include: • discharging at a fixed rate while maintaining an appropriate minimum dilution ratio (i.e., discharge when able to meet the required dilution ratio and cease discharge during periods when unable to meet the necessary dilution ratio); • discharging under a variable waste load allocation (i.e., discharge an appropriate effluent volume based on flow in the receiver to maintain a minimum dilution ratio); and • managing discharge via a hybrid of the two previous options (i.e., discharge effluent at a fixed rate to maintain the required dilution ratio, but the fixed rate is varied on a seasonal basis based on flow). • Collect and monitor contact water to determine whether treatment is required prior to release to the environment. This will inform optimal levels of treatment.				
8-19	Fish and Fish Habitat	1	• Maintain the water management system in place during Decommissioning until such time that water quality is suitable to release to the environment. • Monitor and manage effluent, including contingency for effluent treatment as may be required, so that water discharge objectives are achieved, as defined by applicable provincial and federal regulatory instruments. • Design and implement an Environmental Code of Practice that defines actions levels and appropriate steps to mitigate elevated concentrations of chemical and radiological constituents in treated effluent discharge to acceptable levels. • Workforce members will be transported to/from site via a fly-in/fly-out rotation and will, therefore, not use ground travel options during shift changes, which will eliminate fishing on local lakes during commutes to/from the site and during time off work. Denison site vehicles will not be available for recreational purposes. While at the Project site and off duty, workers may opt to fish local waterbodies. To protect sustainable use of resources, only catch and release of fish will be encouraged, and fish storage or cooking facilities will not be provided. • Implement Project-specific monitoring programs (e.g., effluent monitoring plan, environmental monitoring plan) that include monitoring treated effluent, surface water, and sediment quality and applying adaptive management if necessary. • Work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system. • Develop and implement a decommissioning and reclamation plan to decommission and transfer the site to the Province of Saskatchewan under the Institutional Control Program.	8.3.5	Construction, Operation, Decommissioning	EMS; Engineering Design	Regulatory requirement
8-20	Fish and Fish Habitat	1	Water management infrastructure (e.g., collection pads, ponds, pumping stations), as well as various aspects of the water management and sediment control management systems, will be put into place coincident with the initiation of construction activities.	8.3.6.1	Construction	Engineering Design	Regulatory requirement

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8-21	Fish and Fish Habitat	1	Runoff associated with areas under development will be collected and either stored within management infrastructure (e.g., water management ponds) or potentially released into natural surface water features once it is safe to do so (i.e., suspended solid levels in the water would be at acceptable levels).	8.3.6.1	Construction	EMS; Engineering Design	Regulatory requirement
8-22	Fish and Fish Habitat	1	Two road crossings will be built in locations where crossings previously existed. The previous crossing were decommissioned by Cameco Corporation in 2015. The new crossing will be constructed as clear span bridges, thereby avoiding in-water works, and standard mitigations will be undertaken to minimize potential effects on Fish and Fish Habitat.	8.3.6.1	Construction	Engineering Design	Regulatory requirement
8-23	Fish and Fish Habitat	1	Treated water in the Effluent Monitoring and Release Ponds will be monitored prior to release to a surface waterbody. The treated effluent discharge line will be heated and have secondary containment in place.	8.3.6.1	Operation	EMS; Engineering Design	Regulatory requirement
8-24	Fish and Fish Habitat	1	The site-wide water management system will continue to operate during Decommissioning such that Denison will remain in control of site aspect affected water via the IWWTP. At that time, water (runoff) from the ISR wellfield, and contact water from the developed portion of the site (e.g., contaminated runoff pond, landfill pond, process water pond), will continue to be collected and diverted to the IWWTP. From the IWWTP, the water will be directed back to the ISR wellfield to be pumped as clean water to ground or pumped to the Effluent Monitoring and Release Ponds for monitoring prior to discharge to Whitefish Lake. Following Decommissioning, piping infrastructure will be removed and discharge to surface water will cease.	8.3.6.1	Decommissioning/Post-decommissioning	EMS; Engineering Design	Regulatory requirement
8-25	Fish and Fish Habitat	1	The fish and fish habitat monitoring program should be considered in conjunction with the surface water quantity (hydrology) (Section 8.1.8), surface water quality (Section 8.2.8), sediment quality and benthic invertebrates (Section 8.4.8), and fish health (Section 8.5.8) monitoring programs as it is specifically tied to these monitoring programs from the perspective of pathways of effects. The fish and fish habitat monitoring and follow-up program will have the following objectives: • collecting and recording surface water quality data to confirm that source and receiving water quality predictions for mobilization of solids are consistent with those presented in the EIS; • monitoring to confirm that effluent and receiving water quality meet applicable regulation criteria; • monitoring changes in fish communities/populations within the Project LSA; and • monitoring changes in physical fish habitat within the receiving environment of LA-5. Fish and fish habitat monitoring will occur in tandem with water quality, sediment quality, benthic invertebrate, and fish health sampling. Sampling locations will be co-located to facilitate comparison to water quantity, water quality, and sediment quality characteristics. Changes in fish communities/populations will be assessed through comparison of Construction, Operation, and Decommissioning results to pre-development. Fish and fish habitat monitoring will include collection of metrics associated with species presence, abundance, and life history parameters (e.g., survival, condition, growth) to meet applicable agency guidance (i.e., MDMER and CSA N288.4-19 [CSA Group 2019]).	8.3.8	Construction, Operation	EMS	Regulatory requirement

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			Specific monitoring and follow-up plans for the Fish and Fish Habitat VC will be prepared to refine and finalize the approach and specific metrics following consultation with Indigenous groups, other stakeholders, and relevant federal and provincial agencies with interest in the development and implementation of this VC-specific program				
8-26	Fish and Fish Habitat	1	To minimize the residual effects of the Project on the Fish and Fish Habitat VC, Denison will develop and implement a Surface Water Management Program that includes an integrated framework to manage water quality and water management practices for each of the primary site aspects and areas of the site where contact water is expected. This plan will include the collection and monitoring of contact water to determine whether treatment is required prior to release to the environment, which will inform optimal levels of treatment. This plan will also include the monitoring and management of effluent, including contingency for effluent treatment as may be required so that water discharge objectives are achieved as defined by applicable provincial and federal regulatory instruments.	8.3.8	Construction, Operation	EMS; Engineering Design	Regulatory requirement
8-27	Fish and Fish Habitat	1	Construction of the access road will involve the installation of two stream crossings. These stream crossings are located at the historical watercourse crossings along the proposed airstrip access road. These crossings will be constructed as clear-span bridges, and their mitigative design will provide for protection of the Fish and Fish Habitat VC.	8.3.8	Construction	Engineering Design	Regulatory requirement
8-28	Sediment Quality and Benthic Invertebrates	1	Monitoring and follow-up are proposed for the Sediment Quality and Benthic Invertebrates VCs to verify the accuracy of the predicted effects and effectiveness of proposed mitigation measures. The sediment quality and benthic invertebrate monitoring program should be considered in conjunction with the surface water quantity (hydrology) (Section 8.1.8) and surface water quality (Section 8.2.8) monitoring programs as sediment quality and benthic invertebrate are specifically tied to surface water quantity and quality from the perspective of pathways of effects. Specifically, monitoring of TSS in the effluent monitoring ponds and other catchment ponds prior to discharge to the environment will be important to provide context to further evaluate Project-related effects on sediment and benthic invertebrate communities in the receiving water environment (i.e., Whitefish Lake).	8.4.8	All phases	EMS; EA follow-up program	Regulatory requirement
8-29	Sediment Quality and Benthic Invertebrates	1	The sediment quality and benthic invertebrate monitoring and follow-up program will have the following objectives: • collecting and recording surface water quality to confirm that source and receiving water quality predictions for mobilization of solids are consistent with those presented in the EIS; • monitoring to confirm that effluent and receiver sediment quality meet applicable regulation criteria; and • monitoring benthic invertebrate community structure and abundance in the near-field discharge area to assess any changes that may be attributable to the Project.	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement
8-30	Sediment Quality and Benthic Invertebrates	1	The monitoring and follow-up program will include measurement of sediment quality parameters to meet regulatory criteria (i.e., provincial discharge permits, MDMER [Government of Canada 2022], and CSA N288.4-19 [CSA Group 2019]). At a minimum, this will include collection of non-radiological parameters (e.g., metals, nutrients, pH, and sulphate), radiological parameters, and physical characteristics (grain size).	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement

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8-31	Sediment Quality and Benthic Invertebrates	1	Benthic invertebrate community monitoring will include the collection of samples following regulatory guidance (Government of Canada 2022) on proper collection and analysis to detect change in biota assemblages. This will include reasonable replication over a geographic area. Metrics assessed will be associated with benthic invertebrate community diversity, evenness, density, taxa richness, and similarity indices.	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement
8-32	Sediment Quality and Benthic Invertebrates	1	Sediment and benthic invertebrate monitoring will occur in tandem and sampling locations will be co-located to facilitate comparison of benthic invertebrate community metrics with sediment quality characteristics.	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement
8-33	Sediment Quality and Benthic Invertebrates	1	Sediment and benthic invertebrate monitoring in the natural environment will occur at the point of discharge in Whitefish Lake South (near-field), at an upstream reference location (Whitefish Lake North), and at downstream locations (far-field). The far-field monitoring locations will be located in Whitefish Lake South prior to its discharge to McGowan Lake.	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement
8-34	Sediment Quality and Benthic Invertebrates	1	Constituent concentrations will be compared to the values used in the EIS and to applicable regulatory criteria or objectives.	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement
8-35	Sediment Quality and Benthic Invertebrates	1	Specific monitoring and follow-up plans for the Sediment Quality and Benthic Invertebrates VCs will be prepared to refine and finalize the approach and specific metrics following consultation with Indigenous groups, other stakeholders, and relevant federal and provincial agencies with interest in the development and implementation of this VC-specific program.	8.4.9	All phases	EMS; EA follow-up program	Regulatory requirement
8-36	Fish Health	1	The fish health monitoring and follow-up program will have the following objectives: • collecting and recording surface water quality to confirm that source and receiving water quality predictions for mobilization of solids are consistent with those presented in the EIS; • monitoring to confirm that effluent and receiving water quality meet applicable regulation criteria; and, • monitoring changes in fish tissue concentrations of COPC that may be attributable to the Project.	8.5.8	All phases	EMS; EA follow-up program	Regulatory requirement
8-37	Fish Health	1	The monitoring and follow-up program will include measurements of fish health for comparison to baseline data and regulatory criteria (i.e., Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota [e.g., CCME 2000], MDMER [Government of Canada 2022], CSA N288.4-19 (CSA Group 2019), and applicable United States Environmental Protection Agency criteria (e.g., US EPA 2021). At a minimum, this will include collection of representative fish species from multiple trophic levels and size classes to investigate the bioaccumulation potential of non-radiological (e.g., molybdenum, selenium, mercury, and other metals) and radiological parameters. Fish will also be assessed for their general health condition through assessment of condition and growth metrics consistent with those described in current or updated MDMER EEM technical guidance (e.g., Environment Canada 2012).	8.5.8	All phases	EMS; EA follow-up program	Regulatory requirement
8-38	Fish Health	1	Fish Health monitoring will occur in tandem with Surface Water Quality, Sediment Quality, Benthic Invertebrate and Fish and Fish Habitat sampling. Sampling locations will be co-located to facilitate comparison to water quality and sediment quality characteristics.	8.5.8	All phases	EMS; EA follow-up program	Regulatory requirement

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8-39	Fish Health	1	Sediment and benthic invertebrate monitoring in the natural environment will occur at an upstream reference location (i.e., LA-6 – Whitefish Lake North), at a downstream near-field location close to the point of discharge (i.e., LA-5 – Whitefish Lake South), and at downstream far-field locations (i.e., in LA-5 – Whitefish Lake South prior to its discharge to LA-1 – McGowan Lake).	8.5.8	All phases	EMS; EA follow-up program	Regulatory requirement
8-40	Fish Health	1	The assessment will also include comparison of fish tissue COPC concentrations between a pre-mining period (i.e., before) and the Construction, Operation, and Decommissioning period (i.e., after). It is recognized that additional collection of pre-mining fish tissue concentrations in Whitefish Lake and a reference area are needed.	8.5.8	All phases	EMS; EA follow-up program	Regulatory requirement
8-41	Fish Health	1	Specific monitoring and follow-up plans for the Fish Health VC will be prepared to refine and finalize the approach and specific metrics following consultation with Indigenous groups, other stakeholders, and relevant federal and provincial agencies with interest in the development and implementation of this VC-specific program.	8.5.8	All phases	EMS; EA follow-up program	Regulatory requirement
8-42	Fish and Fish Habitat	1	As baseline surface water did not identify measurable concentrations of total mercury in the LSA or RSA and deposition to large water bodies such as lakes is not likely to contribute to the methyl mercury concentration in the Wheeler River receiving waters, it is most reasonable to conclude that changes in total and methyl mercury can be adequately monitored in relation to sulphate inputs. Denison will undertake monitoring of total and methyl mercury as it relates to the discharge of sulphate to Whitefish Lake.	IR-114, 8.2.4.2.3, 8.2.4.2.4	All phases	EMS; EA follow-up program	Regulatory requirement
8-43	Project Description, Surface Water Quality	1	Denison fully understands its obligations with respect to the MDMER and will comply with the MDMER end of pipe effluent discharge criteria and other requirements of the regulations.	Section 2.2.3.9 Appendix 8-E	Operation, Decommissioning/Post-decommissioning	EMS, EA follow-up program	Regulatory requirement
8-44	Fish Health	3	1. The intent is not to include mercury (and methylmercury) as a COPC for the assessment. As indicated in EIS Section 8.4.6.1, Residual Effects Characterization, mercury is not associated with the local geology and is not expected to be released in the effluent at measurable levels and was therefore not identified as a COPC. Denison notes that there is potential for increased methylmercury production in the receiving environment under a certain combination of factors to which the Project may contribute, such as increased nutrient levels in the environment; however, prediction of methylmercury production is not practical. Denison commits to monitoring mercury and methylmercury in the aquatic environment over the life of the Project to determine the potential changes in mercury concentrations in fish tissue over time. 2. As the Project advances and operational monitoring is underway, Denison will assess health risks from fish consumption by comparing fish tissue data collected during operation from the monitoring program against applicable human health risk-based maximum permissible concentrations. As part of the country food monitoring document developed to support operational licensing, any site-specific contaminant criteria or trigger mechanisms will be developed in consultation with Indigenous Nations and communities. 3. Mercury data presented throughout the draft EIS represents total mercury. Denison agrees to included	Section 8.4.6.1, IR-100	All phases	EMS; EA follow-up program	FUP Commitment, Regulatory requirement, Social responsibility

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			methylmercury, and other relevant COPCs such as lead, arsenic, and cadmium as part of the constituents monitored in fish throughout all project phases.				
8-45	Water Quality / Project Description	1	Denison is committed to investigating BATEA and working with the province and CNSC to ensure discharge concentrations of all constituents including uranium are protective of the aquatic environment.	IR-18	All phases	Engineering Design; EMS; EA Follow-up Program	Regulatory Requirement
8-46	Wetlands / Fish Habitat	1	To further supplement existing information that exists for the LSA wetlands, Denison is committed to undertaking wetland surveys including the collection of water quality, sediment quality, benthic invertebrates and fish and fish habitat surveys prior to the construction to provide an updated baseline for assessing the success of mitigation measures and to assess potential effects of the project on wetlands. These locations will then be further considered as part of the EMP for continued monitoring for these media and biota.	IR-101, Appendix 8-F	All phases	Engineering Design; EMS; EA Follow-up Program	FUP Requirement
8-47	Wetlands/Fish Habitat	1	Wherever possible, wetlands will be avoided through Project design and instituting proper buffers.	IR-101, Section 8.3.5, Appendix 8-F	All phases	Engineering Design	Regulatory Requirement
8-48	Water Quality	4	Denison is in agreement that regular water quality data collection should be instituted and commits to beginning such periodic sampling prior to construction to provide a more robust dataset and following the CCME Guidance Manual for Optimizing Water Quality Monitoring Program Design (2015). Sampling will be conducted monthly during the open water period and twice under ice and will include analysis for alkalinity and nitrate. Any new water quality data will be integrated into Denison's application for a licence to operate, along with updated effluent quality data.	IR-107, IR-114	Prior to Construction	EA Follow-up	FUP Commitment
8-49	Water Quality; Sediment Quality and Benthic Invertebrates; Fish Health	2	Denison has committed to a pre-operational EEM study and will conduct that study in accordance with the regulation and available federal guidance. The pre-operational EEM study will include a study respecting selenium in fish tissue. The preliminary EEM study can be completed prior to operations that will allow for a Before-After-Control-Impact study design, that will provide the ability to monitor change not only in the exposure areas, but in the reference areas, thereby allowing for a reasonable assessment of potential mine-related impacts.	IR-111 and IR-126	Prior to Operation	EA Follow-up	FUP Commitment
8-50	Water Quantity	2	Denison is committed to revisiting the estimates of the IDF as per CNSC's recommendations to consult CSA PLUS 4013:19 (2019) Technical guide: Development, interpretation and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners regarding the consideration of future changes in short-duration precipitation extremes, as applicable, for the licensing phase. Specifically, Denison agrees to provide the requested information related to the IDF (1 in 100 year 24-hour rainfall) and demonstrate climate change resilience of the project (conduct climate risk and resilience assessment per REGDOC 2.9.1) during licensing.	IR-103	Prior to Construction	EA Follow-up	Regulatory Requirement
8-51	Water Quality	2	Denison commits to following the guidance and requirements in REGDOC 2.9.2 to develop effluent discharge targets as part of operational licencing and in consultation with the CNSC.	IR-18	Prior to Operation	EMS; EA Follow-up	Regulatory Requirement
8-52	Water Quality / Sediment Quality	2	Denison suggests that a sensitivity analysis on water quality predictions for low and high precipitation scenarios, including the potential influences of climate change can be completed as part of licensing and as applicable to REGDOC-2.9.2 (Environmental Protection: Controlling Releases to the Environment). Such an analysis will incorporate any updated background water quality information as available.	IR-113	Prior to Construction	EA Follow-up	Regulatory Requirement

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8-53	Water Quality	4	Denison will assess and minimize copper concentrations in effluent through the BATEA assessment during licensing	IR-114 (Nov 2024)	Prior to Operation	EMS; EA Follow-up	Regulatory Requirement
9-1	Ungulates, Furbearers, and Woodland Caribou	2	As part of the decommissioning of the site, Denison is committed to the goal of reclaiming the affected portions of the Project Area and establish the appropriate conditions (e.g., soil quality) to support a regeneration path that would lead to and promote a natural seral stage succession that would be compatible with adjacent habitat types (i.e., to pre-disturbance conditions in line with surrounding habitats).	TRC 182	Decommissioning	Decommissioning Plan	Regulatory commitment
9-2	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	The Wildlife Management Plan (for terrestrial and avian species) and the Draft Caribou Mitigation Plan (for woodland caribou) will identify all sensitive periods and habitat types and identify applicable no-disturbance setback buffers to be adhered to during all Project activities (i.e., no prioritization, applicable for all Project activities, species-specific). Generally, the nesting season for raptors, migratory breeding birds and bird species at risk spans a period from March 15 to August 31; however, the specific sensitive period for migratory birds for the C7 nesting zone (based on the ECCC nesting calendar), in which the Project is located, extends from May 3 to August 20. The calving period for woodland caribou extends from March 31 to July 31. Denning (i.e., for bears) is typically from November until early April and is weather dependent.	TRC 185	All phases	EMS	Regulatory commitment
9-3	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	3	To adequately address potential effects, regardless of the wildlife, seasonal or species-specific sensitivities, pre-disturbance wildlife clearance surveys (i.e., not species-specific surveys) will be completed prior to any work commencing. Results of the wildlife clearance surveys will be used to inform the design and delineation/establishment of suitable setback distances (i.e., specific to species, habitat, life-cycle sensitivities), work delays and/or other species-specific mitigation measures at that location, with discussions with ENV as appropriate. The details on the methodology of species-specific pre-clearance sweep protocols and timing are provided in the Appendix 9-D of the final EIS.	TRC 185; IR-142, IR-159, IR-167 -R1	All phases	EMS	Regulatory commitment
9-4	Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	Pre-construction surveys will be completed for pileated woodpecker nest cavities and nest cavities (if observed) will be registered in compliance with the 36-month waiting period prior to destruction of unoccupied nests (if destruction should be required) as required by the Migratory Birds Regulations, 2022.	TRC 190	All phases	EMS	Regulatory commitment
9-5	Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	Denison is committed to monitoring avian mortality related to avian use of waste and water facilities, as well as mortality events associated with interactions with access roads (particularly related to large-bodied carcasses) and transmission lines. Such mortalities will be documented and reported to the SK MOE on a basis as determined in consultation between the SK MOE and Denison.	IR-173	All phases	EMS	Regulatory commitment
9-6	Terrain, Soil, and Organic Matter/Peat	1	Any stockpiled mineral soil remaining during Decommissioning following progressive reclamation activities will be redistributed across the reclaimed landscape as a growing substrate to support the desired end-land use.	9.1.4.2.2 9.1.6.3.1	Decommissioning	Decommissioning Plan	Regulatory commitment

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			Salvaged soil will be replaced and redistributed within areas of the Project Area to be reclaimed to provide a suitable growing substrate that is expected to support re-establishment of the desired vegetation cover.				
9-7	Terrain, Soil, and Organic Matter/Peat	1	Where applicable and to the extent practical, peat/organic matter within the Project Area will be stripped and salvaged prior to construction.	9.1.4.2.3	Construction	EMS	Regulatory commitment
9-8	Terrain, Soil, and Organic Matter/Peat	1	To the extent practical, reclamation of the Project Area will re-instate predominant landscape features, topographical contours (slope, aspect), and surface drainage patterns in a manner that will tie-in to the existing landscape and maintain surface drainage continuity and hydrologic connectivity. Reclamation/Closure monitoring during the Post-Decommissioning Phase will be completed to verify the status and final conditions of the reclaimed landscape.	9.1.5.2.1 9.1.5.2.2 9.1.5.2.3	Post-decommissioning	Decommissioning Plan	Regulatory commitment
9-9	Terrain, Soil, and Organic Matter/Peat	1	A soil monitoring program/protocol (or equivalent) will verify soil salvage volumes and reclamation suitability.	9.1.5.2.2	All phases	EMS	Regulatory commitment
9-10	Terrain, Soil, and Organic Matter/Peat	1	Project features will be reclaimed during decommissioning activities to form a safe, stable, and self-sustaining landscape. However, some features (e.g., the primary access road) are expected to remain in place during the post-decommissioning phase; other features (e.g., clean waste rock pile) may be integrated into the end-landscape. The Project will be reclaimed to a safe, stable, and self-sustaining landscape. Project features will be reclaimed to a safe, stable, and self-sustaining landscape that includes re-instating topographic contours and surface drainage patterns.	9.1.6.2.1 9.1.6.3.1 9.1.6.4.1	Decommissioning	Decommissioning Plan	Regulatory commitment
9-11	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	Through progressive and final reclamation, disturbed areas within the Project Area will be revegetated with a focus on achieving the creation of a safe, stable, and self-sustaining landscape. Through progressive and final reclamation, disturbed areas within the Project Area will be revegetated with a focus on achieving baseline conditions.	9.3.6.2.1 9.3.6.3.1 9.3.6.4.1 9.4.6.2.1 9.4.6.3.1 9.4.6.4.1	All phases	Decommissioning Plan	Regulatory commitment
9-12	Terrain, Soil, and Organic Matter/Peat	1	Construction monitoring will be conducted during and immediately following Construction to verify that the Project is constructed to design specifications (i.e., in a manner that meets geotechnical requirements) and that mitigation measures are both appropriate and effective in relation to the level of geotechnical risk. This will provide a procedure to adapt mitigation measures (if/where necessary).	9.1.8.1	Construction	EA follow-up program	Regulatory commitment
9-13	Terrain, Soil, and Organic Matter/Peat	1	Construction and geotechnical monitoring will be implemented in accordance with the Environmental Management System (EMS), which will include erosion and sediment controls, soil and vegetation monitoring and the Decommissioning Plan. The timing/frequency of monitoring and reporting	9.1.8.1 9.1.8.2	Decommissioning	EMS; EA follow-up program	Regulatory commitment

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			requirements will be determined in consultation with qualified personnel responsible for construction and geotechnical oversight (e.g., Professional Engineer). Monitoring of soil salvage activities will be implemented in accordance with other mitigation and management plans outlined within an EMS, which will include erosion and sediment controls, soil and vegetation monitoring, and a Decommissioning Plan. Soil salvage will be conducted under the guidance and supervision of a qualified environmental professional with experience ground-truthing site conditions to confirm/verify soil salvage depths and identify potential hazards (e.g., Professional Agrologist or Registered Professional Biologist with dedicated expertise in soil science).				
9-14	Terrain, Soil, and Organic Matter/Peat	1	Construction monitoring procedures will clearly define and delineate indicators and descriptors to identify potential deficiencies (e.g., types of slope failures and leading causes), triggers and corrective actions. These procedures will identify the key personnel (e.g., managers, superintendents, and technical leads) responsible for document review, approval, and implementation.	9.1.8.1 9.2.8.2	Construction	EA follow-up program	Regulatory commitment
9-15	Terrain, Soil, and Organic Matter/Peat	1	Soil and organic matter/peat monitoring will be conducted during soil salvage and stockpiling activities prior to Construction. This will provide a mechanism to verify that soil and organic matter/peat are delineated, stripped, handled, and stockpiled as recommended, and that there is an inventory of salvaged growth substrates at the Project.	9.1.8.2	Construction	EA follow-up program	Regulatory commitment
9-16	Terrain, Soil, and Organic Matter/Peat	1	Periodic monitoring of soil stockpiles will then be conducted (as/when necessary) during the Operation Phase to evaluate the stability of salvaged soil, e.g., in relation to potential erosion and/or degradation. These monitoring activities will provide a mechanism to verify that mitigation measures are both appropriate and effective and provide a procedure to adapt mitigation measures if/where necessary.	9.1.8.2	Operation	EA follow-up program	Regulatory commitment
9-17	Terrain, Soil, and Organic Matter/Peat	1	Soil inventory data, including volume and location, will be recorded by construction supervisors at the time of soil stockpiling. Soil monitoring procedures will clearly define and delineate indicators and descriptors to identify potential deficiencies (e.g., soil salvage hazards and leading causes), triggers, and corrective actions. These procedures will identify the key personnel (e.g., managers, superintendents, and technical leads) responsible for document review, approval, and implementation.	9.1.8.2	Construction	EA follow-up program	Regulatory commitment
9-18	Terrain, Soil, and Organic Matter/Peat	1	Soil quality monitoring—comprising scheduled collection of soil from permanent sampling locations for analysis of COPC—will be conducted during the Operation Phase. This will provide a mechanism to evaluate potential effects of dust on soil quality, and other interrelated VCs.	9.1.8.3	Operation	EA follow-up program	Regulatory commitment
9-19	Terrain, Soil, and Organic Matter/Peat	1	Soil quality monitoring will be conducted under the guidance and supervision of a qualified environmental professional with experience conducting soil sampling including sample collection, chain of custody and interpretation of data (e.g., Professional Agrologist or Registered Professional Biologist with dedicated expertise in soil science).	9.1.8.3	All phases	EA follow-up program	Regulatory commitment
9-20	Terrain, Soil, and Organic Matter/Peat	1	Soil quality monitoring data will be compiled and reported annually/periodically. Soil quality monitoring procedures will clearly define and delineate indicators and descriptors to identify potential deficiencies (e.g., COPC exceedances), triggers, and corrective actions. These procedures will identify the key personnel (e.g., managers, superintendents, and technical leads) responsible for document review, approval, and implementation.	9.1.8.3	All phases	EA follow-up program	Regulatory commitment

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9-21	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	The ERA will be updated throughout the life of the Project and will provide a key tool for environmental performance reporting.	9.2.4.2.2 9.2.6.2.2	All phases	EIS	Regulatory commitment
9-22	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	Denison is committed: (1) to reduce disturbance to Vegetation and Ecosystems, Listed Plant Species, and Wetlands throughout all Project Phases, and (2) to reclaim the Project Area to an ecological trajectory that aligns with the desired end-land use(s) and regulatory requirements at the completion of the mining tenure. A key step will be to appropriately implement all applicable environmental management plans during the given Project phases. A follow-up strategy is proposed to support existing mitigation and thereby minimize uncertainty in support of these commitments.	9.2.8	All phases	EA follow-up program	Regulatory commitment
9-23	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	Project monitoring and adaptive management plans specific to Vegetation include: • Soil monitoring during salvaging and stockpiling activities will be undertaken. • Progressive reclamation and revegetation of disturbed areas will be monitored in accordance with the Decommissioning Plan.	9.2.8	All phases	EA follow-up program	Regulatory commitment
9-24	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	Where mitigation measures are not deemed to be successful, adaptive management techniques will be employed. Findings during monitoring, as well as revised BMPs, improved scientific methods, and regulatory changes will be incorporated into the environmental management plans, to reduce effects during the lifetime of the Project. Interested Parties, Indigenous communities and organizations, and regulatory agencies will be involved in developing mitigation and adaptive management measures where applicable.	9.2.8	All phases	EA follow-up program	Regulatory commitment
9-25	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	Pre-construction listed plant surveys will be undertaken within the Project Area within ecosites that were not encountered during the 2017 surveys, as well as within selected areas of the Project Area with the potential to support listed plants (e.g., transitional habitats favoured by Alaskan clubmoss). Surveys will be undertaken to verify EA predictions and identify mitigation measures to protect Listed Plant Species, as appropriate. Should Listed Plant Species be identified within the Project Area, site- and species-specific mitigation measures will be developed by a qualified vegetation ecologist to avoid and/or minimize potential Project effects.	9.2.3.2 9.2.8.1	Construction	EA follow-up program	Regulatory commitment
9-26	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	Targeted monitoring and inspection will be undertaken during Construction to verify that mitigation measures to reduce effects on Vegetation and Ecosystems, Listed Plant Species, and Wetlands VCs have been appropriately applied, maintained, and removed, where necessary. Environmental inspectors (on-site monitors) will be present during Construction to verify compliance and evaluate the success of mitigation measures outlined in Section 9.2.5, mitigation and management plans specific to Vegetation including the plans for erosion and sediment control management and monitoring of vegetation, and the Decommissioning Plan, and applicable approval conditions.	9.2.8.2	Construction	EA follow-up program	Regulatory commitment
9-27	Vegetation and Ecosystems, Listed Plant	1	Vegetation monitoring will be conducted periodically throughout all Project phases to reduce the potential for effects on vegetation associated with routine vegetation clearing and maintenance within the Project Area and to avoid the introduction and spread of invasive plant species. Vegetation	9.2.8.3	All phases	EA follow-up program	Regulatory commitment

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	Species, and Wetlands		monitoring will verify compliance and evaluate the success of mitigation measures outlined in Section 9.2.5, mitigation and management plans specific to Vegetation including plans for erosion and sediment control, environmental protection of vegetation and soil, and the Decommissioning Plan, and applicable approval conditions. These procedures will identify the key personnel (e.g., Managers, Superintendents and Technical Leads) responsible for document review, approval and implementation.				
9-28	Vegetation and Ecosystems, Listed Plant Species, and Wetlands	1	Vegetation and soil sampling and laboratory analyses for COPC commenced in 2017 at 10 PSPs for radon (further described in Section 9.2.3.1.2), and will continue to be conducted periodically throughout all Project phases to identify if plants within the Vegetation LSA are accumulating COPC within their tissues. Monitoring for COPC in vegetation will be completed in accordance with the methodologies outlined in the EMS, and as outlined in the ERA (Appendix 10-A in Section 10).	9.2.8.4	All phases	EMS; EA follow-up program	Regulatory commitment
9-29	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	All disturbed areas will be reclaimed during this phase, which is expected to result in positive effects on wildlife/avian habitat.	9.3.4.2.1 9.3.4.2.2 9.4.4.2.1 9.4.4.2.2	Decommissioning	Decommissioning Plan	Regulatory commitment
9-30	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	Project activities will be limited to regular monitoring and occasional inspections and all Project components will be removed, resulting in a reduced risk of vehicle collisions with wildlife, exposure to trace metals and radionuclides, hazardous materials (e.g., spills), and risk of entrapment.	9.3.4.2.2 9.4.4.2.2	Post-decommissioning	Decommissioning Plan	Regulatory commitment
9-31	Ungulates, Furbearers, and Woodland Caribou	1	Targeted monitoring programs (described below) will be completed during the Construction, Operation, and Decommissioning phases to verify that Project design and mitigation measures (Section 9.3.5) have been appropriately applied and maintained. Following verification, the success of Project design and mitigation measures will be evaluated to assist in the determination of additional mitigation measure requirements. • wildlife species routinely monitored (e.g., through the Project-wide implementation of the current wildlife card system) throughout the life of the Project in accordance with the management and monitoring plans within the EMS (including implemented setback distances during sensitive time periods, if applicable); and • progressive reclamation and revegetation of disturbed areas (i.e., transitioning into wildlife habitat) monitored in accordance with the Reclamation and Closure Plan.	9.3.8	All phases	EA follow-up program; Decommissioning Plan	Regulatory commitment

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9-32	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	An adaptive management process will be employed, after applicable consultations and approvals, where implemented mitigation measures are found to be unsuccessful. Management plans will be considered living documents, and updated when warranted to include input from consultations, monitoring results, regulatory or legislative changes, and any updated, improved, or revised BMPs and scientific methods.	9.3.8 9.4.8	All phases	EA follow-up program	Regulatory commitment
9-33	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	If unforeseen adverse effects are identified during follow-up programs, Denison will, as per its ongoing adaptive management process, adjust the existing mitigation measures or, if necessary, develop new mitigation measures to address those effects. This could result in Denison refining or modifying the design and implementation of management plans (see Section 16 Assessment Summary and Conclusions), mitigation measures, and Project operations, with the final approach selected depending on the issue identified. Interested Parties, Indigenous Groups, and government agencies will be involved in developing mitigation and adaptive management measures where applicable.	9.3.8 9.4.8	All phases	EA follow-up program	Regulatory commitment
9-34	Raptors, Migratory Breeding Birds, and Bird Species at Risk	1	Targeted monitoring programs (described below) will be completed during the Construction, Operation, and Decommissioning phases to verify that Project design and mitigation measures (Section 9.4.5) have been appropriately applied and maintained. Following verification, the success of Project design and mitigation measures will be evaluated to assist in the determination of additional mitigation measure requirements. • pre-construction nest surveys conducted in accordance with the EMS prior to the commencement of any vegetation clearing or soil disturbance; • avian species routinely monitored throughout the life of the Project (e.g., through the Project-wide implementation of the current wildlife card system) in accordance with the EMS (including implemented setback distances during sensitive time periods, if applicable); and • progressive reclamation and revegetation of disturbed areas (i.e., transitioning into avian habitat) monitored in accordance with the Reclamation and Closure Plan.	9.4.8	All phases	EA follow-up program	Regulatory commitment
9-35	Ungulates, Furbearers, and Woodland Caribou Raptors, Migratory Breeding Birds, and Bird Species at Risk	2	Denison will develop an offsetting plan to satisfy the requirements of the Province of Saskatchewan offsetting framework that the province has created to fulfill its obligations as it concerns implementing the objectives of the Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada.	Appendix 9-E; TRC-183; TRC-200; IR-149; IR-157	Operation	EMS	Regulatory commitment

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9-36	Ungulates, Furbearers, and Woodland Caribou	2	Denison will operate the airstrip and flights in a safe manner and will also seek to minimize interactions with wildlife by following guidance and best practice from Saskatchewan and other jurisdictions. Mitigation measures likely to be incorporated into the operation of the airstrip, with respect to air traffic, would include, as safety allows, maintaining as direct approach and departure flight paths as possible, and obtaining appropriate altitudes, and leaving the LSA and RSA, as quickly as is safely reasonable. Flight paths can be adjusted based on the location of caribou observations or known important areas during sensitive periods, as it safe and practical to do so. Details related to airstrip and flight management will be developed as part of Project licensing and permitting.	IR-149	All phases	EMS	Regulatory commitment
9-37	n/a	3	Pre-construction baseline acoustic bat surveys will be completed prior to construction, building on the 2019 surveys (Appendix 9-B). The surveys will determine the presence/non-absence, diversity and relative abundance of bat species in the Project Area. Results of acoustic bat surveys will be submitted to Saskatchewan's Conservation Data Centre.	IR-174	Pre-construction	EMS	Regulatory commitment
10-1	Worker Health and Safety	1	Workers will also be subject to conventional workplace hazards. These will be managed through a conventional health and safety plan, in compliance with applicable federal and provincial legislation.	10.2.1.1	Construction, Operation, Decommissioning	EMS	Regulatory commitment
10-2	Worker Health and Safety	1	A Radiation Protection Program (RPP) … will include workplace monitoring and mitigation measures designed to ensure that worker doses are kept as low as reasonably achievable (ALARA).	10.2.3.2	Operation; Decommissioning	EMS	Regulatory commitment
10-3	Worker Health and Safety	1	Under the Radiation Protection Program, a radiation work permit process will be in place for any non-routine work that may involve unusually high exposures, ensuring that risks are assessed, and exposure controls are optimized in accordance with the ALARA principle.	Appendix 10-C, section 6.0	Operation; Decommissioning	EMS	Regulatory commitment
10-4	Worker Health and Safety	1	In the drying area and the packaging/loading area, engineering controls will minimize the dust pathway. Engineering controls will include negative pressure enclosure of source equipment and exhaust, as well as ventilation controls in the main rooms (6 exchanges/hour was assumed). As an administrative control, dust levels in the room will be monitored, and individual worker exposures will be monitored and managed. Under normal operation, workers will not be inside the enclosure. PAPR will be available if needed as a control of last resort, for any non-routine situations, such as any necessary work within the enclosures. The approach will respect the hierarchy of control and will comply with Section 13 of the Uranium Mines and Mills Regulations. Actual dust levels will be confirmed during the commissioning phase and the control system will be optimized to ensure that doses are ALARA.	10.2.4; Appendix 10-C, section 6.0; IR-186 and IR-187	Operation	EMS; Engineering Design	Regulatory commitment
10-5	Worker Health and Safety	1	In the core shack, an administrative level of respirable dust equal to ¼ of the ACGIH TLV of 0.27 mg/m^3 has been assumed. Time in the shack will be managed to control dose from inhalation of ore dust. Dust levels will be confirmed during the commissioning phase and the control systems will be optimized to ensure that doses are ALARA. It may be possible to increase air exchange in the core shack, above the planned 6 exchanges per hour, should this be necessary.	10.2.4 ; Appendix 10-C, section 6.0	Operation	EMS; Engineering Design	Regulatory commitment
10-6	Worker Health and Safety	1	In the precipitate removal area, it was assumed that no more than 3 totes of filter cake will be in the area simultaneously at any time. The external dose from this source could be minimized by managing the quantity of filter cake in the work area, as well as worker proximity.	10.2.4 ; Appendix 10-C, section 6.0	Operation	EMS	Regulatory commitment

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10-7	Worker Health and Safety	1	At the special waste pad, external doses from ore cuttings were assumed to be mitigated by a berm around the pad, which provides shielding. However, this area is a potentially substantial source of external dose for non-routine work inside the berm, and any such work will be minimized.	10.2.4 ; Appendix 10-C, section 6.0	Operation; Decommissioning	EMS; Engineering Design	Regulatory commitment
10-8	Worker Health and Safety	1	Radon levels will be monitored in the precipitate removal and yellowcake precipitation areas of the ISR plant, and in the core shack, to support management of radon exposure and dose.	10.2.4	Operation	EMS	Regulatory commitment
10-9	Worker Health and Safety	1	In general, it will be necessary to manage work sequence and schedule to avoid prolonged exposures to the identified sources, especially those identified as being significant to worker dose. Doses can be most effectively reduced by reducing exposure times and maximizing distances from the source, as well as by use of protective shielding.	Appendix 10-C, section 6.0	Operation; Decommissioning	EMS	Regulatory commitment
10-10	Human Health	1	The future permanent resident is a hypothetical adult and one-year-old (male or female) who would reside full time at the Denison camp site after the Post-Decommissioning phase has been fully implemented, in the future centuries. Assumptions for a permanent resident after Post-Decommissioning should be refined near the time of Decommissioning with community input where possible.	10.1.6.1.1	Decommissioning	EMS	Regulatory commitment
10-11	Human Health	1	The presence and concentrations of radionuclides in the receiving environment would be monitored and the associated radiation dose estimates would be periodically reassessed in accordance with the processes outlined in the Environmental Management System.	10.1.6.1.4	All phases	EMS	Regulatory commitment
10-12	Human Health	1	Monitoring should focus on collecting data to verify ERA model predictions, as well as provide data to improve model predictions as the Project begins. Recommended monitoring would support Denison's environmental protection framework with the goal of reducing uncertainty over time through an iterative process. Environmental monitoring would follow requirements and guidance in CSA N288.4-19 (CSA 2019) as well as engagement with local communities	10.1.8/10.1.9	All phases	EMS	Regulatory commitment
10-13	Human Health	2	Based on some short-term exceedances of air quality criteria at the camp and the fenceline, NO_2, particulate matter, and uranium in TSP and PM10 should be monitored as part of any air emissions monitoring plan (refer also to commitment 6-2).	10.1.8	Construction	EA Follow up program	FUP commitment
10-14	Human Health	1	Denison is implementing an environmental monitoring program consistent with requirements and guidance in CSA N288.4-19: *Environmental monitoring programs at nuclear facilities and uranium mines and mills* (CSA 2019). Monitoring would focus on providing data to verify the predictions made by the ERA, to refine the models used in the ERA, and to reduce the uncertainty in the predictions made by the ERA. The environmental monitoring program should include collection of surface water, sediment, and soil samples as well as fish tissue samples, benthic invertebrate tissue samples, and country foods such as blueberries. Monitoring locations would be focused on Whitefish Lake, McGowan Lake and Russell Lake. Monitoring COPCs would include those identified as COPCs in the ERA, including metals and uranium-238 series radionuclides, and chloride and sulphate in lake waters. Monitoring could extend to include other COPCs for other purposes, such as meeting regulatory requirements for monitoring, or addressing COPCs of public interest based on experience at other uranium mines and process plants.	10.1.8	All phases	EMS	Regulatory commitment
10-15	Human Health	1	Denison will include PM10 and PM2.5 to the air quality monitoring plan during construction will be added to Section 6.1.8 and Section 16 in the final EIS.	6.1.8; 16	Construction	EA follow-up program	FUP commitment

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10-16	Human Health	1	Canadian Ambient Air Quality Standards (CAAQS) established under the national Air Quality Management System (CCME 2021b) were used for information purposes, but not selected as screening criteria. For future mitigation and follow up monitoring activities, the CAAQS will be utilized as the applicable standard.	10.1.4.2.1	Construction (when monitoring will occur)	EA follow-up program	FUP commitment
10-17	Human Health	1	To mitigate potential adverse effects on surface water quality, Denison will do the following: • Develop and implement a site-wide water management plan that provides an integrated framework to manage water quality that includes provision for water management practices for each of the primary site aspects, as well as areas of the site where contact water is expected. • Maximize the recycle and reuse of process water to reduce freshwater intake and release to Whitefish Lake. • Design discharge diffuser/outfall to provide effective mixing and dilution and to provide discharge flows that do not detrimentally affect sediments. • Develop site-specific effluent treatment to treat COPCs to appropriate release limits in accordance with federal and provincial standards and licence/permit conditions. • Discharge effluent under a scenario that will meet provincial and federal discharge criteria and be identified through permitting. Scenarios may include: • Discharge at a fixed rate while maintaining an appropriate minimum dilution ratio (i.e., discharge when able to meet the required dilution ratio and cease discharge during periods when unable to meet the necessary dilution ratio). • Discharge under a variable waste load allocation (i.e., discharge an appropriate effluent volume based on flow in the receiver to maintain minimum dilution ratio). • Manage discharge via a hybrid of these (i.e., discharge effluent at a fixed rate to maintain the required dilution ratio, but the fixed rate is varied on a seasonal basis [based on flow]). • Collect and monitor contact water to determine whether treatment is required prior to release to the environment and inform optimal levels of treatment. • Maintain the water management system in place during decommissioning until such time that water quality is suitable to release to the environment. • Monitor and manage effluent, including contingency for effluent treatment as may be required, so that water discharge objectives are achieved as defined in applicable provincial and federal regulatory instruments. • Design and implement an Environmental Code of Practice that defines action levels and appropriate steps to be taken to mitigate elevated concentrations of chemical and radiological COPCs in treated effluent discharge to acceptable levels. • Implement Project-specific monitoring programs (e.g., effluent monitoring plan, environmental monitoring plan) that includes monitoring treated effluent, surface water and sediment quality and applying adaptive management if necessary. • Work with the associated communities to develop and implement the Project-specific monitoring programs and a framework to share the results for the purpose of assessing the performance of the water management system. • Develop and implement a decommissioning and reclamation plan to decommission and transfer the site to the Province under the Institutional Control Program.	10.1.5	Ongoing throughout life of mine	EA follow-up program	Regulatory requirement
10-18	Human Health	1	To mitigate potential effects on air quality, Denison will do the following: • Use scrubbers on the ISR stack to control emissions. • Collect dust measurements during Construction, Operation, and Decommissioning, and determine whether the actual effect of Project activities is different than what was modelled. • Create and implement a dust management plan, including the application of water to control fugitive dust, in addition to other operational strategies to assist in dust control. • Plan vehicle and equipment routes to minimize travel distances, where possible.	10.1.5	Ongoing throughout life of mine	EA follow-up program	Regulatory requirement

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			• Employ standard operating procedures and complete regular inspections of equipment machinery to make sure it is in good working order. • Avoid dust-generating activities (e.g., earthworks, material handling) during dry or high wind conditions. • Avoid dropping material from height. • Make sure all exhausts (e.g., mobile equipment, generators) are in good working condition. • Turn off vehicles and equipment when not being used. • Minimize or reduce vehicle and equipment speed by enforcing speed limits. • Apply water at least twice per day to unpaved roads and surfaces (during summer months). • Maintain unpaved road surfaces via grading or other maintenance practices to reduce the amount of silt (i.e., fines) present in the roadbed material.				
11-1	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	Denison will use high-quality, low sound emission equipment and regular maintenance will reduce noise associated with Project activities	11.1.5/ 11.2.5	All phases	Engineering design	Regulatory requirement
11-2	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	High-noise activities will be located further away from human receptor(s), such as a local leaseholder	11.1.5/ 11.2.5	All phases	Engineering design	Regulatory requirement
11-3	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	Noise-generating equipment will be situated behind on-site obstructions	11.1.5/ 11.2.5	All phases	Engineering design	Regulatory requirement
11-4	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	Monitoring will take place, including collecting sound level measurements from these sources (e.g., in the vicinity of the wellfield, the concrete batch plant, and along the access road from Highway 914) once they are operating and determine whether its actual impact is lower than that which was modelled	11.1.5/ 11.2.5	All phases	Environmental monitoring program	Environmental monitoring program
11-5	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	To control road dust during summer (May to October), water and/or chemical dust suppressant will be applied to all site roads. In the winter months (November to April), natural mitigation from snow/ice can help control unpaved road . vehicle speeds at the Project site are limited to 40 km/h along the site haul roads, which will also limit the amount of road dust generated. The roads are also maintained during the summer months using a grader, which is a lesser source of particulate matter along the roads.	11.1.5/ 11.2.5	All phases	QMS and policies	Social responsibility
11-6	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	Air emissions will be reduced by: • directing processing plant exhaust from drying and packaging areas through a stack prior to release outside of the building; • designing the stack height based on results of air dispersion modelling to be an appropriate height for optimal dispersion; and • employing battery-powered light vehicles where practical to reduce air emissions and noise levels and improve energy efficiency	11.1.5/ 11.2.5	All phases	Engineering design	Regulatory requirement
11-7	ILRU/OLRU - Perceived Suitability of Lands and Resources	1	Strategies to avoid or reduce the likelihood of total suspended particulate and particulate matter exceedances include: • limiting material handling activities during dry conditions and high winds; • limiting vehicle and equipment speeds on unpaved roadways/surfaces; • optimizing the number of vehicle and equipment movements and minimize travel distances,	11.1.5/ 11.2.5	All phases	QMS and policies	Social responsibility

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			where possible; • maintaining unpaved roads via grading or other maintenance practices to reduce the amount of fine particles available for dispersion; and • collecting dust measurements during Project phases to determine whether the actual effect of Project activities is lower than what was modelled				
11-8	ILRU/OLRU - Perceived Suitability of Lands and Resources Quality of Life - Cultural Expression	1	Denison will implement an Environmental Monitoring Program consistent with Canadian Standards Association for nuclear facilities and mines. Monitoring will focus on providing data to verify the predictions made by the ERA, to refine the models used in the ERA, and to reduce the uncertainty in the predictions made by the ERA. The Environmental Monitoring Program will include collection of surface water, sediment, and soil samples as well as fish tissue samples, benthic invertebrate tissue samples, and country foods such as blueberries. Monitoring locations would be focused in the area of Whitefish Lake, McGowan Lake, and Russell Lake.	11.1.5/ 11.2.5/ 12.1.5	All phases	EMS	Environmental monitoring program
11-9	ILRU/OLRU - Perceived Suitability of Lands and Resources Quality of Life - Cultural Expression	1	The KML propose that working cooperatively with Denison is a path towards reconciliation. For each concern brought forward by KML, KML proposed that each concern will be reviewed by Denison for the best possible solution and that effects on land and resources be either nil or minimal. This approach is consistent with Denison's Indigenous Peoples Policy.	11.1.5/ 11.2.5/ 12.1.5	All phases	Ongoing engagement	Social responsibility
11-10	OLRU - Perceived Suitability of Lands and Resources	1	Surface lease agreements, which are required to conduct mining in Saskatchewan, also contain commitments for environmental protection, occupational health and safety, and socio-economic benefits for residents of Saskatchewan's North (Government of Saskatchewan 2018). One provision within surface lease agreements is compensation for commercial loss of income. Payments are typically made to individuals who: 1) held a lease or permit to use the lands immediately prior to the establishment of the mine's surface lease; and 2) used the land to generate commercial income, such as from trapping (Government of Saskatchewan 2018b). Should the need arise, compensation for loss of income may be disbursed to the trapper selected to take up trapping in the Project Area.	11.2.5	All phases	QMS and policies	Regulatory requirement; Social responsibility
11-11	Heritage Resources	2	Denison will follow the Human Resources Management Plan which has been developed to mitigate potential effects of the Project to Heritage Resources. The plan outlines steps Denison will take if a new heritage site is identified during activities taking place over the life of the Project. The management of archaeological resources includes the assessment of the discovery by a qualified archaeologist and mitigation measures including avoidance of the site, shovel testing, systematic and intensive shovel testing, excavation, and/or construction monitoring. The HRMP outlines mechanisms for Indigenous engagement including the communities, implementation of appropriate cultural protocols, the potential for storage of artifacts outside of the Royal Saskatchewan Museum, and the inclusion of Indigenous field assistants when possible.	11.3.5	All phases	QMS and policies	Social responsibility
12-1	Quality of Life - Cultural Expression	1	To reduce the potential negative effects of Project employment, Denison will implement culturally sensitive employment policies that support the attraction and retention of an Indigenous workforce. Encouragement will be made to speak languages of choice while at the site, except during safety sensitive situations. Denison will work with the Indigenous COI to make sure understanding exists regarding the culturally important periods for ERFN and KML #9 (Pinehouse), including important harvest times and cultural camp schedules. Denison will facilitate Indigenous employees taking time off to participate in cultural activities with family or with the broader community, where appropriate.	12.1.5	All phases	Ongoing engagement; QMS and policies	Social responsibility

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12-2	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison will establish health and wellness programming on-site, which will be accessible to all workers.	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-3	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison will contract a primary care paramedic to provide care on site through all phases of the Project.	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-4	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison will provide the appropriate level of First Aid and CPR training to employees to ensure adequate coverage	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-5	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison will provide health promotion and on-site health care programming that will be designed to reflect the needs/interests of the workforce and may include topics such as tobacco cessation, health and stroke awareness, diabetes awareness, mental health and addictions support, cancer awareness, and nutrition awareness. Immunization programs may be administered through the on-site health team	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-6	Quality of Life - Community Well-being and Infrastructure and Services	1	Programming may include the development of life skills programming to address topics such as managing personal finances and coping with stressful situations.	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-7	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison will provide recreation options on site to promote health and wellness.	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-8	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison will provide space for an on-site Elder counsellor to provide culturally relevant programing and support	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-9	Quality of Life - Community Well-being and Infrastructure and Services	1	An Employee and Family Assistance Program (EFAP) will also be part of each worker’s benefits package and will provide supports to individuals and their families that may not be readily available in their communities	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-10	Quality of Life - Community Well-being	1	Pick-up points will be located at two locally central points in communities within the LSA, one additional site in northern Saskatchewan, and potentially other locations to minimize time spent away from families.	12.2.5	All phases	QMS and policies	Social responsibility
12-11	Quality of Life - Community Well-being and Infrastructure and Services	1	First aid facilities will be supplied during Construction.	12.2.5/ 12.3.5	Construction	QMS and policies	Social responsibility

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12-12	Quality of Life - Community Well-being	1	A no alcohol and drug policy will be established at the Project site.	12.2.5	All phases	QMS and policies	Social responsibility
12-13	Quality of Life - Community Well-being and Infrastructure and Services	1	Denison's Environment, Health, Safety, and Sustainability Policy will be enforced.	12.2.5/ 12.3.5	All phases	QMS and policies	Social responsibility
12-14	Quality of Life - Community Well-being	1	Liaison with LSA communities and relevant authorities (e.g., RCMP, health and service providers) will continue.	12.2.5	All phases	Ongoing engagement	Social responsibility
12-15	Quality of Life - Community Well-being	1	Denison will plan a workforce transition plan prior to decommissioning of the mine.	12.2.5	Prior to decommissioning	QMS and policies	Social responsibility
12-16	Quality of Life - Community Well-being	1	Culturally sensitive employment policies that support the Indigenous workforce will be implemented (e.g., having an Elder representative at the Project site to provide cultural programming).	12.2.5	All phases	QMS and policies	Social responsibility
12-17	Quality of Life - Infrastructure and Services	1	Air transportation will be used to transport most workers between the Project site and designated pick-up and drop-off points in communities.	12.3.5	All phases	QMS and policies	Social responsibility
12-18	Quality of Life - Infrastructure and Services	1	All drivers serving the Project will receive appropriate training related to the nature of materials being transported, including driver training to the highest standards based on the transportation of nuclear substances.	12.3.5	All phases	QMS and policies	Social responsibility
12-19	Quality of Life - Infrastructure and Services	1	Vehicles transporting dangerous goods and/or hazardous products will display required placards and labels in accordance with provincial legislation and will follow designated highway corridors.	12.3.5	All phases	QMS and policies	Social responsibility
12-20	Quality of Life - Infrastructure and Services	1	An Emergency Response Plan will be developed in case there is a spill during the transportation of dangerous goods and/or hazardous products.	12.3.5	All phases	QMS and policies	Social responsibility
12-21	Quality of Life - Infrastructure and Services	1	All materials transported by truck will be compliant with any weight restrictions or permits, spring road restrictions, or geometric constraints set out by the Saskatchewan MOHI.	12.3.5	All phases	QMS and policies	Social responsibility
12-22	Quality of Life - Infrastructure and Services	1	Denison will maintain Project roads and the main access road to the site.	12.3.5	All phases	QMS and policies	Social responsibility
12-23	Quality of Life - Infrastructure and Services	1	Require Denison truck traffic to slow to 40 km/hr for a minimum of 2.5 km on either side of the culture camp(s) in September and October (dates may be adjusted at the communities' direction).	12.3.5	All phases	QMS and policies	Social responsibility
12-24	Quality of Life - Infrastructure and Services	1	Immunization programs may be administered through the on-site health team.	12.3.5	All phases	QMS and policies	Social responsibility
12-25	Quality of Life - Infrastructure and Services	1	Workforce education will be provided to encourage healthy lifestyles.	12.3.5	All phases	QMS and policies	Social responsibility
12-26	Quality of Life - Infrastructure and Services	1	Ongoing communication between Denison, LSA communities, and relevant authorities (e.g., RCMP, health and service providers) to provide updates, discuss any Project-related concerns, and make sure that the required resources are in place	12.3.5	All phases	Ongoing engagement	Social responsibility

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12-27	Quality of Life - Infrastructure and Services	1	Mandatory safety orientations will be held for contractors and workers.	12.3.5	All phases	QMS and policies	Social responsibility
12-28	Quality of Life - Infrastructure and Services	1	Health and safety management programs will be developed for Construction, Operation, and Decommissioning.	12.3.5	All phases	QMS and policies	Social responsibility
12-29	Quality of Life - Infrastructure and Services	1	Workers will be trained in fuel handling, equipment maintenance, and fire prevention and response measures.	12.3.5	All phases	QMS and policies	Social responsibility
12-30	Quality of Life - Infrastructure and Services	1	Project-specific contingency, emergency response, and spill prevention plans will be developed to reduce the likelihood and severity of accidents and potential fires.	12.3.5	All phases	QMS and policies	Social responsibility
12-31	Quality of Life - Infrastructure and Services	1	Based on the outcomes of discussions with COI, Denison may provide support and/or training to local emergency services to make sure that staff are adequately prepared in the unlikely event of an accident, malfunction, or spill on Highways 914 or 165. This may include the provision of speciality materials or equipment to deal with an emergency response.	12.3.5	All phases	QMS and policies	Social responsibility
13-1	Economics	1	Denison, through a Human Resource Management Plan, will initially prioritize Indigenous and non-Indigenous communities in the LSA in terms of employment and training opportunities (anticipated to be in institutions in northern Saskatchewan) and will work with the leadership of these communities to assist in determining hiring and training practices during all phases of the Project, which could include such items as on-the-job training and career counselling to help with advancement from foundational positions, advance sharing of job qualification requirements, clearly identifying training requirements and working with various training institutions to make sure such appropriate training is available, and creation of scholarship and support programs. Priority for employment and training will then focus on Indigenous and non-Indigenous residents of the RSA and then beyond the RSA.	13.4	All phases	QMS and policies	Social responsibility
13-2	Economics	1	Denison will establish a procurement approach throughout all phases of the Project, prioritizing the procurement of goods and services for the Project toward businesses based within the LSA communities prior to looking elsewhere in northern Saskatchewan, southern Saskatchewan, and/or outside of Saskatchewan. This procurement approach may consider advance sharing of purchasing requirements of goods and services throughout all phases of the Project, efforts to increase the capacity and capabilities of businesses to increase successful bidding outcomes, and the development of a business registry.	13.4	All phases	QMS and policies	Social responsibility
13-3	Economics	1	Denison will plan a workforce transition plan prior to Decommissioning of the mine.	13.4	All phases	QMS and policies	Social responsibility
13-4	Economics	1	Denison has previously compensated a trapper potentially affected by exploration activities in and around the Project based on the potential for commercial loss, who has since passed away. This will be assessed going forward based on the potential for the Project to negatively effect commercial loss, and where appropriate, Denison will compensate accordingly.	13.4	All phases	QMS and policies	Social responsibility
13-5	Economics	1	Denison will negotiate with the Province of Saskatchewan to develop the Project’s Surface Lease Agreement and the Human Resource Development Agreement, which will outline measures in relation to socio-economic parameters related to the Project.	13.4	All phases	QMS and policies	Regulatory requirement; Social responsibility
14-1	Accident and Malfunctions	1	With respect to design related mitigation commitments the accidents and malfunctions assessment identified the following: • Secondary containment in fuel storage and dispensing areas • Firefighting system • Onsite traffic control (speed limits, signage)	14.0	All phases (as appropriate)	QMS; Engineering Design	FUP commitment; Regulatory commitment (includes EMS, plans/procedures; Acts, Regs); Social

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			• Preventive and routine maintenance for vehicles • Storage inspection, maintenance (for infrastructure, including related to ISR operations) • Primary and secondary containment for drilling mud • Freeze wall (as a secondary containment feature) • Freeze wall monitoring • Lined collection ponds • Site grading to collection areas • Collection pond sized to accommodate PMP • Traffic control measures • Ambient air monitoring (releases to air) • Containment (with reference to stored chemicals) • Remote monitoring systems (for piping systems for ISR well field) • Pipes in trenches and secondary containment for ISR well field • No open drain from pumphouse (for ISR well field) • Redundancy in design (for ISR well field and freeze wall) • Control of pump and injection wells (for ISR well field and freeze wall) • Production plant containment, process sumps and secondary containment • Production plant ventilation • Line pad (clean rock storage) • Surface water monitoring • Groundwater monitoring • Double lined pad (special waste pad) • Leak detection (special waste pad) • Line pad (gypsum [clean] ppt) • Wind erosion control measures (gypsum [clean] ppt) • Double lined pad (iron [contaminated] ppt) • Leak detection (iron [contaminated] ppt) • Piping design pressure higher than pumps shutoff pressure (WTP) • Process monitoring (WTP) • Secondary containment (WTP clarifier) • Recirculation of off-spec water to the process (WTP) • Ponds designed for PMP/PMF (water management infrastructure) • Fencing (of ponds to exclude wildlife) • Secondary containment (electrical transformers) • Redundancy (fire protection system)				responsibility commitment

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
14-2	Accident and Malfunctions	1	With respect to Programs the accidents and malfunctions assessment identified the following: • Quality Management Program • Occupational Health and Safety Program • Radiation Protection Program • Environmental Protection Program • Emergency Preparedness and Response Program • Fire Safety Program • Maintenance Program • Wellfield and Surface Water Program	14.0	All phases (as appropriate)	QMS; Engineering Design	FUP commitment; Regulatory commitment (includes QMS, plans/procedures; Acts, Regs); Social responsibility commitment
14-3	Accident and Malfunctions	1	With respect to Plans the accidents and malfunctions assessment identified the following: • Occupational health and safety plan • Personnel training and orientation plan • Spill management and response plan • Spill management and emergency response plan • Fire safety plan • Travel management plan (traffic • Air traffic control plan (for air traffic) • Ground traffic control plan (for air strip) • Wildlife management plan • Waste management plan • Radiation protection plan • Traffic and transportation plan	14.0	All phases (as appropriate)	QMS; Engineering Design	FUP commitment; Regulatory commitment (includes EMS, plans/procedures; Acts, Regs); Social responsibility commitment
14-4	Accident and Malfunctions	1	With respect to Procedures the accidents and malfunctions assessment identified the following: • Process monitoring and operational procedures • Wellfield development and control procedures • Security procedures • Environmental monitoring procedures • Personnel training procedures • Regular and preventive inspection and testing procedures • Surface water and flood management procedures	14.0	All phases (as appropriate)	EMS; Engineering Design	FUP commitment; Regulatory commitment (includes EMS, plans/procedures; Acts, Regs); Social responsibility commitment
14-5	Accident and Malfunctions	1	Denison is open to considering jointly (with Cameco and Highways) to develop a dusting monitoring plan during the six months of the year when the roads have no snow/ice cover.	TRC 104	All phases	EMS (Transportation Management)	

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
14-6	Accident and Malfunctions	1	Denison will validate emergency response plan documentation associated with the transport of dangerous goods developed by third-party contractors responsible for that transport.	TRC 113	All phases	EMS (Transportation Management, Transportation of Dangerous Goods)	
14-7	Accident and Malfunctions	1	Denison will assess radiological dose to workers that may result from Accident and Malfunction Assessment Bounding Scenarios involving vehicular accidents resulting in releases of radioactivity to the aquatic (see Section 14.6.1 of the EIS) and terrestrial (see Section 14.6.7 of the EIS) environments as part of the licensing process.	IR-216	All phases	Licensing	Regulatory commitment (includes EMS, plans/procedures; Acts, Regs)
15-1	Effects of the Environment on the Project	1	Denison would be an industrial and commercial operator as defined in section 2(l) of *The Wildfire Act* and would have fire suppression obligations pursuant to section 19. This includes responsibility for initially controlling and extinguishing a wildfire burning within a part of designated lands on which the Project actively being conducted or is located. Denison must also submit a wildfire prevention and preparedness plan annually before the start of both the construction and operational phases of the Project in accordance with Section 20 of *The Wildfire Act*. The wildfire prevention and preparedness plan will include details outlined in *The Wildfire Act* including, but not limited to: a description of measures to be taken to protect infrastructure and assets from a wildfire threat, a map showing the location of work activities, the camp and its layout, road access, fuel types, water sources and the location of wildfire suppression equipment.	Section 15 / TRC 21, TRC-23, TRC-24, TRC-25	All phases	EMS (Fire Protection Program)	Regulatory commitment (*The Wildfire Act*)
15-2	Effects of the Environment on the Project	1	Denison understands that if major fires are present along the transportation route, then there may be temporary delays of material to and from the site. Denison would, if necessary, issue a no-travel order in the event that potentially serious or unsafe road conditions could contribute to a traffic accident (e.g., forest fires in proximity transportation routes). The Project will be able to operate safely during any temporary delays in transportation. In terms of worker health and safety while forest fire smoke is present, Denison will consider this through the Occupational Health and Safety Program. Information on how the Project will prepare for and addresses emergencies that may affect the health and safety of persons, the environment, and the protection of property related to forest fires will be included in the Emergency Preparedness and Response Program. Additionally, Project plans related traffic, travel, and transportation will be developed through the permitting and licensing processes as the Project moves forward and transportation management as related to extreme events (including fire) would be considered in these plans.	TRC-116	All phases	EMS (Fire Protection Program, Occupational Health and Safety Program, Emergency Preparedness and Response Program)	Regulatory commitment
15-3	Effects of the Environment on the Project	1	Denison will develop an Emergency Preparedness and Response Program for the Project to address forest fires and extreme weather that may occur.	Section 15.3, 15.4, and 15.5	All phases	EMS (Fire Protection Program, Occupational Health and Safety Program, Emergency Preparedness and	Regulatory commitment

ID (EIS Section-chronological number)	VC/KI (as applicable; related to mitigations)	Last Updated (register version)	Details of Commitment	EIS Section or IR/TRC	Project Phase	Commitment Tracker Method	Scope of Commitment
						Response Program)	

Table 3-2: Denison's Commitments to the Public, Indigenous Nations and Communities

ID	Last Updated (register version)	Details of Commitment	Commitment to	Documented In	Project Phase	Commitment Tracker Method	Scope of Commitment
01	1	Denison has previously compensated a trapper potentially affected by exploration activities in and around the Project based on the potential for commercial loss, who has since passed away. This will be assessed going forward based on the potential for the Project --to negatively effect commercial loss, and where appropriate, Denison will compensate accordingly.	The ERFN Trapper	Section 4, Appendix 4-B and Section 13.3	All phases	QMS and policies	Social responsibility
02	1	In 2023, ERFN and Denison concluded an Agreement in respect of the Project that provides, among other matters, various procedural and substantive commitments by Denison to ERFN and the support and consent of ERFN for the development and operation of the Project in a sustainable manner which respects ERFN's inherent, Aboriginal and Treaty rights, advances reconciliation with Indigenous peoples, and provides economic opportunities and other benefits to ERFN.	ERFN	Section 4.3.2.1.2	All phases	QMS and policies Ongoing engagement	Social responsibility
03	1	Denison is committed to engagement with ERFN where input will be solicited and opportunity for document review will be provided, as necessary, for the Environmental Management Program, including development of the Heritage Resource Management Plan, Emergency Preparedness and Response Plan, and Environmental Effects Monitoring Programs. Denison and ERFN have an agreed upon process for such activities in the future.	ERFN	Section 4.3.2.1.4 Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
04	1	Prior to executing decommissioning activities, Denison shall prepare and submit a detailed decommissioning plan (DDP) to regulators for acceptance. In this case the DDP would reflect input that will be solicited from ERFN and others prior to its submission and would also be informed by conditions on the ground at the Project site at that time, operational experience that has been gained and the regulatory landscape at that time. The decommissioning plan, including the mining area decommissioning objectives, will evolve over time becoming more detailed and specific as the Project advances. Denison is committed to working with ERFN to solicit input through this process.	ERFN	Section 4, Appendix 4-B,	Prior to decommissioning	QMS and policies	Social responsibility, Regulatory requirement
05	1	Denison is committed to continued dialogue with ERFN on the details related to the sale, transport, off-site processing, and final disposal of the process precipitates.	ERFN	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
06	1	Effluent-based and receiver-based monitoring plans will be developed as the Project moves forward and Denison is committed to working with ERFN in that process.	ERFN	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
07	1	Denison is committed to including a consultation element with ERFN in the Heritage Management Plan, should an artifact be found during the development of the Project.	ERFN	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility

ID	Last Updated (register version)	Details of Commitment	Commitment to	Documented In	Project Phase	Commitment Tracker Method	Scope of Commitment
08	1	Denison is committed to working with ERFN to understand how follow-up programs might be executed at the community level to address community perspectives.	ERFN	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
09	1	Denison will work with ERFN to align the ERA updates and reviews of those updates as recommended.	ERFN	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
10	1	To address potential concerns specific to Project related effects to wildlife species of interest to the Indigenous Communities of Interest (COIs), Denison has committed to collaborating with ERFN and KML on a monitoring regime suited to each of their interests and needs. As part of this program, Denison and the Indigenous COIs will be sharing information in an agreed upon fashion, about agreed-upon species of interest.	ERFN, KML, NVP	Response to FIRT IR-129	All phases	QMS and policies Ongoing engagement	Social responsibility
11	1	Denison continues to work with its Indigenous Communities of Interest and has committed to collaborating with ERFN and KML on a community specific monitoring regime, suited to each of their interests and needs, in an agreed-upon fashion. Denison is committed to continual improvement in relation to such collaborative monitoring programs, in order to adapt to areas of interest which can change over time. It is expected that the data collected through such monitoring regimes would also be relevant to other Indigenous nations who may have interest in the Project.	ERFN, KML, NVP	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
12	1	Denison continues to work with its Indigenous Communities of Interest and has committed to collaborating with ERFN and KML on details and updates to the decommissioning plan which includes mining area remediation plans and associated post-decommissioning modelling of groundwater from the remediated mining area, suited to each of their interests and needs. As part of these updates, Denison and the Indigenous community of ERFN and KML will be sharing information in an agreed-upon fashion. It is expected that updates to the decommissioning plan and groundwater modelling would also be relevant to other Indigenous nations who may have an interest in the Project.	ERFN, KML, NVP	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
13	1	Denison continues to work with its Indigenous Communities of Interest and has committed to collaborating with ERFN and KML on a community specific monitoring regime, suited to each of their interests and needs. Denison has committed to engagement with ERFN and KML as it relates to effluent discharge criteria, suited to each of their interests and needs.	ERFN, KML, NVP	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility
14	1	Denison will establish an Emergency Preparedness and Response Program to identify how the Project will prepare for and addresses emergencies that may affect the health and safety of persons, the environment, and the protection of property.	ERFN, KML, NVP	Section 4, Appendix 4-B	All phases	QMS and policies	Social responsibility
15	1	Denison is committed to providing Indigenous people and businesses with sustainable economic opportunities and benefits and sharing the economic benefits of Denison's business activities.	ERFN, KML, NVP	Section 4, Appendix 4-B	All phases	QMS and policies	Social responsibility
16	1	Denison’s vision in respect of this concern is that Denison and KML work together as partners in discussions about highways with the Provincial Government. However, in respect of actions Denison can undertake	KML, NVP	Section 4, Appendix 4-B and Section 12.3.5	All phases	QMS and policies Ongoing engagement	Social responsibility

ID	Last Updated (register version)	Details of Commitment	Commitment to	Documented In	Project Phase	Commitment Tracker Method	Scope of Commitment
		regarding traffic along the road at times important for the undertaking of cultural activities, Denison commits to (Section 12): 1) Assisting KML with the clear identification of the forthcoming culture camp along highway 914 (providing clear signage) 2) Having Project vehicle slow down to 40km/hr from mid-August to mid-October, during the times when KML members may be using the portion of the road near the culture camp. To be specific, this includes 2.5km before the entry into the culture camp, and 2.5km after the entry into the culture camp.					
17	1	Denison and the YNLR have identified the need to further discuss how cumulative effects was undertaken in relation to the Project and have each committed to meeting in the first quarter of 2024.	YNLR	Section 4.3.4.2.5	All phases	Ongoing engagement	Social responsibility
18	1	Denison acknowledges that the Hatchet Lake Denesųłiné First Nation has the potential for established Indigenous and Treaty Rights proximal to the Project. The Hatchet Lake Denesųłiné First Nation, as represented by the YNLR will be identified as an Indigenous COI in the revised draft and final EIS, including in Section 3, Section 4, and Section 11.	YNLR	Section 4, Appendix 4-B	All phases	EIS (revised draft and final versions)	Social responsibility
19	1	Denison continues to work with its Indigenous Communities of Interest. Denison is committed to continual improvement in relation to such collaborative monitoring programs, in order to adapt to areas of interest which can change over time. YNRL will be informed throughout the monitoring program design and implementation process.	YNLR	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility
20	1	Denison has been collaboratively working with the Nuhenéné through the YNLR office in a mutually agreed upon manner and will continue to do so.	YNLR	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility
21	1	A Capacity Funding Agreement was signed with the MN-S to complete a Métis Knowledge Study by the end of October 2023. As part of this study agreement, Denison agreed to fully fund the Métis Knowledge Study. Denison received the Métis Knowledge Study from the MN-S on October 24, 2023. Denison has updated the revised draft and final EIS to include relevant information in the assessment from the Métis Knowledge Study.	MN-S	Section 4, Appendix 4-B	All phases	EIS (revised draft and final versions)	Social responsibility
22	1	Denison has updated the revised draft and final EIS executive summary to acknowledge that the Project falls within the MN-S Homeland.	MN-S	Section 4, Appendix 4-B Executive summary	All phases	EIS (revised draft and final versions)	Social responsibility
23	1	The specific details related to hazardous waste management will be documented as part of the overall waste management program that will be developed as the Project advances from the environmental assessment process into licensing and permitting. Hazardous wastes will be managed consistent with regulatory requirements, using licensed third-party waste management/haulage providers and licensed waste management facilities. Denison will inform the MN-S and relevant locals when such documentation has been prepared through engagement mechanisms in place at that time.	MN-S	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
24	1	Denison continues to engage with the MN-S at their direction, inclusive of engagement in NR1 and NR3 and is committed to such engagement with respect to decommissioning planning, mitigation, and monitoring.	MN-S	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility

ID	Last Updated (register version)	Details of Commitment	Commitment to	Documented In	Project Phase	Commitment Tracker Method	Scope of Commitment
25	1	Denison has been discussing the interests and concerned identified by PCBN on an on-going basis since March of 2023, and will continue to share information regarding the Project.	PCBN	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility
26	1	Denison is committed to collaborating with Indigenous peoples and communities to build long-term, respectful, trusting, and mutually beneficial relationships. With respect to using Kitsaki-owned businesses to support Denison's activities, Denison is proud of the work we have done to date with Kitsaki Management-owned companies including CanNorth and Northern Resource Trucking and understand the opportunities for further work in the future as the Project progresses. Denison also understand the interests in general employment opportunities at the Project once approval is received to proceed and are happy to have already received the contact information for the Community Relations Liaison Officer for Lac La Ronge Indian Band (LLRIB). This helpful contact will ensure that we have a fulsome listing of entities to which employment opportunities can be shared over the next while. Further, we understand as a company working in northern Saskatchewan, Denison wishes to respect and support efforts and initiatives that our neighbours, such as LLRIB feel are important.	LLRIB	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
27	1	The plans within the air quality management program will incorporate monitoring requirements directed by provincial and federal regulators and by Indigenous groups and other Interested Parties as requested.	BNDN	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
28	1	BNDN will be informed throughout the monitoring program design and implementation process.	BNDN	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility
29	1	Denison will work with Indigenous COIs to understand culturally important periods relative to harvest times and cultural camps to facilitate Indigenous employees taking time off to participate in such activities.	Indigenous COIs	Section 4, Appendix 4-B and Section 12.1.5	All phases	Ongoing engagement	Social responsibility
30	1	Denison, through a Human Resource Development Plan, will initially prioritize Indigenous and non-Indigenous communities in the LSA in terms of employment and training opportunities (anticipated to be in institutions in northern Saskatchewan) and will work with the leadership of these communities to assist in determining hiring and training practices during all phases of the Project, which could include such items as on-the-job training and career counselling to help with advancement from foundational positions, advance sharing of job qualification requirements, clearly identifying training requirements and working with various training institutions (such as Northlands College) to make sure such appropriate training is available, and creation of scholarship and support programs. Priority for employment and training will then focus on Indigenous and non-Indigenous residents of the RSA and then beyond the RSA.	LSA communities	Section 4, Appendix 4-B and Appendix 4-C Section 13.4	All phases	QMS and policies	Social responsibility
31	1	Denison will establish a procurement approach throughout all phases of the Project, prioritizing the procurement of goods and services for the Project toward businesses based within the LSA communities prior to looking elsewhere in northern Saskatchewan, southern Saskatchewan, and/or outside of Saskatchewan. This procurement approach may consider advance sharing of purchasing requirements of goods and services throughout all	LSA communities	Section 4, Appendix 4-B and Appendix 4-C and Section 13.4	All phases	QMS and policies	Social responsibility

ID	Last Updated (register version)	Details of Commitment	Commitment to	Documented In	Project Phase	Commitment Tracker Method	Scope of Commitment
		phases of the Project, efforts to increase the capacity and capabilities of businesses to increase successful bidding outcomes, and the development of a business registry.					
32	1	Denison remains committed to maintaining positive relationships with Indigenous communities and will be open to discussion on any issues or concerns that arise over the course of the Project.	All	Section 4.2 and Section 4.3 Section 4, Appendix 4-B, Appendix 4-C	All phases	Ongoing engagement	Social responsibility
33	1	Access north of the Key Lake gatehouse on Highway 914 is restricted and provides for controlled access for employees of northern mines, Indigenous resource harvesters from select communities, cabin owners, and lease holders.	All	Section 4, Appendix 4-B, Appendix 4-C Section 12.1 and Section 12.3	All phases	QMS and policies	Social responsibility
34	1	Mitigation measures associated with potential effects to cultural continuity (including knowledge transfer and language) are described in Section 12.1.5 and include: • Implementation of Denison's Indigenous Peoples Policy and advancement of reconciliation • Using a commuter rotation system has also shown to be effective in allowing Indigenous employees continued opportunities to spend time on the land, and important factor in the transmission of knowledge and language. Encouragement to speak languages of choice while at the site, except during safety sensitive situations, will be made.	All staff	Section 4, Appendix 4-B and Section 12.1.5	All phases	QMS and policies	Social responsibility
35	1	Denison will provide space for an on-site Elder counsellor to provide culturally relevant programing and support.	All staff	Section 12.2.5	Operations	QMS and policies	Social responsibility
36	1	Pick-up points will be located at two locally central points in communities within the LSA, one additional site in northern Saskatchewan, and potentially other locations to minimize time spent away from families.	All staff	Section 12.2.5	Operations	QMS and policies	Social responsibility
37	1	Services and programs will be provided on-site and will be accessible to workers. These services and programs may alleviate pressures on social and health services within LSA communities.	All staff	Section 12.3.5	Operations	QMS and policies	Social responsibility
38	1	Health and wellness programming will be established on-site, including recreation options. Health promotion and on-site health care programming will be designed to reflect the needs and interests of the workforce and may include tobacco cessation, health and stroke awareness, diabetes awareness, mental health and additions support, cancer awareness, and nutrition awareness, among others.	All staff	Section 12.3.5	Operations	QMS and policies	Social responsibility
39	1	Programming may include the development of life skills programming to address issues such as coping with stressful situations and/or managing personal finances.	All staff	Section 12.3.5	Operations	QMS and policies	Social responsibility
40	3	Denison has committed to collaborating with YNLR in respect to woodland caribou monitoring plans, groundwater monitoring plans, and other environmental monitoring plans aligning with specific areas of interest expressed by YNLR.	YNLR	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility

ID	Last Updated (register version)	Details of Commitment	Commitment to	Documented In	Project Phase	Commitment Tracker Method	Scope of Commitment
41	3	Denison has committed to sharing information on environmental monitoring plans as they develop, to support collaboration on monitoring plans of specific interest to YNLR.	YNLR	Section 4, Appendix 4-B	All phases	QMS and policies Ongoing engagement	Social responsibility
42	3	Denison has committed to considering local and traditional knowledge in all facets of the Project, to the extent that local knowledge holders wish to share such information.	YNLR	Section 4, Appendix 4-B	All phases	Ongoing engagement	Social responsibility

4 References

Canadian Council of Ministers of the Environment (CCME). 2015. Guidance Manual for Optimizing Water Quality Monitoring Program Design. PN 1543 ISBN 978-1-77202-020-5 PDF, 2015. ccme.ca/en/res/guidancemanualforoptimizingwaterqualitymonitoringprogramdesign_1.0_e.pdf

Canadian Council of Ministers of the Environment (CCME). 2000. Canadian Tissue Residue Guidelines for the Protection of Wildlife Consumers of Aquatic Biota – Methylmercury. Canadian Environmental Quality Guidelines.

Canadian Nuclear Safety Commission (CNSC). 2023. Letter J. Way (CNSC) to J. Switzer (Denison) *RE: Results of the Federal-Indigenous Review Team technical review of the October 21st, 2022. Draft Environmental Impact Statement Submission for the proposed Wheeler River Project*. e-Doc: 6991467. March 20, 2023.

CSA Group. 2019. *N288.4-19 – Environmental monitoring programs at nuclear facilities and uranium mines and mills*.

CSA Group. (2019). Technical guide: Development, interpretation and use of rainfall intensity- duration-frequency (IDF) information: Guideline for Canadian water resources practitioners. CSA PLUS 4013:19. https ://www.csagroup.org/store/product/2703080/

Denison Mines Corp. (Denison). 2022. Wheeler River Project. Draft Environmental Impact Statement. October 2022.

Environment Canada. 2012. *Metal Mining Technical Guidance for Environmental Effects Monitoring*. Cat. No.: En14-61/2012E-PDF.

Government of Canada. 2022. Metal and Diamond Mining Effluent Regulations, SOR/2002-222.

Saskatchewan Ministry of Environment, Environmental Assessment Branch (SK EAB). 2021. Guidelines for the Terms of Reference and Environmental Impact Statement. November 2021.

United States Environmental Protection Agency (US EPA). 2021. *2021 Revision* to: Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater 2016. Report No. EPA 822-R-21-006*.

Operational Policy Statement: Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under CEAA 2012

This document provides guidance on federal environmental assessments commenced under the former *Canadian Environmental Assessment Act, 2012*. It is retained for the completion of transitional environmental assessments commenced prior to the *Impact Assessment Act*. For more information on transitional environmental assessments, please consult the Legislation and Regulations page.

Canadian Environmental Assessment Agency

November 2015

Document Information

Disclaimer

This Operational Policy Statement (OPS (Operational Policy Statement)) is for information purposes only. It is not a substitute for the *Canadian Environmental Assessment Act, 2012* (CEAA (Canadian Environmental Assessment Act) 2012) or its regulations. In the event of an inconsistency between this OPS (Operational Policy Statement) and CEAA (Canadian Environmental Assessment Act) 2012 or its regulations, CEAA (Canadian Environmental Assessment Act) 2012 or its regulations would prevail.

For the most up-to-date versions of CEAA (Canadian Environmental Assessment Act) 2012 and regulations, please consult the Department of Justice website.

Updates

This document may be reviewed and updated periodically. To ensure that you have the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

This document is also available in Adobe's Portable Document Format [PDF (Adobe Acrobat document) - 192 KB (kilobytes)].

Table of Contents

1.0 Purpose

This document supports the implementation of *Canadian Environmental Assessment Act, 2012* (CEAA (Canadian Environmental Assessment Act) 2012) provisions related to determining whether a designated project is likely to cause significant adverse environmental effects. Specifically, it provides guidance on how to apply the provisions when the Canadian Environmental Assessment Agency (the Agency) is the responsible authority.

The document informs the preparation of Agency documents such as the Environmental Impact Statement (EIS (environmental impact statement)) Guidelines and the Environmental Assessment (EA (environmental assessment)) report. It is intended to support proponents of designated projects in the preparation of an EIS (environmental impact statement), in conjunction with other Agency policy and guidance instruments. It also provides direction to Agency employees throughout the EA (environmental assessment) of a designated project in their interactions with those engaged in federal EA (environmental assessment)s, such as proponents, review panel members, federal authorities, other jurisdictions, Aboriginal groups and the public.

2.0 Application

This document is intended for use in an EA (environmental assessment) of a designated project for which the Agency is the responsible authority, including EA (environmental assessment)s by review panel.

When the National Energy Board (NEB) is the responsible authority, direction and guidance can be found in the NEB filing manual. Applicants seeking guidance on nuclear projects should refer to the Canadian Nuclear Safety Commission’s regulatory framework.

The term “project” refers to designated projects under CEAA (Canadian Environmental Assessment Act) 2012 for which the Agency is the responsible authority, and “project EA (environmental assessment)” refers to the EA (environmental assessment) of designated projects conducted under CEAA (Canadian Environmental Assessment Act) 2012 for which the Agency is the responsible authority.

Throughout the document, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA (Canadian Environmental Assessment Act) 2012.

This guidance replaces the Agency’s 1994 *Reference Guide: Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects* and is for application under CEAA (Canadian Environmental Assessment Act) 2012. The 1994 reference guide will continue to apply for project EA (environmental assessment)s initiated under the former *Canadian Environmental Assessment Act* and are being completed under the transitional provisions of CEAA (Canadian Environmental Assessment Act) 2012.

3.0 Relevant Provisions of CEAA (Canadian Environmental Assessment Act) 2012

Section 5 of CEAA (Canadian Environmental Assessment Act) 2012 describes the environmental effects that must be considered in the implementation of the legislation.

Section 19 specifies the factors to be taken into account in the EA (environmental assessment) of a designated project, including the environmental effects described in section 5 and the significance of these effects. This includes cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out, as well as environmental effects of accidents and malfunctions that may occur in relation to the designated project. Section 19 also requires that the EA (environmental assessment) of a designated project take into account mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects.

For projects where the Agency is the responsible authority, subsection 52(1) requires the Minister of the Environment (the Minister) to decide if, taking into account the implementation of any mitigation measures the Minister considers appropriate, the project is likely to cause significant adverse environmental effects referred to in section 5. Should the Minister decide that a project is likely to result in significant adverse environmental effects, subsection 52(2) calls for referral to the Governor in Council for a decision on whether those effects are justified in the circumstances.

As per section 54 of CEAA (Canadian Environmental Assessment Act) 2012, the Minister must issue an EA (environmental assessment) decision statement to the proponent of a designated project. The decision statement includes the decision of whether significant adverse effects are likely to occur and any conditions, established under section 53 with which the proponent must comply.

4.0 Determination of Significance under CEAA (Canadian Environmental Assessment Act) 2012

Determining whether a project is likely to cause significant adverse environmental effects (often referred to as determination of significance) is central to the practice of project EA (environmental assessment). The determination of significance includes considering whether the predicted environmental effects are adverse, significant and likely. A proponent, the Agency or a review panel may make a determination of significance in the course of a project EA (environmental assessment). Such determinations of significance are separate from, but may inform, the decision made by the Minister under subsection 52(1) of CEAA (Canadian Environmental Assessment Act) 2012.

When a project is predicted to have adverse environmental effects, as defined in section 5 of CEAA (Canadian Environmental Assessment Act) 2012, the EA (environmental assessment) examines whether the project is likely to cause significant adverse environmental effects after taking into account the implementation of technically and economically feasible mitigation measures.

This OPS (Operational Policy Statement) describes how the determination of significance is nested within the environmental assessment framework (EA (environmental assessment) framework) and explains the approach recommended by the Agency for reaching a determination on significance. Guidance is also provided on information requirements, documentation needed to support the determination of significance and on roles relative to decision-making.

Environmental Assessment Framework

Environmental effects are commonly identified by comparing the current state (health, status or condition) of a Valued Component (VC (Valued Component)) to the predicted future state of the VC (Valued Component) with the project in place. VC (Valued Component)s are selected to focus the assessment of section 5 environmental effects, taking into account direction provided by the Agency, or in the case of an EA (environmental assessment) by review panel, by the Agency or the Minister.

The information collected and considered for each VC (Valued Component) (including information from Aboriginal communities and the public) is processed through the EA (environmental assessment) framework. This iterative framework consists of the following steps: scoping, analysis, mitigation, significance, and follow-up (further described in Appendix 1).

The determination of whether a project is likely to cause significant adverse environmental effects (step 4 in the EA (environmental assessment) framework) relates to the residual adverse environmental effects. A residual adverse environmental effect is an adverse environmental effect of a project that remains, or is predicted to remain, after mitigation measures have been implemented.

Significance is determined for each residual adverse environmental effect using VC (Valued Component)s to focus information gathering on each effect.

Proponents are expected to determine whether their project is likely to cause significant adverse environmental effects in their EIS (environmental impact statement) with respect to the residual adverse environmental effects. This requirement is outlined in the EIS (environmental impact statement) Guidelines issued by the Agency for each project EA (environmental assessment).

Such determinations must be made for project-specific effects and for any cumulative environmental effects. Both of these determinations, documented in the EA (environmental assessment) report or panel report, are taken into account in the decision made by the Minister under section 52 of CEAA (Canadian Environmental Assessment Act) 2012.

The determinations must take into account uncertainties. All project EA (environmental assessment)s involve some level of uncertainty, and observed results will often deviate, to some degree, from predictions made in the EA (environmental assessment). Uncertainty could be related to a number of factors such as: project design and components, baseline environmental conditions, VC (Valued Component) response, effectiveness of mitigation, overall scope of effects, and natural and human causes of accidental events.

The level of effort applied to the determination of significance is established on a case-by-case basis using the same factors as the overall EA (environmental assessment), i.e.:

- the characteristics of the project;
- the potential environmental effects;
- the state (health, status or condition) of VC (Valued Component)s that may be impacted by the environmental effects;
- the potential for mitigation and the extent to which mitigation measures may address potential environmental effects; and,
- the level of analysis required to address issues raised by Aboriginal groups or the public.

5.0 Approach

This approach is nested within the significance step of the EA (environmental assessment) framework (see Appendix 1, step 4)

The recommended approach to determining if a designated project is likely to cause significant adverse environmental effects consists of three stages:

- Stage 1: Determining whether the residual environmental effects are **adverse**;
- Stage 2: Determining whether the residual adverse environmental effects are **significant**;
- Stage 3: Determining whether the significant adverse environmental effects are **likely**.

This approach is carried out for each potential environmental effect.

Stage 1: Adverse

Only residual environmental effects that are adverse are considered in the determination of significance under CEAA (Canadian Environmental Assessment Act) 2012. Identification of these effects is the result of the scoping, analysis and mitigation steps of the EA (environmental assessment) framework (steps 1-3 in Appendix 1). The identification of residual adverse environmental effects applies to the full life cycle of the project: construction, operation, decommissioning and abandonment of the project.

An adverse environmental effect can be described in qualitative or quantitative terms. Examples of adverse environmental effects for generic VC (Valued Component)s that may be linked to section 5 of CEAA (Canadian Environmental Assessment Act) 2012 are listed below.

Examples:

- Loss of fish or fish habitat
- Migratory bird mortality
- Decline in the health, status, or condition of marine plants
- Reductions in species diversity or abundance of marine animals

- Reduction in air quality on federal lands or in another province during project operation
- Loss of, or damage to, habitats, including habitat fragmentation that would affect the current use of lands and resources for traditional purposes by Aboriginal peoples
- Negative impacts on human health, such as contamination of country food relied upon by Aboriginal peoples
- Loss of, or damage to, physical and cultural heritage resources of Aboriginal peoples (e.g., changes to sites of cultural importance) during project construction
- Loss of, or damage to, Aboriginal historical, archaeological, paleontological, or architectural resources

Stage 2: Significant

This stage involves considering if the residual adverse environmental effects identified in stage 1 are significant for each potentially affected VC (Valued Component).

Key criteria (further described in Appendix 2) that should be considered in this stage include:

- Magnitude;
- Geographic extent;
- Timing;
- Frequency;
- Duration; and
- Reversibility.

Other criteria may also be considered provided that they are described and a rationale for their use is documented. In the case of a proponent seeking to ensure proper documentation of such project-specific criteria, discussion with Agency staff is recommended.

The extent to which an individual criterion will influence the determination of significance will vary depending on the VC (Valued Component) under consideration, the nature of the project and its potential environmental effects, as well as the context.
Example: A migratory bird may interact with the construction phase of a project during a short period of time every year and within a small portion of its habitat. If the interaction occurs during its breeding period and in its breeding habitat, it may be more harmful than an interaction occurring during other times of the year or in other parts of its habitat.

The ecological and social context within which potential environmental effects may occur should be taken into account when considering the key criteria above in relation to a particular VC (Valued Component), as the context may help better characterize whether adverse effects are significant. For example, information on the context is useful when it reveals:

- a unique characteristic of the area (e.g., proximity to park lands, ecologically critical or fragile areas, valuable heritage resources);
- unique values or customs of a community that influence the perception of an environmental effect (including cultural factors);
- a VC (Valued Component) that is important to the functioning of an ecosystem, ecological community or community of people; or
- a VC (Valued Component) for which a target has been established.

Activities over the life-cycle of the project should be considered. For example planned decommissioning activities may influence the criteria. As well, it is important to note that the environmental effects may extend beyond the period of physical interaction between the project activity and VC (Valued Component).

Stage 3: Likely

The determination of likelihood is based on consideration of probability and uncertainty, and is considered only when it is established through stage 2 that one or more predicted residual adverse effects are significant.

The probability of an environmental effect occurring may be based on knowledge and experience with similar past environmental effects. The full life cycle of a project, including its various stages and lifespan, should also be considered in determining the probability of occurrence of an effect.

6.0 Implementation Guidance

The following guidance is provided to assist in clarifying information requirements, documentation, and how the determination of significance informs decision-making.

Information requirements

The Agency issues EIS (environmental impact statement) Guidelines to proponents specifying the nature, scope and extent of the information and analysis required for the preparation of the EIS (environmental impact statement). In an EA (environmental assessment) by review panel, the Minister determines the scope of the factors to be taken into account. The Agency, Minister or review panel may also issue information requests to a proponent seeking additional clarification, the collection of information, and the undertaking of studies, if necessary.

Community knowledge and Aboriginal traditional knowledge can contribute to the determination of significance. The public and Aboriginal groups can provide information, offer a different interpretation of the facts or question the conclusions put forward during an EA (environmental assessment) process.

EA (environmental assessment) practitioners should use qualitative or quantitative information in determining the confidence level associated with a prediction that supports the determination of significance, e.g. the range within which a predicted value lies within a stated degree of probability.

Documentation

Practitioners are expected to develop clear descriptions of what would be considered a significant adverse environmental effect on a VC (Valued Component). The determination of significance should be presented in a rational, defensible way, and the reasons for the determination should be clearly documented, including the following:

- A residual environmental effect should take into account the predicted effectiveness of proposed mitigation measures and any uncertainties associated with these measures.
- Practitioners should submit analysis of each of the key criteria presented in Appendix 2, as well as any other criteria used in the determination of significance. A rationale must be presented if a particular criterion is deemed not relevant.
- The analysis of likelihood of the significant adverse environmental effects should provide sufficient detail, to substantiate how conclusions were reached.
- The degree of scientific uncertainty related to the data and methods used within the framework of the environmental analysis should be described.

Decision-making: Roles and Responsibilities

The proponent is responsible for providing the necessary information to assess significance and to provide conclusions on determination of significance. This is done through the EIS (environmental impact statement), as well as subsequent responses to information requirements, where applicable.

The Agency or review panel examines the proponent's information and conclusions on determination of significance, as well as other perspectives on significance received during the EA (environmental assessment) process. The Agency or review panel then outlines its rationale and conclusions on determination of significance in the EA (environmental assessment) report or the panel report. These conclusions may align with, or may differ from, those presented by the proponent.

The EA (environmental assessment) report or panel report is considered by the Minister in making the decision under subsection 52 (1) of CEAA (Canadian Environmental Assessment Act) 2012.

Appendix 1: Environmental Assessment Framework

Step 1: Scoping

Identification of the initial focus of an environmental assessment including: the identification of VC (Valued Component)s, potential environmental effects, and spatial and temporal boundaries; and the examination of other physical activities that may contribute to cumulative environmental effects.

Step 2: Analysis

Data collection or generation through means such as surveys, literature reviews, on-site testing, community knowledge and Aboriginal traditional knowledge, and a clear description of methods used to predict environmental effects.

Step 3: Mitigation

Identification of technically and economically feasible measures to mitigate any significant adverse effects by reduction, elimination or control or, when these forms of mitigation are not possible, restitution measures such as replacement, restoration or compensation.

Step 4: Significance

Development of conclusions about whether a project is likely to result in significant adverse effects, taking into account the implementation of any mitigation measures.

Step 5: Follow-up

Development of a program to verify the accuracy of the EA (environmental assessment) of a designated project and/or the effectiveness of mitigation measures.

Appendix 2: Key Criteria for Determination of Significance

As outlined in stage 2 of the approach for determining significance, in addition to the criteria outlined below, EA (environmental assessment) practitioners should also consider the ecological and social context within which the potential residual adverse environmental effect may occur, in determining significance.

Magnitude

Magnitude refers to the amount of change in a measurable parameter relative to baseline conditions or other standards, guidelines or objectives (e.g., proportion of species habitat affected, number of lost hunting days).

The magnitude of an environmental effect should be expressed in measureable or quantifiable terms, whenever possible. There may be multiple measureable parameters relevant to a VC (Valued Component). When using quantitative or qualitative descriptions of magnitude, clear definitions of terms should be provided. The definition of these terms may vary according to the VC (Valued Component) under consideration. For example, if using categories such as “low”, “moderate” or “high” each category should be clearly defined, and the rationale for identifying an environmental effect as being a low, moderate or high magnitude should be clearly documented.

Some considerations that may influence the evaluation of the magnitude of an effect include:

- natural variability, normal fluctuations, or shifts in baseline conditions;
- scale at which magnitude is considered (for example, the percentage of a population affected may represent 80% at a local level and 5% at the

regional level);

- resiliency of the VC (Valued Component) and surrounding area to change (for example, considering whether especially vulnerable segments of the VC (Valued Component) are affected); and
- whether the VC (Valued Component) has already been adversely affected by other physical activities or natural change.

Geographic extent

Geographic extent refers to the spatial area over which the environmental effect is predicted to occur. Typical qualitative scales for characterizing geographic extent include site specific, local, regional, provincial, national or global. Prediction of the geographic extent should be quantitative whenever possible (e.g. hectares of habitat change). The traditional territories of potentially affected Aboriginal groups should be considered where relevant.

Depending on the VC (Valued Component), it may be important to take into account the extent to which adverse environmental effects caused by the project may occur in areas far removed from it (e.g. the long-range transportation of atmospheric pollutants).

Timing

Timing considerations should be noted when it is important in the evaluation of the environmental effect (e.g. when the environmental effect could occur during breeding season, or during a period of species migration through the area). It may also be relevant to discuss variation in timing of project activities, such as reservoir level fluctuations, and how that may cause varying environmental effects.

For non-biophysical environmental effects, it is important to take into account seasonal aspects of land and resource use and whether timing is related to Aboriginal spiritual and cultural considerations.

Frequency

Frequency describes how often the environmental effect occurs within a given time period (e.g., alteration of aquatic habitat will occur twice per year).

Frequency should be described using quantitative terms where possible, such as daily, weekly or number of times per year. It may also be described qualitatively as rare, sporadic, intermittent, continuous, or regular. If using qualitative terms, these should be defined for each VC (Valued Component).

Duration

Duration refers to the length of time that an environmental effect is discernible (e.g. day, month, year, decade, permanent). This can refer to the amount of time required for the VC (Valued Component) to return to baseline conditions, through mitigation or natural recovery (e.g. vegetation re-colonization, return of wildlife to an area where habitat was avoided due to disturbance).

The duration of the environmental effect may be longer than the duration of the activity that caused the environmental effect. For example, the discharge of a substance into a water body may occur only during operation of a project, but the environmental effect to aquatic biota may last beyond the operational lifespan of the project. In this example, if the discharge is continuous throughout operation and results in reduced fish populations, then the frequency of the environmental effect is continuous and the duration spans operation and post-operation up to the point where fish populations return to baseline.

Environmental effects may not occur immediately following the activity causing them, but these effects still need to be considered. For example when a new reservoir is created there will be a delay before increases in methyl mercury concentrations occur in fish. Similarly, the effect on the intergenerational transfer of knowledge in an Aboriginal community may not be observed for many years after a project disrupts a specific traditional use of the land.

Reversibility

A reversible environmental effect is one where the VC (Valued Component) is expected to recover from the environmental effects caused by the project. This would correspond to a return to baseline conditions or other target (e.g., a population management objective, remediation target), through mitigation or natural recovery within a reasonable timescale.

Reversibility is influenced by the resilience of the VC (Valued Component) to imposed stresses and the degree of existing stress on that VC (Valued Component).

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Canadian Water Quality Guidelines for the Protection of Aquatic Life

AMMONIA

Ammonia (CAS # 7664-41-7, atomic mass 17.03) is a colourless alkaline gas which has a pungent suffocating odour at ambient temperature and pressure (WHO 1986; CCREM 1987). It freezes at -77.8°C and boils at -33.35°C, and is often stored or shipped in liquified form (Geadah 1985).

Ammonia is an important component of the nitrogen cycle and because it is oxidized in the environment by microorganisms (i.e., nitrification), it is a large source of available nitrogen in the environment (Raven & Johnson 1989). The complexity of the nitrogen cycle, various rate determining environmental conditions for nitrification (e.g., pH, temperature), and the physical behaviour of ammonia (e.g., volatilization, adsorption) make determining the fate of ammonia in the environment extremely complex. Ammonia can form explosive mixtures with air at concentrations between 16 and 27% by volume, but is generally regarded as non-flammable (WHO 1986; Geadah 1980). Ionized ammonium salts form when ammonia dissolves in dilute acids. Some of these salts are found in nature (water, soil, atmosphere) (WHO 1986).

Ammonia is highly soluble in water and its speciation is affected by a wide variety of environmental parameters including pH, temperature, and ionic strength. In aqueous solutions, an equilibrium exists between un-ionized (NH_3) and ionized (NH_4^+) ammonia species. Un-ionized ammonia refers to all forms of ammonia in water with the exception of the ammonium ion (NH_4^+) (Environment Canada 1997; CCREM 1987). Ionized ammonia refers to the ammonium ion. The term 'total ammonia' is used to describe the sum of ammonia (NH_3) and ammonium (NH_4^+) concentrations and may also be expressed as 'total ammonia-nitrogen', due to the slightly different relative molecular masses (Environment Canada 1997; CCREM 1987; WHO 1986).

In Canada, the Haber-Bosch process is the key commercial method of ammonia production. In this process, a catalyst is used to speed up the reaction between hydrogen and nitrogen (in a 3-to-1 ratio) combined under high pressure and high temperature (approximately 600°C) to produce ammonia (Harding 1959; Geadah 1985; Environment Canada 1997).

Total domestic demand for ammonia in Canada in 1996 and 1997 was approximately 3508 kt and 3535 kt, respectively. 1277 kt and 1226 kt of ammonia were exported in 1996 and 1997, respectively (CPI 1998). Ammonia is used in numerous applications in the refrigeration, pulp and paper, mining, food processing, refining, and animal husbandry sectors (Environment Canada 1997; Environment Canada 1992). The principal use of ammonia is the production of nitrogenous fertilizers (ammonium nitrate, ammonium phosphate, urea, and ammonium sulphate). In the agriculture industry, anhydrous ammonia is directly

Table 1. Water quality guidelines for un-ionized ammonia for the protection of aquatic life.

Aquatic life	Guideline value (mg·L)
Freshwater	0.019
Marine	NRG[1]

[1] No recommended guideline

Table 2. Water quality guidelines for total ammonia for the protection of aquatic life (mg·L^{-1} NH_3).

Temp (°C)	pH							
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10
0	231	73.0	23.1	7.32	2.33	0.749	0.250	0.042
5	153	48.3	15.3	4.84	1.54	0.502	0.172	0.034
10	102	32.4	10.3	3.26	1.04	0.343	0.121	0.029
15	69.7	22.0	6.98	2.22	0.715	0.239	0.089	0.026
20	48.0	15.2	4.82	1.54	0.499	0.171	0.067	0.024
25	33.5	10.6	3.37	1.08	0.354	0.125	0.053	0.022
30	23.7	7.50	2.39	0.767	0.256	0.094	0.043	0.021

* The guideline values and all reported total ammonia concentrations in this factsheet are reported in mg/L NH_3; measurements of total ammonia in the aquatic environment are often also expressed as mg/L total ammonia-N. The present guideline values (mg/L NH_3) can be converted to mg/L total ammonia-N by multiplying the corresponding guideline value by 0.8224.
** Values falling outside of shaded area should be used with caution.
*** No recommended guideline for marine waters.

applied to fields and ammonia is injected into animal feed to increase its nutrient value (Environment Canada 1997; Environment Canada 1992).

In the textile industry, ammonia is used in the fabrication of synthetic fibres (such as nylon and rayon), and as a curing agent in leather making (Environment Canada 1997). The health care industry uses ammonia in the manufacture of pharmaceuticals, vitamins, amino acids, lotions, and cosmetics. The household chemical industry uses ammonia for the manufacturing of cleansing agents and detergents (Environment Canada 1999). In addition, ammonia is used in the production of many goods including explosives, rocket fuel, beer, plastics, rubber, nitrogen oxides required for manufacturing sulphuric acid, in sugar purification, and in the treatment and transformation of metals (Chemical and Engineering News 1980, as cited in WHO 1986; Environment Canada 1997).

Ammonia commonly enters the environment as a result of municipal, industrial, agricultural, and natural processes. Natural sources of ammonia include the decomposition or breakdown of organic waste matter, gas exchange with the atmosphere, forest fires, animal waste, human breath, the discharge of ammonia by biota, and nitrogen fixation processes (Environment Canada 1997; Geadah 1985).

Point sources of ammonia include emissions and effluents from a wide variety of industrial plants such as iron and steel mills, fertilizer plants, oil refineries, and meat processing plants (Environment Canada 1997; CCREM 1987; WHO 1986). The manufacturing of explosives and the use of explosives in mining and construction can also be significant point sources of ammonia (Pommen 1983, as cited in CCREM 1987). The largest non-industrial point sources are sewage treatment plants (Environment Canada 1999). Accidental ammonia spills are a major anthropogenic source of ammonia entering the Canadian environment (Environment Canada 1992). An ammonia spill can occur during the production, processing, storage, application, or disposal stage of the chemical's life cycle (Environment Canada 1992). Environment Canada ranked ammonia as the top priority on the Environment Canada 1990 Canadian Chemical Spill Priority List. Additionally, the Major Industrial Accidents Council of Canada (MIACC) has identified ammonia as a priority substance (Environment Canada 1992). From 1974 to 1984, there were 107 reported spills of anhydrous ammonia (a total of 46 t), which accounted for 5.5% of all chemical spills in Canada during that time. From 1985 to 1990 there were 92 reported ammonia spills. The number of spills may be higher, as spill reports to the National Analysis of Trends in Emergencies System (NATES) are voluntary (Environment Canada 1992).

Non-point sources of ammonia include agricultural, residential, municipal, and atmospheric releases. Major agricultural sources include areas with intensive farming, accidental releases or spills of ammonia-rich fertilizer, and the decomposition of livestock wastes (Environment Canada 1992; WHO 1986). Residential and municipal sources of ammonia include the use and disposal of cleansing agents that contain ammonia, improper disposal or accidental spills of ammonia products, and urban runoff (Environment Canada 1997; WHO 1986). Combustion processes such as the burning of municipal waste, emissions from sewage treatment plants, domestic heating, the decay of vegetation, and the production and use of chemical fertilizers increase atmospheric concentrations of ammonia. Mobile sources of ammonia to the atmosphere arise from all forms of transportation (Environment Canada 1997).

The National Pollutant Release Inventory (NPRI 1996) states that, in 1996, 32 037 metric tonnes of ammonia were released into the Canadian environment from reporting industries. Of all the substances reported, ammonia was ranked second in total amount released. Approximately 56% of the ammonia was released to air, 24% released underground, 18% to water, and 2% to land. Due to the reporting requirements of the NPRI, some large anthropogenic sources (municipal sewage treatment plants, transportation systems, and animal husbandry systems) are excluded from these totals.

The main factors that influence the equilibrium between un-ionized and ionized ammonia are pH and temperature (Environment Canada 1999; Jofre and Karasov 1999; EPA 1998). Raising pH by one unit can cause the un-ionized ammonia concentration to increase nearly tenfold, while a $5^{o}C$ temperature increase can cause an increase of 40-50% (Environment Canada 1999). Emerson et al. (1975) examined data on ammonia-water equilibrium systems and prepared calculations for pKa at different temperatures and percent NH_3 in ammonia solutions as a function of pH and temperature. Two equations were developed:

EQUATION 1.

$$pKa = 0.0901821 + 2729.92 / T$$

Where,

T = Temperature in K; Absolute zero = - 273.15 ^{o}C

T (in K) = T (in ^{o}C) + 273.15

EQUATION 2.

$$f = 1 / [10^{(pKa - pH)} + 1]$$

Where,

f = fraction of total ammonia that is un-ionized
pKa = dissociation constant from equation 1

Using the equations above, a table describing the percent of NH_3 in low ionic strength water for temperatures (0 – 30^{o}C) and pH (pH= 6 – 10) is presented (Table 3). The ionic strength of the water is also an important influence on the un-ionized ammonia concentration. As the ionic strength increases in hard or marine waters, there is a decrease in the un-ionized NH_3 concentration (Environment Canada 1997; Emerson et al. 1975). Freshwater systems with up to 200 - 300 mg· L^{-1} total dissolved solids may have a negligible reduction in percent NH_3. The effect of ionic strength is much smaller than the effects of temperature and pH (Soderberg and Meade 1991).

Table 3. Percent un-ionized aqueous ammonia solutions for 0-30^{o}C and pH 6-10 (Emerson et al. 1975)

Temp (^{o}C)	pH								
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10
0	0.008	0.026	0.082	0.261	0.820	2.55	7.64	20.7	45.3
5	0.012	0.039	0.125	0.394	1.23	3.80	11.1	28.3	55.6
10	0.018	0.058	0.186	0.586	1.83	5.56	15.7	37.1	65.1
15	0.027	0.086	0.273	0.859	2.67	7.97	21.5	46.4	73.3
20	0.039	0.125	0.396	1.24	3.82	11.2	28.4	55.7	79.9
25	0.056	0.180	0.566	1.77	5.38	15.3	36.3	64.3	85.1
30	0.080	0.254	0.799	2.48	7.46	20.3	44.6	71.8	89.0

In surface waters, both nitrification and volatilization are important competitive fate processes for ammonia (Environment Canada 1999). Volatilization increases with increasing wind speed, temperature, and pH. In addition, the partial pressure of ammonia in solution increases with increasing pH, and in aqueous solutions, ammonia may form complexes with a number of metal ions. It may be sorbed onto suspended and bed sediments and to colloidal particles. Ammonia may also be exchanged between sediments and overlying water. Ammonia concentrations in water vary seasonally and regionally. In natural waters, concentrations of total ammonia are generally less than 0.1 mg·L^{-1}. Higher levels of ammonia are generally indicative of organic pollution (McNeely et al. 1979 as cited in WQB 1989).

The data on Canadian environmental concentrations presented below have been selected from a database prepared by Environment Canada in support of the Second Canadian Environmental Protection Act Priority Substances List (CEPA PSL II) assessment for ammonia (Environment Canada 1998). Detection limits were often not reported in the database.

From 1993 to 1996, concentrations of dissolved ammonia in twenty rivers sampled in the Northwest Territories ranged from 0.0002 to 0.294 mg·L^{-1} (n=521), with an average concentration of 0.0148 mg·L^{-1}. Total ammonia sampled from two rivers in the Northwest Territories waters ranged from 0.002 to 0.19 mg·L^{-1} (n=4) (Environment Canada 1998).

Concentrations of dissolved ammonia collected from 165 rivers and lakes across British Columbia between 1990 and 1996 ranged from ND (not detected) to 180 mg·L^{-1} (n=5135), with an average concentration of 0.689 mg·L^{-1}. The maximum concentration was detected in the Fraser River at a hydro station south of Mission City in 1993. Total ammonia levels from 32 water bodies in British Columbia ranged from ND to 8.4 mg·L^{-1} (n=2129), with an average concentration of 0.0858 mg·L^{-1} (Environment Canada 1998). Similarly, concentrations of total ammonia sampled from 232 waterbodies in the province of Alberta between 1990 and 1996 ranged between ND and 10.2 mg·L^{-1} (n=2599), with an average concentration of 0.183 mg· L^{-1} (Environment Canada 1998). Dissolved ammonia concentrations from 414 rivers and lakes in Alberta ranged between ND and 8.8 mg·L^{-1} (n=1929), with an average concentration of 0.110 mg·L^{-1} (Environment Canada 1998).

In 1987, total ammonia concentrations in the South Saskatchewan River, 140 m below the outfall diffuser of Saskatoon's sewage treatment plant outfall, reached a maximum of 4.26 mg·L^{-1} (WQB 1989). For five kilometres downstream of the sewage treatment plant outfall, a few of the transects had mean total ammonia concentrations within the effluent plume that surpassed the Saskatchewan Surface Water Quality Objective for total ammonia for the protection of aquatic life of 0.44 mg·L^{-1} (WQB 1989).

Total ammonia concentrations in Ontario between 1994 and 1996 ranged from 0.001 mg·L^{-1} at several locations to 16.5 mg·L^{-1} at Hayward Creek downstream from Molson and Lim Lakes, with an average concentration of 0.144 mg·L^{-1}, and an average pH of 7.92 (Environment Canada 1998). Concentrations of total ammonia ranged between 0.375 and 0.938 mg·L^{-1} in stormwaters monitored in Ontario between 1985 and 1986 (Marsalek and Ng 1989). In 1987-88, distributions of ammonia, nitrite, and total dissolved nitrogen were measured in Hamilton Harbour, Lake Ontario. In the spring and summer seasons, levels of un-ionized ammonia in Hamilton Harbour surpassed the International Joint Commission (IJC) objective of 20 µg·L^{-1} at all sampling sites (NWRI 1990). Loadings of total ammonia from multiple sources in Hamilton Harbour were estimated to be 7500 kg/day (DOE-MOE 1989, as cited in NWRI 1990). Approximately 70% (5300 kg/day) of the total loading in 1987 was released by the Hamilton sewage treatment plant. Other sources of ammonia to Hamilton Harbour include steel industries and combined sewer overflows (NWRI 1990). Since the late 1970s and early 1980s, total quantities of ammonia in Hamilton Harbour have been greatly reduced. For example, reductions in the total ammonia loading from steel industries, alone, decreased from 24000 kg/day in 1967 to 857 kg/day by 1987. However, the reductions from the municipal sewage treatment plants were less noticeable.

Water samples from 206 river sampling stations in Quebec indicated that total ammonia concentrations ranged from ND to 15.9 mg·L^{-1} (n=2035), with an average concentration of 0.103 mg·L^{-1}. Samples of total ammonia collected from 62 lake sampling stations in Quebec ranged from 0.01 to 0.82 mg $^{-1}$, with an average concentration of 0.082 mg·L^{-1} (Environment Canada 1998). No dates were reported for the samples collected in Quebec. Between 1981 and 1985, the average concentration of total ammonia sampled from 276 lakes in Nova Scotia was 0.09 mg·L^{-1}. Ammonia levels ranged from <0.01 mg·L^{-1} to a maximum level of 0.3 mg·L^{-1} (Environment Canada 1998).

Concentrations of ammonia in the atmosphere in urban areas typically vary from 5 – 25 µg·m^{-3} and in rural areas between 2-6 µg·m^{-3}. Agricultural areas with a high use or production of manure may release ammonia concentrations between 100 - 200 µg·m^{-3}. Particulate ammonium concentrations have been detected above oceans at levels ranging from 0.01-0.1 µg·m^{-3} (WHO 1986).

Water Quality Guideline Derivation

The Canadian water quality guidelines for un-ionized and total ammonia for the protection of aquatic life (Tables 1 and 2) were developed using the CCME protocol (CCME 1991) and the community ecological risk criteria from Environment Canada (1999). It should be noted that due to the paucity of ammonia toxicity data on marine organisms; currently, there is insufficient information to adequately derive a full or interim guideline for the protection of marine life. As a result, no marine guideline is recommended.

Freshwater Life

There are several factors that are known to affect the toxicity of ammonia in freshwater. These factors may have an effect on the concentrations of un-ionized ammonia in water or impact directly on the organism making it more or less susceptible to ammonia (Environment Canada 1999). Factors shown to affect ammonia toxicity include pH, temperature, dissolved oxygen concentration, ionic strength, salinity, previous acclimatization to ammonia, fluctuating or intermittent exposure, and the presence of other toxic substances (Environment Canada 1997). Of these, pH is thought to be the most important factor influencing ammonia toxicity.

The speciation of ammonia is very important to understanding ammonia toxicity. As un-ionized ammonia is known to be more toxic than the ammonium ion, the influence of pH and temperature, on the relative proportion of ionized and un-ionized ammonia, in particular is important. It is thought that un-ionized ammonia is more toxic to aquatic organisms because it is a neutral molecule and is therefore able to diffuse across biological membranes more readily than other forms (EPA 1998).

There is a substantial body of data available on the toxicity of ammonia to aquatic organisms, in particular acute, chronic, and sub-lethal effects of ammonia in fish. Less information is available on the toxicity of ammonia to invertebrates and benthic organisms. Mean 48- and 96-hr LC_{50} values reported for freshwater invertebrates and fish ranged from 1.10 to 22.8 mg·L^{-1} for invertebrates and from 0.56 to 2.37 mg·L^{-1} for fish species (Environment Canada 1999). Several authors have suggested that the ammonium ion may contribute to the toxicity of total ammonia especially at low pH (Borgmann 1994; Thurston et al. 1981; Armstrong et al. 1978). However, the weight-of-evidence suggests that the un-ionized fraction is the best indicator of ammonia toxicity

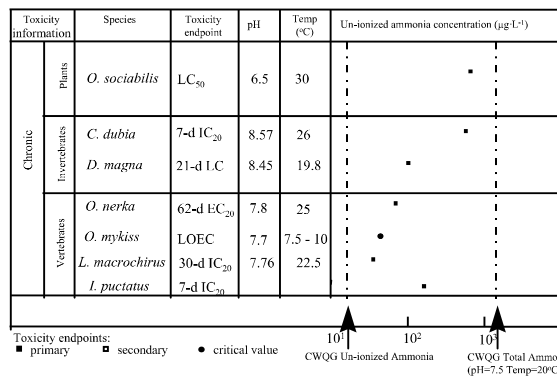
(Environment Canada 1999; Frias-Espericueta et al. 1999; EPA 1998).

Ochromonas sociabilis, a freshwater alga, was exposed to ammonia concentrations to observe the effect of ammonia on growth and mortality (Bretthauer 1978). Un-ionized ammonia concentrations ranging from 0.06 to 0.15 mg·L^{-1} had an insignificant effect on growth. Concentrations of 0.015 to 0.03 mg·L^{-1} were found to enhance alga growth. Development was reduced at 0.3 mg·L^{-1} of NH_3 and mortality was observed at 0.6 mg·L^{-1}. Nimmo et al. (1989) conducted a 7-day life-cycle test on water fleas (*Ceriodaphnia dubia*). Test conditions included water from the St. Vrain River, Colorado at 25°C and pH 7.8. An EC_{20} (# of neonates per original female) of 15.2 mg·L^{-1} total ammonia was calculated using regression analysis and square root transformation (EPA 1998). The total ammonia concentration can be converted to un-ionized ammonia using the equations (EQ 1 & 2) from Emerson et al. (1975). Using this approach, the EC_{20} is 0.525 mg·L^{-1} for un-ionized ammonia.

Rainbow trout (*Oncorhynchus mykiss*) were tested for sensitivity to un-ionized ammonia (NH_3) concentrations ranging from 0.01 to 0.07 mg·L^{-1} over a period of 5 years (Thurston et al. 1984). No correlation between ammonia concentration and number of eggs produced was observed in the parental generation. Pathological lesions in the gills and extensive tissue degradation in the kidneys were directly correlated with ammonia concentrations above 0.04 mg·L^{-1}, after 4 months of exposure.

Sockeye salmon (*Oncorhynchus nerka*) were exposed to total ammonia for 62 day from fertilization to hatching (Rankin 1979). Concentrations of un-ionized ammonia were calculated and ranged from 0.00097 - 4.92 mg NH_3 L^{-1} at 10°C and pH 8.2 and hatchability was the measured endpoint. Hatchability was 63.3%, 49% and 0% in controls, at 0.12 mg·L^{-1}, and 0.46 mg·L^{-1}, respectively. An EC_{20} was calculated for this study by Environment Canada (1999) with correction for control mortality. The reported EC_{20} was 0.057 mg·L^{-1} un-ionized ammonia. Bader and Grizzle (1992) exposed catfish (*Ictalurus punctatus*) fry to ammonia in a 7-day static renewal test. An IC_{20} for fry growth was determined by Environment Canada (1999) at 0.162 mg·L^{-1} un-ionized ammonia. There was no incremental mortality up to 0.490 mg·L^{-1}exposure. Smith et al. (1984) conducted a 30-day early life-stage test on bluegill sunfish (*Lepomis macrochirus*). The test exposed 28-day old embryos and monitored them to the swim-up fry life stage. No significant reduction was found in percent of hatch up to a concentration of 37 mg·L^{-1} un-ionized ammonia, however, larvae were deformed and generally died within 6 days. An IC_{20} (survival and growth) of 0.060 mg·L^{-1} was calculated (Environment Canada 1998) for this study.

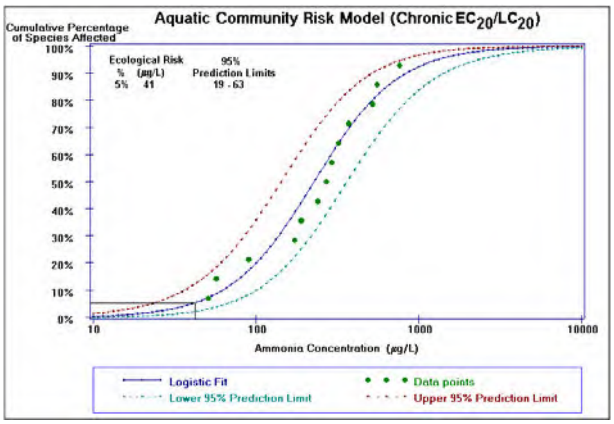
Figure 1. Select freshwater chronic toxicity data for un-ionized ammonia.



Un-ionized Ammonia (NH_3)

The most sensitive freshwater study identified was for the rainbow trout (*O. mykiss*). The reported lowest observed effect concentration (LOEC) for un-ionized ammonia in a five year chronic study is 0.04 mg·L^{-1}, exposure to this and higher concentrations resulted in pathological lesions in the gills and tissue degradation in the kidneys (Thurston et al. 1984). Consistent with this study, Environment Canada's (1999) aquatic community ecological risk criteria on the impact of ammonia at the community level of both invertebrates and fish indicated that 5% of the species in an aquatic community would exhibit a 20% reduction in growth or reproduction at an un-ionized ammonia concentration of 0.041 mg·L^{-1}. Thus, an identical low toxic threshold of 0.4 mg·L^{-1} was derived using two separate approaches namely the CCME Aquatic Life Protocol (CCME 1991) and a regression-based approach described in the ecological risk criteria for un-ionized ammonia (Environment Canada 1999). Following CCME protocol for the derivation of Water Quality Guidelines for the Protection of Aquatic Life (CCME 1991), the application of a safety factor to the designated low-threshold effects value should occur; however, the current protocol allows for deviation from the standard method of guideline development in cases where sufficient scientific weight of evidence permits. Such is the case for un-ionized ammonia. In the determination of the community ecological risk criteria (Figure 2), Environment Canada (1999) predicted 95% confidence intervals surrounding their sensitive ammonia data. The lower 95% prediction limit is 0.019 mg·L^{-1} and the upper 95% prediction limit is 0.063 mg·L^{-1} (Figure 2). Their analysis of the data using a two parameter logistic model produced an adequate model fit (i.e., < 5%) according to the goodness-of-fit statistic (G test). Therefore, based on this weight of evidence that has made use of the complete data envelope for un-ionized ammonia a safety factor is not applied to the most sensitive study (Thurston et al. 1984), but rather, the lower 95% prediction limit (0.019 mg·L^{-1}) will be set as the guideline.

Figure 2. Aquatic Community Risk Model (Environment Canada 1999).



Reprinted with permission from Miles Constable, Draft Ammonia CEPA Assessment 1999.

Total Ammonia ($NH_3 + NH_4^+$)

In order to derive a Water Quality Guideline for the Protection of Aquatic Life for total ammonia, a series of calculations are required to convert un-ionized ammonia to total ammonia. Equations for these calculations are provided by Emerson et al. (1975) and EPA (1998). The variability of pH and temperature on a nation-wide basis is substantial. The impact of these factors on the speciation of ammonia is an important consideration when deriving a Water Quality Guideline for the Protection of Aquatic Life. As a result, the total ammonia guideline is not a specific value, but rather a range of values over various pHs and temperatures. Table 2 provides total ammonia guidelines over a range of pH (6.0-10.0) and temperature (0-30 ºC) based upon the un-ionized ammonia guideline of 0.019 mg·L^{-1} and the equations presented in Emerson et al. (1975) and EPA (1998). It is recommended that the most conservative total ammonia guideline closest to the pH and temperature conditions of the waterbody be applied. Values falling outside of the pH and temperature ranges indicated in Table 2 should be used with caution because there was a lack of toxicity data to accurately determine the toxic effects at the low and high extremes of the reported ranges. In addition, results of the toxicity data that were available outside of the reported ranges (pH 6-10; temp. 0-30ºC) were often ambiguous and confounding. No safety factor is applied to these values based on the weight of evidence described above.

References

Armstrong, D.A., D. Chippendale, A.W. Knight and J.E. Colt. 1978. Interaction of ionized and un-ionized ammonia on short-term survival and growth of prawn larvae, *Macrobrachium rosenbergii*. Biological Bulletin (Woods Hole) 154:15-31.

Bader, J.A., and J.M. Grizzle. 1992. Effects of Ammonia on Growth and Survival of Recently Hatched Channel Catfish. J. Aquat. Animal Health 4:17-23.

Borgmann, U. 1994. Chronic toxicity of ammonia to the amphipod *Hyalella azteca*: Importance of ammonium ion and water hardness. Environ. Pollut. 86:329-335.

Bretthauer, R. 1978. Some ecological limits of tolerance to *Ochromonas sociabilis*. Verh. Internat. Verein. Limnol. 20(3):1850-1854.

CCME (Canadian Council of Ministers of the Environment). 1991. Appendix IX—A protocol for the derivation of water quality guidelines for the protection of aquatic life (April 1991). In: Canadian water quality guidelines, Canadian Council of Resource and Environment Ministers. 1987. Prepared by the Task Force on Water Quality Guidelines. [Updated and reprinted with minor revisions and editorial changes in Canadian environmental quality guidelines, Chapter 4, Canadian Council of Ministers of the Environment, 1999, Winnipeg.]

CCREM (Canadian Council of Resource and Environment Ministers). 1987. Canadian Water Quality Guidelines. Prepared for the Task Force on Water Quality Guidelines.

Chemical and Engineering News. 1980. C and EN's top fifty chemical products. Am. Chem. Soc. 16.

CPI (CPI Product Profiles). 1998. Ammonia. June 1998. Camford Information Services Inc. 38 Groemsport Cr., Scarborough, Ontario, M1T 2K9.

DOE-MOE. 1989. Remedial Action Plan for Hamilton Harbour. Draft Summary Report, March 1989. 162p.

Environment Canada (Environment Canada). 1999. Canadian Environmental Protection Act Priority Substances List II – Supporting document for Ammonia in the Aquatic Environment. DRAFT –August 31, 1999.

Environment Canada (Environment Canada). 1998. Canadian Water Quality Data for Ammonia. Provided by Miles Constable, Toxic Substances Division, Environment Canada, Edmonton, Alberta.

Environment Canada (Environment Canada). 1997. Problem formulation for Ammonia in the aquatic environment. Canadian Environmental Protection Act Priority Substances List 2. Version 5.0, November 4, 1997.

Environment Canada (Environment Canada). 1992. Canadian Environmental Protection Act – Ammonia Spills Assessment

Report. Draft Assessment #3, August 24, 1992. Environmental Emergencies Branch, Environment Canada. Ottawa, Canada.

Emerson, K., R.E. Lund, R.V. Thurston and R.C. Russo. 1975. Aqueous ammonia equilibrium calculations: effect of pH and temperature. J. Fish. Res. Board Can. 32: 2379-2383.

EPA (U.S. Environmental Protection Agency). 1998. 1998 Update of Ambient Water Quality Criteria for Ammonia. Office of Water. EPA 822-R-98-008. Washington, D.C. 148 p.

EPA (U.S. Environmental Protection Agency). 1985. Ambient Water Quality Criteria for Ammonia – 1984. PB85-227114. Washington, D.C.

Frias-Espericueta, M.G., M. Harfush-Melendez, J.I. Osuna-Lopez, F. Paez-Osuna. 1999. Acute toxicity of ammonia to juvenile shrimp *Penaeus vannamei* Boone. Bull. Env. Contam. Tox. 62:646-652

Geadah, M., 1985. National Inventory of Natural and Anthropogenic Sources and Emissions of Ammonia (1980). Environmental Protection Programs Directorate, Environmental Protection Service, Environment Canada Report EPS5/IC/1.

Harding, A.J. 1959. Ammonia manufacture and uses. London, Oxford University Press.

Jofre, M.B. and W.H. Karasov. 1999. Direct effect of ammonia on three species of North American anuran amphibians. Environ. Toxicol. Chem. 18(8):1806-1812.

Marsalek, J. and H.Y.F. Ng. 1989. Evaluation of pollution loadings from urban non-point sources: Methodology and applications, Journal Great Lakes Research, 15(3): 444-451.

McNeely et al. 1979. Water Quality Sourcebook: A guide to water quality parameters. Environment Canada publication, Ottawa, Ontario. Cited in WQB 1989.

Nimmo, D.W.R., D. Link, L.P. Parrish, G.J. Rodriguez, W. Wuerthele, and P.H. Davies. 1989. Comparison of on-site and laboratory toxicity tests: Derivation of site-specific criteria for un-ionized ammonia in a Colorado transitional stream. Environ. Toxicol. Chem... 8:1177-1189.

NPRI (National Pollutant Release Inventory). 1996. Summary Report, 1996. Environment Canada, Minister of Supply and Services Canada, Catalogue #EN40-495/1-1996E, ISBN #0-662-2672F9-X.

NWRI (National Water Research Institute). 1990. Ammonia and nitrite contamination of Hamilton Harbour, Lake Ontario. NWRI Contribution No. 90-29.

Pommen, L.W. 1983. The effect on water quality of explosives use in surface mining. Vol. 1 Nitrogen Sources, Water Quality, and Prediction and Management of Impacts. British Columbia Ministry of the Environment, Victoria, British Columbia, Tech. Rep. 4. cited in CCREM 1987

Rankin, D.P. 1979. The influence of un-ionized ammonia on the long-term survival of sockeye salmon eggs. Technical Report 9-12. Department of Fisheries and Oceans, Nanaimo, British Columbia, Canada.

Raven, P.H. & G.B. Johnson. 1989. Biology. Times Mirror/Mosby College Publishing. New York ISBN 0-8016-4041-5

Smith, W.E., T.H. Roush, and J.T. Fiandt. 1984. Toxicity of Ammonia to Early Life Stages of Bluegill (Lepomis macrochirus).EPA-600/x-84-175. In-house report, U.S. EPA, Duluth, MN.

Soderberg, R.W. and J.W. Meade. 1991. The effects of ionic strength on un-ionized ammonia concentration. Prog. Fish-Cult. 53:118-120

Thurston, R.V., C. Chakoumakos, and R.C. Russo. 1981. Effect of fluctuating exposures on the acute toxicity of ammonia to rainbow trout (*Salmo gairdneri*) and cutthroat trout (*S. clarki*). Water Res. 15:911-917.

Thurston, R.V., R.C. Russo, R.J. Luedtke, C.E. Smith, E.L. Meyn, C. Chakoumakos, K.C. Wang, and C.J.D. Brown. 1984. Chronic toxicity of ammonia to rainbow trout. Trans. Am. Fish. Society 113:56-73.

WHO (World Health Organization). 1986. Environmental Health Criteria 54. Ammonia. IPCS International Programme on Chemical Safety. Geneva, Switzerland. ISBN 92-4-154194-6.

WQB (Water Quality Branch). 1989. Ammonia and residual chlorine monitoring study – South Saskatchewan River at Saskatoon. July and August 1987. Saskatchewan Environment and Public Safety. WQB 116. Saskatoon, Saskatchewan.

Reference listing:

Canadian Council of Ministers of the Environment. 2010. Canadian water quality guidelines for the protection of aquatic life: Ammonia. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

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Recovery Strategy Series

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Woodland Caribou, Boreal population

2020

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Note: The Woodland Caribou, Boreal population is referred to as "boreal caribou" in this document.

For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

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[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

AMENDED RECOVERY STRATEGY FOR THE WOODLAND CARIBOU (*RANGIFER TARANDUS CARIBOU*), BOREAL POPULATION, IN CANADA (2020)

The Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada was posted on the Species at Risk Public Registry in October 2012 (Environment Canada, 2012a).

Under Section 45 of the *Species at Risk Act* (SARA), the competent Minister may amend a recovery strategy at any time. This Amended Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (hereafter, "amended recovery strategy") is for the purposes of:

- Identifying critical habitat in northern Saskatchewan's Boreal Shield range (SK1).
- Updating population and habitat condition information, based on information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).
- Other minor edits to update factual information and/or to improve internal consistency within the document.

At the time of final posting, this amended recovery strategy replaces the 2012 Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada (Environment Canada, 2012a).

PREFACE

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the Species at Risk (SAR) Public Registry.

The Minister of Environment and Climate Change and Minister responsible for the Parks Canada Agency is the competent minister under SARA for the Woodland Caribou, Boreal population, and has prepared both the 2012 Recovery Strategy and this amended recovery strategy, as per section 37 of SARA.

Environment and Climate Change Canada's Canadian Wildlife Service led the development of the 2012 Recovery Strategy. Seven provinces, two territories, one Indigenous government, four wildlife management boards and the Parks Canada Agency contributed information for the recovery strategy. Additional effort was made by Environment and Climate Change Canada to engage Indigenous communities that the minister considered directly affected by the recovery strategy. These efforts included two rounds of engagement, one before and the second one after the proposed recovery strategy was posted on the SAR Public Registry, to gather information on boreal caribou and to provide communities with an opportunity to comment on the proposed recovery strategy. In the first round, 271 Indigenous communities were contacted and 161 engaged, and in the second round, 265 Indigenous communities were contacted and 87 engaged. In addition, 25 formal submissions were received from Indigenous communities and organizations.

Following the posting of the proposed recovery strategy on August 26, 2011, the standard 60-day public comment period was extended by 120 days to February 22, 2012 as a result of Environment and Climate Change Canada's desire to consult Indigenous communities prior to finalizing the recovery strategy. The high level of interest in boreal caribou resulted in the submission of 19,046 comments during and subsequent to the public comment period. The majority of these were received as copies of form letters initiated by environmental group's campaigns. A total of 192 more detailed and/or technical submissions were received from governments, wildlife management boards, Indigenous communities and organizations, industry stakeholders, environmental organizations and academia.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected. Environment and Climate Change Canada's Canadian Wildlife Service also led the development of this amended recovery strategy in order to identify critical habitat in northern Saskatchewan's Boreal Shield range (SK1). The work completed for the amended recovery strategy was done in

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

collaboration with the Government of Saskatchewan, the Science and Technology Branch of Environment and Climate Change Change, and the Parks Canada Agency. Prior to posting the proposed amended recovery strategy on the Species at Risk Public Registry, 34 Indigenous communities and 31 Indigenous organizations/governments located within and adjacent to SK1 were invited to share information, comments and dialogue on the draft amendment to the recovery strategy. At the time of posting the proposed amendment, 11 communities and five organizations/governments participated in information sessions and/or meetings.

Landscape level planning is essential for the recovery of boreal caribou. Provinces and territories have the primary responsibility for management of lands, natural resources and wildlife within boreal caribou ranges; however, this responsibility does vary in some parts of the country. For example, in the Northwest Territories, the Tłı̨chǫ Government manages land and resources (including wildlife) within Tłı̨chǫ Lands, as described in the Tłı̨chǫ Agreement (a combined comprehensive land claims and self-government agreement). There are also wildlife management boards that have been established under land claims agreements as the primary instrument for wildlife management in some regions of the country.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that are or will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada and the Parks Canada Agency, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of boreal caribou and Canadian society as a whole.

This recovery strategy is being followed by range plans or other similar documents and/or action plans that provide information on recovery measures that are being or will be taken by provinces and territories, Environment and Climate Change Canada and the Parks Canada Agency, other federal departments, wildlife management boards, Indigenous communities, stakeholders, and other organizations, to achieve the survival and recovery of boreal caribou. Environment and Climate Change Canada, for its part, released its Action Plan for boreal caribou in February 2018, which sets out the measures that the Government of Canada is taking and will take to support the recovery of boreal caribou (Environment and Climate Change Canada, 2018). In addition to this Action Plan, Parks Canada Agency site-specific Action Plans that address boreal caribou conservation and recovery efforts on lands administered by the Agency can be found on the SAR Public Registry. Implementation of this recovery strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

ACKNOWLEDGEMENTS

Environment and Climate Change Canada would like to express its gratitude to the Indigenous people who shared their knowledge about boreal caribou in support of the recovery of this species. Knowledge was shared by Indigenous Knowledge holders and Indigenous communities and organizations on boreal caribou life history, habitat use, population status, threats facing the species and conservation measures, and this information has been used in the development of this recovery strategy (see Appendices B and C). Indigenous people consistently indicated that conservation of boreal caribou is essential, as this species is integral to the culture, identity and survival of their communities. The Indigenous Knowledge that was shared may also be used to support the development of range plans and/or action plans for boreal caribou, where consent for such use is granted. Environment and Climate Change Canada appreciates that so many Indigenous people were willing to share their knowledge and experiences to help in the recovery of this species.

Gratitude is also extended to federal, provincial and territorial jurisdictions, the Tłı̨chǫ Government, and wildlife management boards with management responsibility for boreal caribou, for generously sharing information and providing expertise to develop this recovery strategy. The Boreal Caribou Working Group, comprised of Environment and Climate Change Canada staff from across Canada, contributed extensively by working with Canadians to gather information and support processes to collect Indigenous Knowledge used to inform the development of this recovery strategy, and by compiling material and drafting the recovery strategy. Appreciation is extended to Environment and Climate Change Canada's Wildlife and Landscape Science Directorate (WLSD), the boreal caribou Science Management Committee and boreal caribou science advisors, for their extensive efforts and contribution to the recovery strategy through the provision of the 2008 Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada, and the Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada, 2011 Update. Thanks are also given to the National Boreal Caribou Technical Committee for providing advice and feedback on the science work that was undertaken by WLSD as part of the schedule of studies to inform the identification of critical habitat in northern Saskatchewan's Boreal Shield range (SK1). Acknowledgement and thanks are given to all other parties that provided advice and input used in the development of this recovery strategy, including the Species at Risk Advisory Committee (SARAC), Indigenous governments, communities and organizations, industry stakeholders, non-government organizations and academia.

EXECUTIVE SUMMARY

This recovery strategy is for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population herein referred to as “boreal caribou”, assessed in May 2002 as threatened and re-examined and confirmed as threatened in November 2014 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This document is an amended version of the boreal caribou recovery strategy published by Environment and Climate Change Canada under the title Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada (Environment Canada, 2012a). At the time of final posting, the final version of this amended recovery strategy will replace the 2012 Recovery Strategy.

Boreal caribou are distributed broadly throughout the boreal forest, occurring in seven provinces and two territories and extending from the northeast corner of Yukon east to Labrador and south to Lake Superior. Boreal Caribou require large areas comprised of continuous tracts of undisturbed habitat rich in mature to old-growth coniferous forest, lichens, muskegs, peat lands, and upland or hilly areas. Large areas with suitable quality habitat allow boreal caribou to disperse across the landscape when conditions are unfavorable (e.g. natural fire disturbance, anthropogenic disturbance) and to maintain low population densities to reduce their risk of predation.

The geographic area occupied by a group of boreal caribou that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame is referred to as a range. There are 51 boreal caribou ranges in Canada. Information available to delineate boreal caribou ranges varies in certainty and therefore ranges are categorized into three types: conservation units, improved conservation units and local population units. In this recovery strategy, the group of boreal caribou occupying any of the three types of ranges is referred to as a “local population” of boreal caribou.

Due to the specific life history characteristics they possess, boreal caribou are limited in their potential to recover from rapid, severe population declines. Habitat alteration (i.e. habitat loss, degradation, and fragmentation) from both anthropogenic and natural sources, and increased predation as a result of habitat alteration have led to local population declines throughout their distribution. Some local populations of boreal caribou are at risk because of other factors, mainly over-harvest. Threats are closely interrelated and act cumulatively to have direct or indirect impacts on boreal caribou and their habitat. Recovery of all boreal caribou local populations across Canada is technically and biologically feasible.

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Indigenous harvesting activities, consistent with existing Aboriginal and treaty rights. Ranges that are highly disturbed will take decades to recover from habitat alteration, as boreal caribou occur in mature boreal forest ecosystems that have evolved over centuries. Achieving this recovery goal for all local populations will take a number of decades.

To guide recovery efforts, the population and distribution objectives for boreal caribou across their distribution in Canada are, to the extent possible, to:

- Maintain the current status of the 15 existing self-sustaining local populations; and
- Stabilize and achieve self-sustaining status for the 36 not self-sustaining local populations.

Performance indicators are identified as a means by which progress towards achieving the population and distribution objectives can be measured. The critical habitat necessary to achieve the population and distribution objectives for the recovery and survival of boreal caribou is now fully identified within this amended recovery strategy, as critical habitat is identified for all 51 boreal caribou ranges.

Critical habitat was not identified in the Boreal Shield range (SK1) in the 2012 Recovery Strategy due to a lack of data on population size and trend, and the uniqueness of the disturbance regime (i.e. high fire and very low anthropogenic disturbance). As required under the *Species at Risk Act* (SARA), a schedule of studies was developed to identify critical habitat in SK1. That schedule of studies for SK1 is now complete.

Critical habitat for boreal caribou is identified as: i) the area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat in all ranges other than SK1, and a minimum of 40% undisturbed habitat in SK1; and ii) biophysical attributes required by boreal caribou to carry out life processes.

With the exception of SK1, this recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

The disturbance management threshold for SK1 is 40% undisturbed habitat in the range, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the SK1 local population will not be self-sustaining. Based on the best available information, SK1 is the first local population that is currently self-sustaining below the 65% undisturbed habitat threshold (based on 3 years of data). For this reason, and because of the uniqueness of the disturbance regime in SK1, a lower undisturbed habitat threshold has been identified for this range.

Environment and Climate Change Canada (2019) demonstrated that the SK1 local population is sensitive to small increases in anthropogenic disturbance and small decreases in adult survival. The analyses also showed that anthropogenic disturbance is not equivalent to fire, with the former having a stronger negative effect on population condition. Therefore, caution is warranted with respect to additional anthropogenic disturbance in this range. For SK1 critical habitat, activities that pertain specifically to increasing the level of anthropogenic disturbance in SK1 above 5% (while maintaining a minimum of 40% undisturbed habitat in the range) has been added to the list of factors that increase the likelihood that critical habitat will be destroyed. The range plan for SK1 should outline how total anthropogenic disturbance in the range will be maintained at or below 5%. In addition, the SK1 local population should continue to be monitored to ensure that future changes in range condition (fire and anthropogenic disturbance) do not compromise the ability of the range to support a self-sustaining local population.

The recovery of boreal caribou requires actions that will vary according to both the habitat and population conditions within each boreal caribou range. This recovery strategy provides broad strategies and general approaches to achieve the population and distribution objectives, which will assist in the development of range plans and action plans. The suite of actions needed to maintain or recover the self-sustaining status of a boreal caribou local population will be determined and managed by the responsible jurisdictions in collaboration with Environment and Climate Canada, and consistent with this recovery strategy. The recovery actions most appropriate for a specific range will be governed by local opportunities and constraints, and the level of urgency for a given recovery action will be determined by both the population and habitat conditions within the range.

To guide the protection of critical habitat and the recovery of boreal caribou, range plans or other similar documents and/or action plans are being prepared by provincial and territorial jurisdictions. These plans provide detailed information on recovery measures that are being or will be implemented by provinces and territories, Environment and Climate Change Canada, other federal departments, wildlife management boards, Indigenous communities, stakeholders, and other organizations involved in the conservation, survival and recovery of boreal caribou. Success in recovering boreal caribou will depend on the commitment, collaboration and cooperation among all interested parties.

RECOVERY FEASIBILITY SUMMARY

Recovery of boreal caribou is considered to be both technically and biologically feasible across the species' distribution in Canada based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility.

Current evidence supports the conclusion that the recovery of all local populations is biologically and technically feasible. However, small local populations, and particularly those isolated from the core distribution of the national boreal caribou population, are at greater risk of not becoming self-sustaining. In these situations, a local population may have greater difficulty withstanding stochastic events, and may not experience enough immigration to maintain genetic diversity and therefore will be at greater risk of not persisting in the long-term. There may be other situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible and, as such, may affect the likelihood of achieving the population and distribution objectives.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.
Yes. According to current best estimates, there are approximately 34,000 (see Section 3.2.2) boreal caribou across nine provinces and territories in Canada capable of successful reproduction and available to improve local population growth rates and abundance to achieve self-sustainability (Environment Canada, 2011b).

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.
Yes. Some boreal caribou local populations have sufficient suitable habitat within their ranges. For other boreal caribou local populations where sufficient suitable habitat is currently unavailable to support local populations at a self-sustaining level, sufficient habitat could be made available through habitat management or restoration.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.
Yes. The primary threat to most boreal caribou local populations is unnaturally high predation rates as a result of human-caused and natural habitat loss, degradation, and fragmentation. These habitat alterations support conditions that favour higher alternate prey densities (e.g. moose (*Alces alces)*, deer (*Odocoileus spp*.)), resulting in increased predator populations (e.g. wolf (*Canis lupus*), bear (*Ursus spp.*)) that in turn increase the risk of predation to boreal caribou. This threat can be mitigated through coordinated land and/or resource planning, and habitat restoration and management, in conjunction with predator and alternate prey management where local population conditions warrant such action. In some ranges, over-exploitation through hunting can also be an issue. This threat can be avoided or mitigated through regulations and stewardship.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.
Yes. Recovery techniques (e.g. protection and management of boreal forest habitat, habitat restoration, predator and alternate prey management, hunting regulations, stewardship initiatives)

are available to achieve the population and distribution objectives for boreal caribou, although there is uncertainty with regard to the effectiveness of some of these techniques, as they have not yet undergone a sufficiently long trial period.

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1 COSEWIC SPECIES ASSESSMENT INFORMATION

Date of Assessment: November 2014

Common Name (population): Caribou (Boreal population)

Scientific Name: *Rangifer tarandus*

COSEWIC Status: Threatened

Reason for Designation: This population occurs at naturally low densities in mature boreal forest habitats from Labrador to Yukon, with small, isolated populations at the southern part of the range, including along the Lake Superior coastline and in the Charlevoix region of Québec. Over the past century, local subpopulations have been lost; range contraction has proceeded from the south by up to 50% of historical range in some areas. Despite considerable conservation efforts, range-wide declines have continued since the last assessment in 2002, particularly in Alberta, northeastern British Columbia, and Labrador. Some populations remain poorly monitored, particularly those in the northern portion of the range. For 37 of 51 subpopulations where trend data are available, 81% are in decline, as indicated by negative population growth rates. Some of the most intensively managed subpopulations may remain critically imperiled. Reasons for decline are mainly due to increased predation and habitat loss, the latter stemming from the combination of anthropogenic (natural resource extraction) and natural (fires) disturbance. The proliferation of linear landscape features such as roads and seismic lines facilitates predation by wolves, and the conversion of mature – old conifer stands to younger seral stages promotes increases in alternate prey such as Moose and White-tailed Deer. Shifts in the northern distribution of White-tailed Deer, mediated by landscape change, also bring novel parasites into parts of the range of this population. In some regions, overhunting poses a threat to long-term conservation. Threats are closely interrelated and act cumulatively to impact this population. Population increases do not appear likely in one-third of subpopulations where disturbances exceed a threshold of viability. A >30% decline in population is projected in the near term.

Canadian Occurrence: Yukon, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland and Labrador.

COSEWIC Status History: The Boreal population was designated threatened in May 2000. Status re-examined and confirmed in May 2002 and November 2014.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

In 2000, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, as threatened. The species was added to the List of Wildlife Species at Risk (Schedule 1) under SARA, at Proclamation, in 2003. In 2011, COSEWIC adopted new "Designatable Units" (DU) for caribou (*Rangifer tarandus*) in Canada using a number of variables to classify the different herds or groups of herds

(COSEWIC, 2011). These DU descriptions provided a clear and consistent scheme for identifying DUs due to the complexity of *Rangifer tarandus* in Canada. Woodland Caribou (*Rangifer tarandus caribou*), Boreal population is equivalent to COSEWIC's DU6, which is called Caribou (*Rangifer tarandus*), Boreal population. The 2014 COSEWIC assessment for the species was completed under this new DU structure/name (COSEWIC, 2014). However, until such time as Schedule 1 of SARA is amended to reflect the new common and scientific names changes, the species remains Woodland Caribou (*Rangifer tarandus caribou*), Boreal population under SARA. In this recovery strategy, the Woodland Caribou, Boreal population is referred to as simply "boreal caribou".

2 SPECIES STATUS INFORMATION

Boreal caribou are listed as threatened under Canada's *Species at Risk Act* (SARA), based on an observed, estimated, inferred or suspected reduction in population size of > 30% over three caribou generations (approximately 20 years). Boreal caribou have been provincially/territorially ranked in most jurisdictions (see Table 1). Boreal caribou have not been ranked globally by NatureServe.

Table 1. Canadian status and provincial/territorial designations for boreal caribou.

Canadian Status	Provincial/Territorial Designation
SARA – Schedule 1 (Threatened)	NT – Threatened YT – Not Listed BC – Red Listed (Threatened – Endangered) AB – Threatened SK – Not Listed MB – Threatened ON – Threatened QC – Vulnerable (Special Concern – Threatened) NL – Threatened

3 SPECIES INFORMATION

Caribou and reindeer are members of a single species, *Rangifer tarandus*. The term "caribou" is used to describe the various subspecies present in North America, whereas "reindeer" refers to the domesticated, semi-domesticated or wild subspecies found in Eurasia (Hummel and Ray 2008). Although there is considerable variation in phenotypic traits in this species (e.g., body size, pelage colour, morphology), caribou and reindeer are able to interbreed and produce fertile, viable offspring (Hummel and Ray 2008). It should be noted that reindeer occur in North America, particularly Newfoundland, as a result of human introductions.

Banfield (1974) recognized four existing subspecies of caribou in Canada, including Peary Caribou (*Rangifer tarandus pearyi*), Barren-ground Caribou (*R. t. groenlandicus*), Grant's Caribou (*R. t. granti*), and Woodland Caribou (*R. t. caribou*). A fifth subspecies, the Dawson's Caribou (*R. t. dawsoni*), which occurred in Haida Gwaii (i.e. Queen Charlotte Islands, BC) is extinct. Each subspecies displays differences in morphology, behaviour, and areas of geographic occurrence. Boreal caribou are among those caribou populations that were classified by Banfield (1974) as Woodland Caribou.

Boreal caribou are endemic to Canada, and are distributed across nine provinces and territories, including British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Newfoundland and Labrador, Northwest Territories, and Yukon (see Figure 1) (DU6; COSEWIC 2011).

3.1 Species Description

Like all Woodland Caribou, boreal caribou are a medium-sized (1.0-1.2 m shoulder height and weighing 110-210 kg) member of the deer family (*Cervidae*) (Thomas and Gray, 2002). Adults have a dark brown coat with a creamy white neck, mane, shoulder stripe, underbelly, underside of the tail, and patch above each hoof (Banfield, 1974; Boreal Caribou ATK Reports, 2010-2011). A distinctive characteristic of all caribou is large crescent-shaped hooves that provide flotation in snow and soft ground (e.g. peat lands), and assist in digging through snow to forage on lichens and other ground vegetation (Thomas and Gray, 2002). Antlers of boreal caribou are flattened, compact, and relatively dense. As a unique feature among the deer family, both male and female boreal caribou have antlers during part of the year, although some females may have only one antler or no antlers at all (Thomas and Gray, 2002; Boreal Caribou ATK Reports, 2010-2011). In comparison to Barren-ground Caribou, boreal caribou antlers are thicker and broader, and their legs and heads are longer.

3.2 Population and Distribution

Boreal caribou are forest-dwelling, sedentary caribou that occur only in Canada and are distributed broadly across the boreal forest (Thomas and Gray, 2002; Festa-Bianchet, 2011). The Canadian distribution of boreal caribou stretches from the northeast corner of Yukon east to Labrador, and extends as far south as Lake Superior (see Figure 1) (Environment Canada, 2008; Environment Canada, 2011b). Across Canada, the southern limit of boreal caribou distribution has progressively receded northward since the early 1900s (see Figure 1), a trend that continues today (Thomas and Gray, 2002; Schaefer, 2003; Festa-Bianchet et al., 2011). Indigenous Knowledge indicates that boreal caribou have moved northward as a result of habitat loss in the south (Boreal Caribou ATK Reports, 2010-2011).

Figure 1. Distribution (i.e. extent of occurrence) of boreal caribou in Canada. The current distribution of boreal caribou is shown in brown. The estimated southern extent of historical Woodland Caribou distribution is indicated by the dashed line.

3.2.1 Boreal Caribou Ranges

The geographic area occupied by a group of boreal caribou that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame is referred to as a range (Environment Canada, 2011b). Boreal caribou are distributed across 51 ranges (see Figure 2 and Table 2) based on the best available information provided by the provincial and territorial jurisdictions, including observational and telemetry data, and biophysical analyses (Environment Canada, 2011b).

> In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (conservation unit, improved conservation unit, local population unit).

Environment and Climate Change Canada (2011b) identified three types of boreal caribou ranges, categorized based on the degree of certainty in the delineated boundaries. Eight ranges have been identified as “conservation units” (low certainty), 20 ranges as “improved conservation units” (medium certainty), and 23 ranges as “local population units” (high certainty) (see Appendix F). It is anticipated there will be changes to conservation units and improved conservation units as more information becomes available. In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (conservation unit, improved conservation unit, local population unit).

As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As new and more refined information is continually being collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges.

Ranges can and do vary greatly in size; some cover very large areas (e.g. Northwest Territories range (NT1): 44,166,546 ha), whereas others are much smaller (e.g. Charlevoix range (QC2): 312,803 ha). Whether a range can support a self-sustaining local population is a function of both the amount and quality of habitat available for boreal caribou.

Of the 51 boreal caribou local populations, 15 are “self-sustaining”, 26 are “not self-sustaining” and 10 are “as likely as not self-sustaining”, based on Environment and Climate Change Canada’s (2011b) methodology and data from provincial and territorial jurisdictions (see Figure 3 and Appendix F). In the population and distribution objectives, “not self-sustaining” local populations refers to both the local populations assessed as “as likely as not self-sustaining” and those assessed as “not self-sustaining”. The assessment of the likelihood of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions.

In some cases, there are discrepancies between the range boundaries as presented in Figure 2, which were based on information provided by provincial and territorial jurisdictions, and the information that was provided by Indigenous Knowledge holders. These will be addressed in range plans and/or action plans (see Sections 7.3 and 9) where provinces and territories, Indigenous communities, and other people with knowledge of a particular boreal caribou range can work together to ensure range boundaries are based on the best available information.

Boreal caribou use of a range may change over time as a result of variation in ecological conditions (e.g. vegetation change as a result of natural disturbances, predator/prey dynamics) and patterns of human disturbance (e.g. industrial development) affecting the landscape. Variation in habitat conditions, resource availability, and the amount and arrangement of disturbance on the landscape, influences patterns of boreal caribou range use that result in either: a) a discrete range, where boreal caribou occupy a clearly defined area with little exchange with other ranges (e.g. Coastal range (ON6), Charlevoix range (QC2)); or b) a continuous range where boreal caribou are dispersed over a large area and may move more freely and over greater distances within the area characterized by common biophysical attributes (e.g. Northwest Territories range (NT1)).

Figure 2. Geographic distribution of the 51 known ranges of boreal caribou in Canada as of June 2012.

Table 2. Range identification and range names for the 51 known ranges of boreal caribou in Canada.

Range ID	Range Name
NT1	Northwest Territories
BC1	Maxhamish
BC2	Calendar
BC3	Snake-Sahtahneh
BC4	Parker
BC5	Prophet
AB1	Chinchaga (incl. BC portion)
AB2	Bistcho
AB3	Yates
AB4	Caribou Mountains
AB5	Little Smoky
AB6	Red Earth
AB7	West Side Athabasca River
AB8	Richardson
AB9	East Side Athabasca River
AB10	Cold Lake
AB11	Nipisi

Range ID	Range Name
AB12	Slave Lake
SK1	Boreal Shield
SK2	Boreal Plain
MB1	The Bog
MB2	Kississing
MB3	Naosap
MB4	Reed
MB5	North Interlake
MB6	William Lake
MB7	Wabowden
MB8	Wapisu
MB9	Manitoba North
MB10	Manitoba South
MB11	Manitoba East
MB12	Atikaki-Berens
MB13	Owl-Flinstone
ON1	Sydney

Range ID	Range Name
ON2	Berens
ON3	Churchill
ON4	Brightsand
ON5	Nipigon
ON6	Coastal
ON7	Pagwachuan
ON8	Kesagami
ON9	Far North
QC1	Val d'Or
QC2	Charlevoix
QC3	Pipmuacan
QC4	Manouane
QC5	Manicouagan
QC6	Quebec
NL1	Lac Joseph
NL2	Red Wine Mountain
NL3	Mealy Mountain

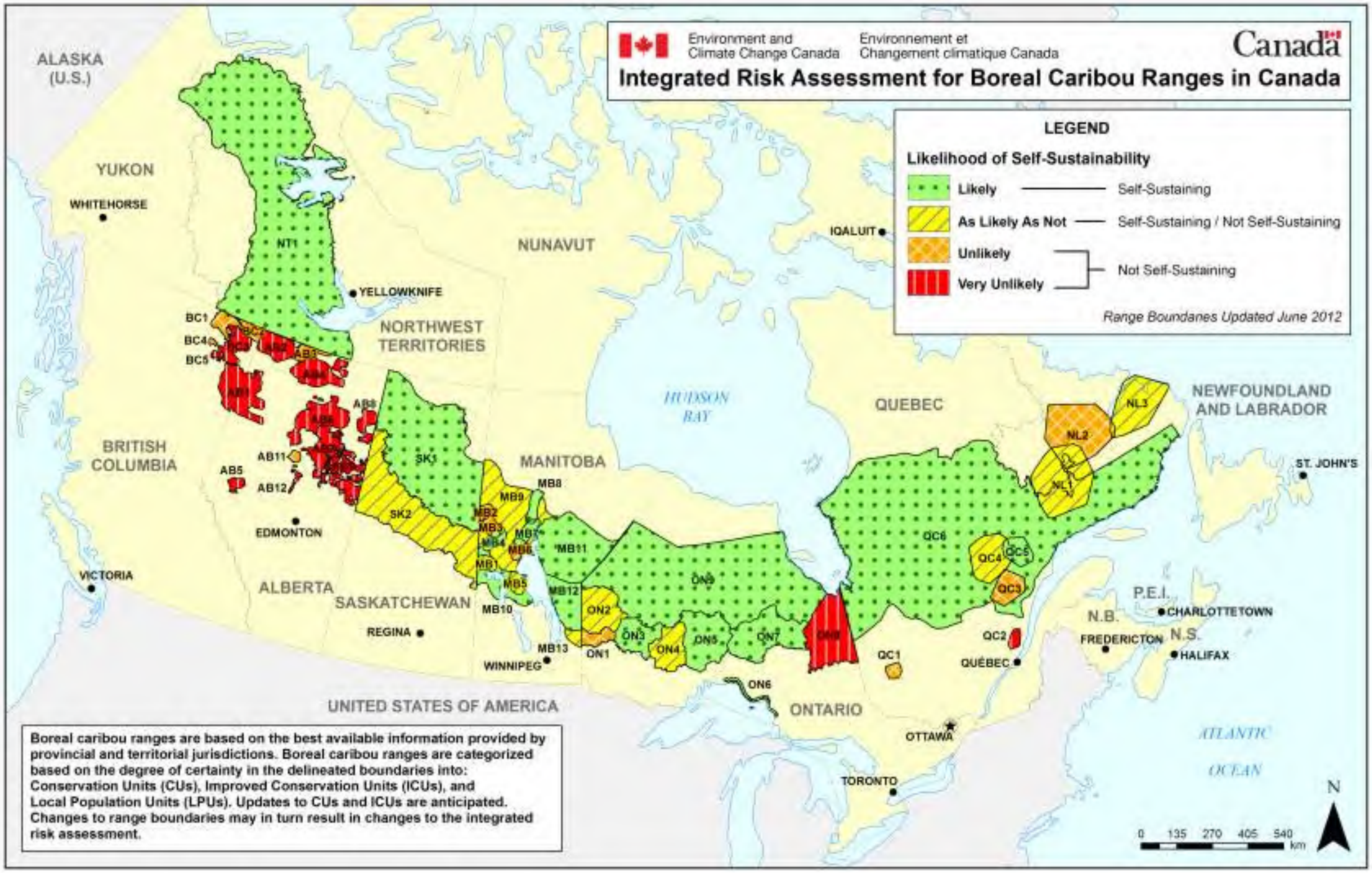

Figure 3. Integrated risk assessment for boreal caribou ranges in Canada as of June 2012, reflecting the capacity of each range to maintain a self-sustaining local population of boreal caribou. The likelihood of self-sustainability for the Boreal Shield range (SK1) has been updated from "unknown" to "likely" in this amended recovery strategy. The integrated risk assessments for the remaining ranges have not been updated.

3.2.2 Local Populations

Precise enumeration of the size of a boreal caribou local population is a challenge due to the large areas that boreal caribou occupy (often over thousands of square kilometres), the low densities at which they occur (making survey from aircraft challenging), and their relatively solitary habits (Environment Canada, 2008; Callaghan et al., 2010). Across Canada, densities average two to three animals per 100 km^2, but densities vary regionally and can be higher in areas with high quality habitat (Environment Canada, 2011b). The literature also reports that more than 300 boreal caribou are needed for self-sustaining local populations, thereby requiring ranges of at least 10,000 to 15,000 km^2 in size subject to type and quality of habitat (Environment Canada, 2011b).

Within ranges, boreal caribou are often found in small groups of fewer than 15 individuals. This will vary seasonally in accordance with life processes (e.g. calving, rutting, wintering) and based on local conditions within the range (Boreal Caribou ATK Reports, 2010-11). Boreal caribou typically form relatively mixed-sex groups; however, during calving periods females are generally solitary (Boreal Caribou ATK Reports, 2010-2011; Nagy et al., 2011).

Based on the best available information, the current overall number of boreal caribou in Canada is estimated to be approximately 33,000-34,000 individuals (Environment Canada, 2011b; COSEWIC, 2014). This number is based on mean local population size estimates as provided by the provincial and territorial jurisdictions. It is important to note that the overall national population size estimate is only a crude approximation, as population estimates over time are unavailable in most regions. Appendix F outlines the current population size and trend information for each of the 51 ranges, as provided by provincial and territorial jurisdictions (Environment and Climate Change Canada, 2017).

3.3 Needs of the Boreal Caribou

3.3.1 Habitat and Biological Needs

Boreal caribou require large range areas comprised of continuous tracts of undisturbed habitat. In general, boreal caribou prefer habitat consisting of mature to old-growth coniferous forest (e.g. jack pine (*Pinus banksiana*), black spruce (*Picea mariana*)) with abundant lichens, or muskegs and peat lands intermixed with upland or hilly areas (Stuart-Smith et al., 1997; Rettie and Messier, 2000; Courtois, 2003; Brown et al., 2007; Boreal Caribou ATK Reports, 2010-2011). Large range areas reduce the risk of predation by allowing boreal caribou to maintain low population densities throughout the range and by allowing them to avoid areas of high predation risk, such as areas with high densities of alternate prey species (e.g. moose and deer) and predators (e.g. wolf and bear) (Rettie and Messier, 2001; Brown et al., 2003; Whittington et al., 2011) (see Section 4.2). Boreal caribou use a variety of habitats to avoid predators, including muskegs and bodies of water, as well as mature and old-growth forests (Boreal Caribou ATK Reports, 2010-2011).

Boreal caribou select habitat that provides food, particularly terrestrial and arboreal lichens, during late winter and early spring, and avoid early stage, successional forests and recently disturbed areas (Schaefer and Pruitt, 1991; Stuart-Smith et al., 1997; Rettie and Messier, 2000;

Dunford et al., 2006; Boreal Caribou ATK Reports, 2010-2011), which have poor feeding options, impede movement, and attract other ungulates (Whitefeather Forest, 2006). In order to access forage during winters with deep or crusted snow, boreal caribou require habitat that has arboreal lichens and shallower snow (such as mature coniferous stands with closed canopies and upland or hilly areas exposed to wind), where it is easier to dig for ground lichens (Vandal and Barrette, 1985; Thomas and Armbruster, 1996; Courbin et al., 2009; Boreal Caribou ATK Reports, 2010-2011; Moreau et al., 2012).

Boreal caribou have specific habitat requirements during calving and post-calving periods. To calve, pregnant cows travel to isolated, relatively predator-free areas where nutritious forage is available, such as islands in lakes, peat lands or muskegs, lakeshores and forests (Boreal Caribou ATK Reports, 2010-2011). Unavailable, inadequate or degraded habitat affects the reproductive success of females as well as the survival of calves, and can result in population decline (Thomas and Gray, 2002; McCarthy et al., 2011; Pinard et al., 2012).

Boreal caribou shift their use of habitat and their distribution within the range in response to various natural processes (e.g. forest fire, food availability, weather conditions) and human activities (e.g. development, logging, recreation) (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011b). For example, any mature and old-growth forest stands lost to fire or tree removal practices will result in the degradation of suitable habitat in the short-term. In response to such changing environmental conditions, boreal caribou will shift within their range. Over time, a disturbed area may recover and become suitable for use by boreal caribou.

3.3.2 Connectivity

Connectivity of habitat both within a range and between ranges is essential for boreal caribou persistence on the landscape. Within a range, habitat connectivity allows for seasonal movement among habitats with the different resources needed by boreal caribou to satisfy their life history requirements (see Appendix H for examples of biophysical attributes), and for boreal caribou to use different areas as they respond to disturbance or as disturbed habitat recovers (Saher and Schmiegelow, 2005).

Connectivity between boreal caribou ranges allows for immigration and emigration between local populations, which increases gene flow, thereby helping to maintain genetic diversity and the species' subsequent resilience to environmental stressors (e.g. disease, severe weather). Studies have demonstrated that isolation of local populations as a result of disturbance to the landscape (i.e. any form of anthropogenic or natural habitat alteration), can result in a significant reduction in genetic diversity (Courtois et al., 2003; Weckworth et al., 2012). Connectivity between ranges also maintains recovery or rescue effects between boreal caribou ranges. Finally, connectivity within and between boreal caribou ranges will allow for movement in response to changing environmental conditions (e.g. climate change) (Racey and Armstrong, 2000; Courtois et al., 2003; McLoughlin et al., 2004; Pither et al., 2006; Boreal Caribou ATK Reports, 2010-2011).

3.3.3 Limiting Factors

Boreal caribou possess certain life history characteristics that limit their potential to recover from rapid, severe population declines. As a primary anti-predator survival strategy, boreal caribou spatially separate themselves from predators and alternate prey, maintaining low population densities across their range (Bergerud, 1988; Bergerud, 1996; Johnson et al., 2001; Environment Canada, 2008). Accordingly, continuous tracts of undisturbed habitat of suitable quality (i.e. with the required biophysical attributes) are needed to ensure self-sustaining local populations.

Boreal caribou have a low reproductive output relative to other ungulates and therefore are vulnerable to higher rates of mortality whether caused by predation or over-harvesting. Females typically do not produce young until three years of age and then have only one calf per year (Bergerud, 2000). In addition, while all age classes of boreal caribou are vulnerable to predation, calf mortality can be especially high, particularly within the first thirty days after birth (Bergerud and Elliot, 1986; Gustine et al., 2006). Calves disperse themselves over the landscape as an anti-predator tactic. In most cases predation is the main proximate factor limiting boreal caribou population growth, since the survival of calves to one year of age is usually low and is often insufficient to compensate for annual adult mortality in declining populations (Bergerud, 1974; Stuart-Smith et al., 1997; DeMars et al., 2011).

Small local populations with few adult females (and hence few births) and low calf survival have a low potential for population growth (Bergerud, 1980; Bergerud, 2000; McCarthy et al., 2011). In addition to being affected by reproductive and mortality rates related to their age distribution, small local populations can be disproportionately affected by stochastic events (e.g. environmental events such as winter icing or heavy snowfalls, fire, disease). Consequently, population growth is likely to be highly variable in small local populations, with an increased probability of extirpation (Caughley, 1994; Courtois et al., 2007).

4 THREATS

4.1 Threat Assessment

There are a variety of threats that directly and/or indirectly affect boreal caribou and their habitat across Canada. A summary of these threats and their national level of concern are provided below (see Table 3). The level of concern was determined using best available information, including Indigenous Knowledge and comments received through engagement with Indigenous communities. Threats and their level of concern differ between regions and local populations. For example, the level of concern for the effect of hunting on local populations is high in Labrador, while it remains medium nationally. Actions to mitigate threats are being or will be addressed in range plans and/or action plans (see Sections 7.3 and 9).

Many of the threats to boreal caribou and their habitat are related and may interact, in which case they can have cumulative impacts that may not be evident when threats are examined individually (Weclaw and Hudson, 2004; Boreal Caribou ATK Reports, 2010-2011; Badiou et al., 2011). Additionally, the impacts of threats on the size and distribution of boreal caribou local populations have a lag effect, which can take years to manifest (Vors et al., 2007).

Table 3. Threat assessment table for boreal caribou.

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Habitat Alteration (Disturbance)						
Habitat alteration (loss, degradation or fragmentation) as a result of human land-use activities	High	Widespread across Canada	Current	Continuous	High	High
Habitat alteration (loss, degradation or fragmentation) as a result of forest fire	Medium	Widespread across Canada	Current	Recurrent	Moderate	High
Natural Processes						
Predation	High	Widespread across Canada	Current	Continuous	High	High
Parasites and disease	Low	Localized across Canada	Anticipated	Unknown	Unknown	Low

Threat	Level of Concern[1]	Extent	Occurrence	Frequency	Severity[2]	Causal Certainty[3]
Biological Resource Use						
Hunting	Medium	Localized across Canada	Current	Seasonal	Moderate	Medium
Climate and Natural Disasters						
Climate change and severe weather	Medium	Widespread across Canada	Current	Unknown	Unknown	Low-Med
Other Threats						
Noise and light disturbance	Low-Med	Localized across Canada	Current	Recurrent	Unknown	Low
Vehicle collisions	Low	Localized across Canada	Current	Recurrent	Low	Low
Pollution	Low	Localized across Canada	Unknown	Unknown	Unknown	Low

1 Level of concern: qualifies the level of concern for managing the threat for the recovery of the species, consistent with the population and distribution objectives. This criterion considers all other criteria in the table.

2 Severity: reflects the population-level effect (i.e. high means a very large population-level effect; low means a limited population-level effect).

3 Causal certainty: reflects the degree of evidence that is known for the threat (i.e. high: available evidence strongly links the threat to stresses on population viability; medium: there is a correlation between the threat and population viability according to best available information; low: the threat is assumed or plausible).

4.2 Description of Threats

The threats to boreal caribou and their habitat identified in Table 3 are described below.

4.2.1 Habitat Alteration (Disturbance)

Habitat alteration occurs when changes are made on the landscape that adversely impact the ecosystem, either temporarily or permanently, reducing the overall function of habitat within the range for boreal caribou. Habitat loss is a change to a landscape that results in areas with no immediate or long-term future value to boreal caribou (e.g. conversion to agriculture, development of industrial facilities) whereas habitat degradation refers to a reduced but not total loss of habitat value for boreal caribou (e.g. reduction in the availability or quality of habitat following timber harvesting or seismic line development). Habitat fragmentation is the dissection of habitat by human-made linear features (e.g. roads, seismic lines, pipelines, hydroelectric corridors) and polygonal features (e.g. forestry cut blocks) that may affect how boreal caribou use habitat or may result in a negative impact on the overall condition of a local population.

Environment and Climate Change Canada mapped total disturbance levels on boreal caribou ranges across their distribution in Canada as a predictor of self-sustainability for boreal caribou local populations. The total disturbance footprint was measured as the combined effects of fire that has occurred in the past 40 years and buffered (500 m) anthropogenic disturbance defined as any human-caused disturbance to the landscape that could be visually identified from Landsat imagery at a scale of 1:50,000. Although the effect of anthropogenic disturbance varies for individual ranges (i.e. in some ranges extending up to 14 km), Environment and Climate Change Canada (2011b) demonstrated that the application of a 500 m buffer to mapped anthropogenic features best represents the combined effects of increased predation and avoidance on caribou population trends at the national scale (Environment Canada, 2011b).

Data and approaches used to measure disturbance in Environment and Climate Change Canada's meta-analysis (2011b) were consistently applied across all provinces and territories. Disturbance data have been used for the purposes of this recovery strategy. Provinces and territories may have updated information and tools (e.g. Lidar remote sensing, detailed field sampling, other inventory techniques) to measure disturbance that were not considered in the national-level integrated risk assessment. Strong evidence validated by Environment and Climate Change Canada may be used to update disturbance measures and the integrated risk assessment.

Environment and Climate Change Canada (2011b) developed a methodology for consideration of disturbance management thresholds, which is described in more detail in Appendix E. With the exception of the Boreal Shield range (SK1), this amended recovery strategy identifies 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that a local population will not be self-sustaining.

For SK1, this amended recovery strategy identifies 40% undisturbed habitat in the range as the disturbance management threshold, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the SK1 local population will not be self-sustaining (see Appendices D and E).

In any given range, habitat disturbance reduces the suitability of adjacent habitat, increase rates of predation, increase access to the land for hunting opportunities, and can act as barriers to boreal caribou movement (Chubbs et al., 1993; Smith et al., 2000; Dyer et al., 2001; Lander, 2006; Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011b). In some cases boreal caribou may use areas of inadequate or degraded habitat (e.g. remnant habitat following certain types of forest fires, buffer habitat surrounding certain types of development), particularly in highly disturbed ranges where opportunities for movement to suitable undisturbed habitat are limited or unavailable. In these situations boreal caribou are at a higher mortality risk. In addition, large-scale disturbances to the landscape (e.g. intense forest fire, widespread forest harvest) can cause boreal caribou to cease their use of portions of the range.

4.2.1.1 Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Human Land-use Activities

Indigenous Knowledge and science identify disturbance primarily associated with the following human land-use activities as having a negative effect on boreal caribou local populations across Canada: forestry; oil and gas exploration and development; mining and mineral exploration and development; hydro-electric development; and tourism. These activities affect boreal caribou through a combination of direct and functional habitat loss, decreased habitat quality (i.e. habitat degradation), and development of linear features such as roads and seismic lines (i.e. habitat fragmentation) (Thomas and Gray, 2002; Vors et al., 2007; Boreal Caribou ATK Reports, 2010-2011).

The effects of habitat alteration may reduce the viability of a boreal caribou local population through the reduction of habitat quality and quantity, possibly leading to a reduction in the size of the range, and potentially resulting in the extirpation of a local population.

4.2.1.2 Habitat Alteration (Loss, Degradation or Fragmentation) as a Result of Forest Fire

Forest fires are required for boreal forest regeneration and have historically played a significant role in the local population size and distribution of boreal caribou within their range and across their Canadian distribution (Thomas and Gray, 2002; Dzus et al., 2010). Natural processes such as forest fires can directly alter habitat, making it unsuitable for boreal caribou (e.g. loss of mature conifer stands, loss of lichens and other forage plants, barriers to movement) (Environment Canada, 2011b). Boreal caribou generally do not return to burned areas for several decades until the forest is old enough to support lichens and other food sources, although they may make limited use of burned areas to feed on new growth (Boreal Caribou ATK Reports, 2010-2011).

Historically, when a forest fire occurred, boreal caribou would shift their use of habitat from the burned areas to areas that are more suitable. However, with the increase of industrial exploration and development, in a number of ranges there are fewer available suitable areas into which boreal caribou can move. When combined with human-caused disturbance, forest fires can threaten boreal caribou recovery even though they are a natural component of the boreal forest ecosystem. In some areas, forest fires have been reported as occurring more frequently than in the past (Whitefeather Forest, 2006; Boreal Caribou ATK Reports, 2010-2011).

4.2.2 Natural Processes

4.2.2.1 Predation

Across most of the distribution of boreal caribou, human-induced habitat alterations have caused an imbalance in predator-prey relationships resulting in unnaturally high predation rates. This is the major factor affecting the viability of most boreal caribou local populations (Bergerud, 1988; Stuart-Smith et al., 1997; Rettie and Messier, 1998; Schaefer et al., 1999; James and Stuart-Smith, 2000; Wittmer et al., 2005; Chabot, 2011). Based on the weight of evidence coming from science and Indigenous Knowledge, increased wolf and/or bear predation is the main proximate cause of boreal caribou decline across Canada (Bergerud, 1988; Edmonds, 1988; Seip, 1992;

Boertje et al., 1996; Boreal Caribou ATK Reports, 2010-2011; Pinard et al., 2012). However, in some parts of Canada, cougar (*Puma concolor*), coyotes (*Canis latrans*), lynx (*Lynx canadensis*), and eagles (*Haliaeetus leucocephalus* and *Aquila chrysaetos*) have also been identified as predators of boreal caribou, particularly calves (Thomas and Gray, 2002; Boreal Caribou ATK Reports, 2010-2011; McCarthy et al., 2011).

Human-caused habitat alterations have been shown to facilitate movement of predators within the boreal forest and hence can increase the abundance, distribution and hunting efficiency of species that prey on boreal caribou (James and Stuart-Smith, 2000; Neufeld, 2006; Boreal Caribou ATK Reports, 2010-2011). Additionally, although boreal caribou may not be the target prey species, they are taken opportunistically when encountered. In boreal caribou ranges with habitat alterations that provide favorable conditions for prey species such as deer and moose, predators such as wolves can increase in number, which can significantly reduce or even eliminate boreal caribou local populations (Seip, 1991; Seip, 1992; Wittmer et al., 2005; Courtois and Ouellet, 2007; Courbin et al., 2008; Boreal Caribou ATK Reports, 2010-2011). In addition to deer and moose, elk (*Cervus canadensis*), bison (*Bison bison*), and beaver (*Castor canadensis*) are other species that predators of boreal caribou commonly hunt and that have increased in number within the distribution of boreal caribou (Boreal Caribou ATK Reports, 2010-2011).

4.2.2.2 Parasites and Diseases

Viral, parasitic, and bacterial diseases can affect individual boreal caribou and may have effects at the local population level in certain parts of the country, although it is not thought to be one of the major threats affecting boreal caribou at the national level.

Other natural processes such as forest insects and disease can leave large areas of forest defoliated, and eventually dead, and may have an effect on boreal caribou habitat. In particular the mountain pine beetle (*Dendroctonus ponderosae*), which covers large areas of northeastern British Columbia and northern Alberta and threatens to move into Saskatchewan, could indirectly affect boreal caribou (Richie, 2008; Environment Canada, 2011a).

4.2.3 Biological Resource Use

4.2.3.1 Hunting

Hunting has and continues to contribute to the decline of boreal caribou (Bergerud, 1967; Kelsall, 1968; Bergerud, 1974; Bergerud, 1978; Courtois et al., 2007; Boreal Caribou ATK Reports, 2010-2011). Both targeted hunting and incidental harvest (when boreal caribou intermingle seasonally with legally hunted migratory caribou ecotypes) of boreal caribou are of concern in several areas, and may be contributing to local population declines and/or preventing recovery (Environment Canada, 2011a).

Although the extent of hunting is poorly understood in most areas, analyses of historical population trends, data from radio-collared animals, and current demographic information suggest that hunting remains a significant component of adult female boreal caribou mortality and hence is a primary threat in some ranges (Dzus, 2001; Schmelzer et al., 2004; Courtois et al., 2007). Hunting of boreal caribou is facilitated by the construction of roads and other linear features and by the use of off-road vehicles that enable access to previously inaccessible areas (Boreal Caribou ATK Reports, 2010-2011). Moreover, Indigenous Knowledge indicates that technological advances in hunting tools (e.g. high-powered rifles and scopes) and in methods used to locate and access hunting sites (e.g. GPS, satellite tracking, aircraft, snowmobiles, trucks) have facilitated the chase of boreal caribou, resulting in a greater number of caribou being taken (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011a).

4.2.4 Climate and Natural Disasters

4.2.4.1 Climate Change and Severe Weather

Climate change has been identified by Indigenous Knowledge holders and scientists as a threat to boreal caribou and their habitat. Both groups indicate that there are many uncertainties surrounding the impacts of climate change and how climate change may interact with other threats. The long-term effects of climate change and the implications on boreal caribou habitat are unknown.

Greater weather variability and severe weather events, which are expected to increase with climate change, are likely to increase the frequency and severity of wildfires and cause more freeze-thaw cycles, freezing rain, deep snow, hot summer temperatures, and changes in the forest composition and food supply (Thomas and Gray, 2002; Vors and Boyce, 2009; Boreal Caribou ATK Reports, 2010-2011). In some areas, a shift in the timing and length of seasons, with earlier spring thaws and later freeze-ups, has been observed by many Indigenous Knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Climate change will likely also lead to changes in habitat which, in the Northwest Territories, can increase permafrost melting.

Climate related changes in habitat favour deer and other prey species, which expand into boreal caribou range, increasing predator populations and predation of boreal caribou, and facilitating the spread of disease. Climate change may result in habitat change for boreal caribou, as it drives boreal forest composition to shift northwards, and results in other factors including the spread of forest insects that cause tree mortality (e.g. mountain pine beetle) (Johnston, 2009; Johnston, 2010).

4.2.5 Other Threats

Other threats that have a lower level of concern at the national scale (although they may be of greater concern for individual ranges) include:

Noise and Light Disturbance: Noise and light disturbance result in short-term behavioural and physiological responses of individual boreal caribou, including a startle response, elevated heart rate, and production of glucocorticoids. Sustained or repeated disturbance can result in avoidance of areas and the reduction in use of suitable habitat (Sapolsky, 1992; Creel et al., 2002).

Vehicle Collisions: In some areas, boreal caribou are vulnerable to mortality from vehicle or rail collisions (Brown and Hobson, 1998); however, on a national scale, vehicle collisions are not thought to pose a major threat to boreal caribou (Boreal Caribou ATK Reports, 2010-2011).

Pollution: The threat of pollution (e.g. from oil and gas, chemical spraying for forestry, pesticides, hydro, salt, dust and litter coming from the creation of roads) was identified as a concern through meetings held with Indigenous communities (Environment Canada, 2011a) and by Indigenous Knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Very little is known about the severity of this threat to boreal caribou local populations.

5 POPULATION AND DISTRIBUTION OBJECTIVES

The national population of boreal caribou is currently made up of local populations distributed across 51 ranges in Canada (see Figure 2 and Table 2). Boreal caribou ranges are the fundamental units of conservation and management for boreal caribou recovery planning and actions (Thomas and Gray, 2002). The range is the appropriate unit of analysis for identifying critical habitat and other requirements for self-sustaining local populations of boreal caribou. The range represents the geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and is used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame.

5.1 Recovery of Boreal Caribou

5.1.1 Varying Ecological Conditions

Indigenous Knowledge and comments received through engagement with Indigenous communities identifies the need for continued presence of self-sustaining local populations in all boreal caribou ranges across Canada (Boreal Caribou ATK Reports, 2010-2011; Environment Canada, 2011a). This is reflected in the knowledge that all animals are connected to each other and that boreal caribou are essential to the balance of nature and for their role in the boreal ecosystem.

Boreal caribou encounter a wide variety of ecological conditions across their distribution. Taken together, all boreal caribou ranges contribute to ensuring that the full ecological gradient is represented and captures local adaptations to change. This allows for maintenance of the evolutionary potential of the species and accounts for the full spectrum of ecological interactions boreal caribou can have within the full array of ecological settings (Redford et al., 2011).

Science supports that conservation of a species such as boreal caribou is achieved by maintaining multiple local population units across a species' geographical range, in representative ecological settings, with replicate local populations in each setting that are self-sustaining, genetically robust, ecologically functional, and resilient to climate and other changes (Environment Canada, 2011b). Without connectivity, redundancy and representivity across several ecological scenarios there is an increased risk to the survival and recovery of boreal caribou.

Small local populations, particularly those isolated from the core distribution of the national population of boreal caribou, are at greater risk of not becoming self-sustaining or maintaining self-sustaining status. In these situations, a local population may have greater difficulty withstanding stochastic events, and may not experience enough immigration to maintain genetic diversity or adequate population size, and therefore will be at greater risk of not persisting in the long-term. Accordingly, different recovery actions (e.g. translocation, captive breeding) may be necessary to maintain and recover small local populations, and particularly those that are declining. There may be considerable uncertainty regarding the effectiveness of such recovery tools. It will be important to assess feasibility and conduct a risk assessment prior to undertaking any such activities.

There are several small local populations including Parker (BC4) and Prophet (BC5) in British Columbia, Nipisi (AB11) and Slave Lake (AB12) in Alberta, The Bog (MB1), Kississing (MB2), North Interlake (MB5), William Lake (MB6) and Owl-Flinstone (MB13) in Manitoba, and Red Wine Mountain (NL2) in Newfoundland and Labrador. Small isolated local populations include Little Smoky (AB5) in Alberta, Coastal (ON6) in Ontario, and Val D'Or (QC1) and Charlevoix (QC2) in Quebec (see Figure 2).

5.1.2 Connectivity Between and Within Boreal Caribou Ranges

Maintaining a long-term self-sustaining status for boreal caribou ranges depends on connectivity within and between ranges. Connectivity between ranges enables immigration and emigration between neighbouring boreal caribou local populations, which allows for the maintenance of local population size and genetic diversity. Maintaining genetic diversity is needed to maintain the resilience of a local population as described in Section 3.3.2.

Connectivity also allows wide ranging mammals like boreal caribou to adapt to changes in their natural environment (e.g. climate change, disturbance), recognizing that a contiguous population does not mean that each range must be physically connected to other ranges or that areas of habitat within a range must be physically connected to other areas. However, it does mean that the distance between ranges and between core habitat areas within a range should not be so large that no movement of boreal caribou could occur, though it may not be their preferred habitat type. Connectivity between ranges benefits gene flow and helps to maintain or increase population size. Connectivity within a range is important for seasonal movement and the use of habitat as boreal caribou respond to disturbance or as disturbed habitat recovers (Saher and Schmiegelow, 2005).

5.2 Objectives

5.2.1 Recovery Goal

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible.

The recovery goal reflects the best available information, including scientific knowledge, Indigenous Knowledge and comments received through engagement with Indigenous communities. The goal is informed by the scientific principles of conservation and reflects the intent to recover all local populations. Achieving the recovery goal would allow for local population levels sufficient to sustain traditional Indigenous harvesting activities, consistent with existing Aboriginal and treaty rights. Feedback received from Indigenous communities indicated a strong support for this recovery goal.

Recovery for boreal caribou is the achievement of self-sustaining local populations, which are demographically and genetically viable connected local populations across the species' distribution. Current evidence supports the conclusion that the recovery of all local populations is biologically and technically feasible. As noted in Sections 3.3.3 and 5.1.1, small and isolated local populations are at greater risk of not becoming self-sustaining or maintaining self-sustaining status. There may be situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible. Each boreal caribou local population contributes to the biodiversity, ecological functionality, and resilience of the species to environmental change, reducing the risk of species' extinction (Ray, 2011).

5.2.2 Population and Distribution Objectives

To guide recovery efforts, the population and distribution objectives (see Figure 4) are, to the extent possible, to:

- Maintain the current status of the 15 existing self-sustaining local populations (green dotted ranges); and
- Stabilize and achieve self-sustaining status for the 36 not self-sustaining local populations (blue hatched ranges).

"Not self-sustaining" local populations refers to the local populations assessed as "as likely as not self-sustaining" and those assessed as "not self-sustaining". The population and distribution objective for the Boreal Shield (SK1) local population has been changed from "stabilize and achieve self-sustaining status" to "maintain self-sustaining status" in this amended recovery strategy, based on work carried out by P.D. McLoughlin (University of Saskatchewan, personal communications) and Environment and Climate Change Canada (2019) that indicates that the SK1 local population is self-sustaining.

5.3 Timelines to Recovery

Boreal caribou exist in mature boreal forest ecosystems that evolved over centuries, and in turn take decades to recover from disturbance. Reversing ecological processes detrimental to boreal caribou (e.g. habitat degradation and loss, the increase in predator and alternate prey populations), and instituting changes to management frameworks and ongoing land use arrangements, will often require time frames in excess of 50 to 100 years. Given these realities, while it is currently biologically and technically feasible to recover all local populations, under the best efforts of all parties, some local populations will not return to a self-sustaining status for a number of decades.

For several boreal caribou local populations, immediate actions to avoid extirpation are needed such that recovery can be achieved over time. Recovery will be monitored continuously and reported every five years (see Section 8).

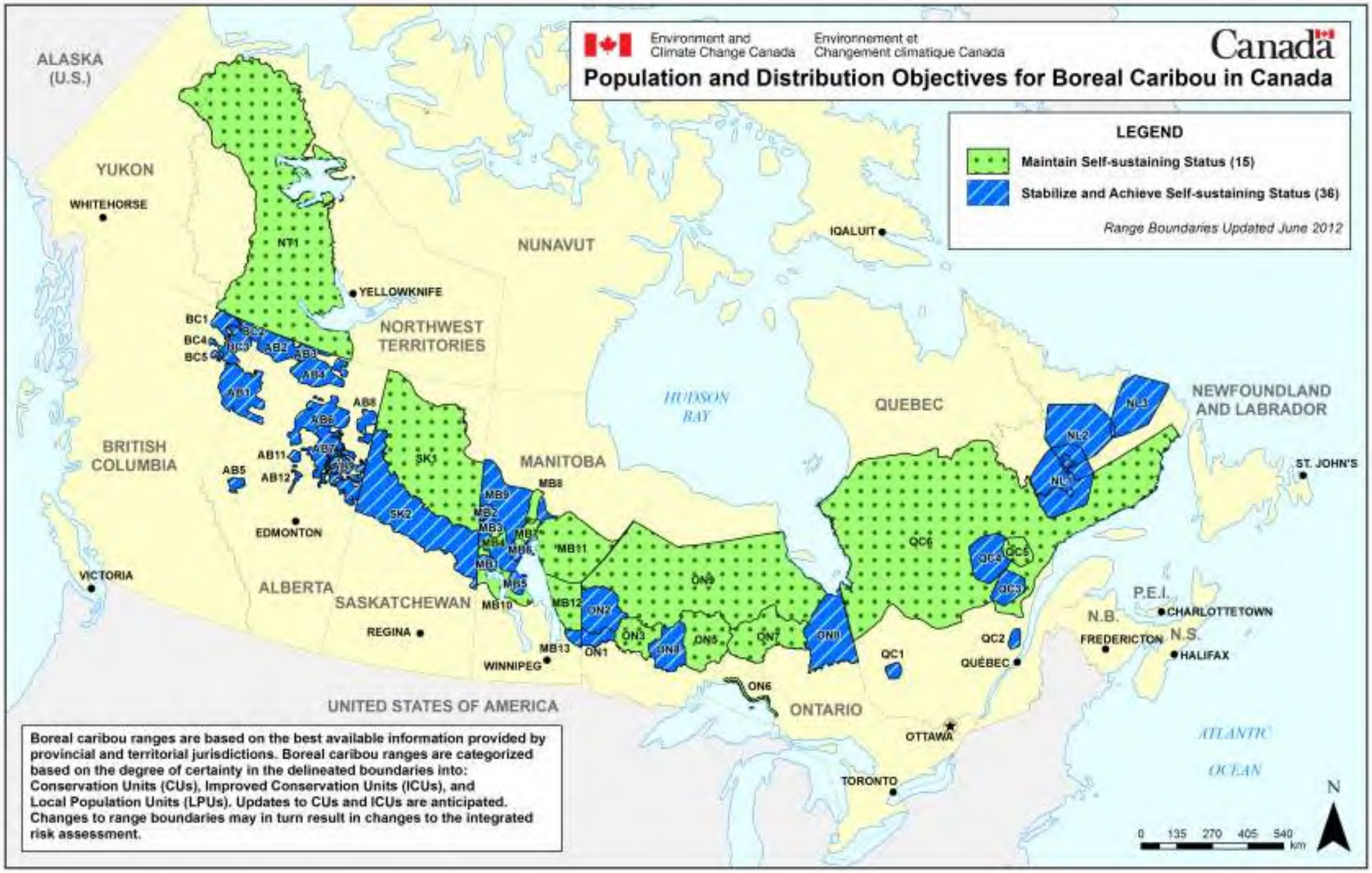

Figure 4. Population and distribution objectives for boreal caribou in Canada. The population and distribution objective for the Boreal Shield range (SK1) has been updated from "stabilize and achieve self-sustaining status" in the 2012 Recovery Strategy to "maintain self-sustaining status" in this amended recovery strategy.

5.4 Prioritizing Recovery Actions and Managing Risk

All local populations are included in the goal for the recovery of boreal caribou based on their contributions to connectivity, representivity and redundancy. Each local population also faces different challenges to maintain or achieve self-sustaining status. Successful recovery of boreal caribou will require practical considerations and implementation of recovery actions tailored for each range. Prioritization of recovery actions is being addressed at the range and/or action planning stage where the allocation of effort and the rate of risk reduction for individual ranges can best be determined.

Range and/or action planning considers a multitude of information and factors, such as regional ecological conditions, local population size and trend, boreal caribou movement between ranges, habitat condition between ranges, distribution of resources for restoration efforts, and others. In prioritizing recovery actions, consideration should be given to the current risk of extirpation of a local population, the length of time to achieve a self-sustaining status, ecological needs of connectivity, representivity and redundancy, as well as population and habitat conditions.

5.5 Achieving Recovery for Self-Sustaining Local Populations

Recovery is achieved for the 15 self-sustaining local populations by maintaining population and range conditions that support their self-sustaining status.

5.6 Achieving Recovery for Not Self-Sustaining Local Populations

Recovery is achieved for the 36 not self-sustaining local populations through a combination of coordinated habitat restoration and population management actions applied over time to return a local population to a self-sustaining status. For each not self-sustaining local population, the timeframe for achieving recovery will vary depending on whether the habitat condition and/or the population condition is/are a limiting factor.

For boreal caribou ranges where local populations are declining, stabilizing the local population by halting its decline will require immediate action. For all ranges wherein the local population size is small, achieving a stable population trend and recovering the population to a minimum of 100 animals[3] will be necessary to mitigate risk of quasi-extinction. Although certain local populations with fewer than 100 animals may be stable and persist over the short-term where adequate suitable habitat supply is available, the long-term persistence of those populations is less certain. In some instances, continued human intervention may be required to achieve the minimum population size target.

In addition to managing local population size, habitat management will also be necessary. This recovery strategy identifies 65% undisturbed habitat in all ranges except SK1, and 40% undisturbed habitat in SK1, as the disturbance management threshold. This provides a

[3] 100 animals provides a 0.7 probability of not reaching a quasi-extinction threshold of less than 10 reproductively active females under stable conditions over 50 years (Environment Canada, 2011b).

measurable probability (60% for all ranges with the exception of SK1, which has a 71% probability) for a local population to be self-sustaining (see Appendix E).

For boreal caribou ranges with undisturbed habitat below the threshold:

- Restoration of disturbed habitat to a minimum of 65% undisturbed habitat will be necessary in all ranges except SK1, where the threshold is set at 40% undisturbed habitat.

For boreal caribou ranges with undisturbed habitat equal to or above the threshold:

- Maintenance of a minimum of 65% undisturbed habitat will be necessary in all ranges except SK1, where maintenance of a minimum of 40% undisturbed habitat will be necessary.

There are 31 ranges that do not meet the disturbance management threshold of 65% undisturbed habitat (40% undisturbed habitat for SK1) (see Section 7.1). Of these ranges, local population trends are declining (16 local populations), stable (eight local populations) or unknown (seven local populations).

There are 20 ranges where the habitat condition meets or exceeds the disturbance management threshold. Of these ranges, four local populations are declining, two local populations are stable, and the trend of 14 local populations is unknown.

6 BROAD STRATEGIES AND GENERAL APPROACHES TO MEET OBJECTIVES

6.1 Actions Already Completed or Currently Underway

Federal, provincial and territorial governments, wildlife management boards, Indigenous people, non-government organizations, and affected industries across Canada have taken and continue to take a range of actions to manage and protect boreal caribou and their habitat. Environment and Climate Change Canada's 5-Year Progress Report, published in October 2017, highlights progress made by governments, Indigenous people, and other partners and stakeholders in implementing the 2012 Recovery Strategy (Environment and Climate Change Canada, 2017). Examples of actions already completed or currently underway vary across Canada, and include:

- Identification and delineation of boreal caribou ranges and habitats within ranges;
- Assessment of the population size and/or trend and/or distribution of local populations of boreal caribou across Canada;
- Consideration of boreal caribou habitat requirements when planning and implementing forest harvesting and other industrial activities;
- Development and implementation of operating guidelines for industrial development within boreal caribou ranges;
- Land-use planning to identify areas within boreal caribou ranges where boreal caribou conservation is prioritized;
- Closed, restricted, and/or managed hunting by Indigenous and non-Indigenous people, on a voluntary basis or through regulations;
- Predator and alternate prey management in some ranges where local populations of boreal caribou are rapidly declining;
- Development of cooperative stewardship agreements and activities to support the engagement of Indigenous organizations and stakeholders in the monitoring, management, and conservation of boreal caribou;
- Preparation of outreach materials on boreal caribou and dissemination to interest groups and the general public;
- Research on boreal caribou ranges, habitat, ecology and limiting factors; and
- Continue to implement the Action Plan for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada – Federal Actions, including as it relates to the development of conservation agreements (Environment and Climate Change Canada, 2018).

Collectively, these actions, and the level of commitment associated with these actions, are an encouraging foundation upon which to build. Table 4 outlines the status of provincial and territorial recovery planning for boreal caribou.

Table 4. Status of boreal caribou recovery planning, as of April 2019, in provincial and territorial jurisdictions where boreal caribou occur.

Provincial/ Territorial Jurisdiction	Recovery Document	Recovery Goal/Objective
Northwest Territories	• Recovery Strategy for the Boreal Caribou (*Rangifer tarandus caribou*) in the Northwest Territories, 2017	• Ensure a healthy and sustainable boreal caribou population across their territorial range that offers harvesting opportunities for present and future generations.
British Columbia	• Implementation Plan for the Ongoing Management of Boreal Caribou in British Columbia, 2011 • An updated recovery planning document is being collaboratively developed	• Decrease the expected rate of decline • Significantly reduce the risk of extirpation for four populations within 50 years
Alberta	• A Woodland Caribou Policy for Alberta, June 2011 • Alberta Woodland Caribou Recovery Plan, 2004/05 – 2013/14	• Achieve self-sustaining woodland caribou herds and maintain the distribution of caribou in the province • Ensure long-term habitat requirements throughout caribou ranges in the province
Saskatchewan	• Conservation Strategy for Boreal Woodland Caribou (*Rangifer tarandus caribou*) in Saskatchewan, 2013	• Sustain and enhance woodland caribou populations, and maintain the ecosystems they require, throughout their current range
Manitoba	• Manitoba's Boreal Woodland Caribou Recovery Strategy, 2015	• Self-sustaining local populations of boreal caribou across all management units • Management and protection of caribou habitat to sustain boreal caribou populations
Ontario	• Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*)(Forest-dwelling, Boreal Population) in Ontario, 2008 • Ontario's Woodland Caribou Conservation Plan, 2009	• Maintain self-sustaining, genetically-connected local populations of Woodland Caribou (forest-dwelling boreal population) where they currently exist, improve security and connections among isolated mainland local populations, and facilitate the return of caribou to strategic areas near their current extent of occurrence
Quebec	• Quebec Recovery Plan for Woodland Caribou, 2013-2023	• Maintain suitable habitat for caribou • Maintain current distribution • Achieve and maintain uniform distribution (> 11,000 caribou)
Newfoundland and Labrador	• Recovery Strategy for Three Woodland Caribou Herds (*Rangifer tarandus caribou*; Boreal population) in Labrador, 2004 • Updated Recovery Plan is being prepared	• Prevent extinction and improve status of current herds • Determine and achieve viable, self-sustaining wild populations distributed throughout their available current and historical ranges for each of the three herds

6.2 Strategic Direction for Recovery

The following table (see Table 5) and narrative describe, at a national level, the broad strategies and general approaches to be taken and the research and management activities needed to address the threats to boreal caribou and achieve the population and distribution objectives for each range. Many strategies and approaches are interrelated and details on their implementation and their level of priority will differ across the country and by local population and habitat conditions. Sequencing and timing of specific recovery actions and their level of priority will be outlined and addressed in range plans and/or action plans (see Sections 7.3 and 9).

Table 5. Recovery planning table for boreal caribou

Threat or Limitation	Priority[5]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Landscape Level Planning			
Habitat alteration as a result of human land-use activities Habitat alteration as a result of natural processes	Urgent	Undertake landscape level planning that considers current and future boreal caribou habitat requirements	• Develop range plans (see Section 7.3) that outline range-specific population and habitat management activities with measurable targets to achieve recovery goal. • Undertake coordinated land and/or resource planning to ensure that development activities are planned (type, amount, and distribution) and implemented at appropriate spatial and temporal scales (e.g. consider sensitive periods/areas such as calving). • Plan to maintain habitat within and between boreal caribou ranges, to maintain connectivity where required. • Undertake coordinated planning among provincial and territorial jurisdictions that jointly manage ranges (i.e. transboundary ranges) to reach agreement on the overall strategic direction for local population recovery. • Develop range-appropriate cumulative effects assessment approaches. Very large ranges (Northwest Territories (NT1), Far North (ON9), and Quebec (QC6)) will require different approaches. • Communicate among governments, wildlife management boards, Indigenous communities and organizations, non-governmental organizations, and other organizations responsible for land and/or resource management and/or conservation within the boreal forest to ensure coordination of planning and management and, where applicable, facilitate cross-jurisdictional cooperation and implementation.
Habitat Management			
Habitat alteration as a result of human land-use activities Habitat alteration as a result of natural processes	Urgent	Manage habitat to meet current and future habitat requirements of boreal caribou	• Protect key areas for boreal caribou through appropriate habitat management and protection mechanisms (e.g. legislated protected areas, no development zones, mixed use zones, and conservation agreements). • Undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts (e.g. restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented ranges).

Threat or Limitation	Priority[5]	Broad Strategy to Recovery	General Description of Research and Management Approaches
			• Measure and monitor disturbance on the landscape (see Section 4.2.1). Update range plans to reflect changes in habitat condition. • Where ranges are highly disturbed, identify areas that will be prioritized for boreal caribou recovery and targeted for early habitat reclamation. Incorporate management guidelines and actions into permitting conditions for activities identified as affecting boreal caribou or their habitat. • For ranges that are jointly managed (i.e. transboundary), undertake collaborative habitat management among responsible provincial and territorial jurisdictions to ensure equitable efforts are underway. • Encourage stewardship of boreal caribou habitat among industries, interest groups, and Indigenous communities and organizations. • Assess the impact of natural disturbance (e.g. forest fire) on the long-term habitat management of boreal caribou ranges. Where necessary, incorporate short- and long-term boreal caribou habitat considerations, along with other considerations, into forest fire management. • Monitor habitat and use adaptive management to assess progress and adjust management activities as appropriate.
Mortality and Population Management			
Predation	High	Manage predators and alternate prey	• Where necessary, apply predator management as an interim management tool, in conjunction with other management approaches (e.g. habitat restoration and management), to achieve boreal caribou local population growth. Alternate prey management may also be applied in conjunction with predator management. • Where applicable, consider effective indirect predator management techniques as an alternative to direct predator management (e.g. limiting predator access, penning of boreal caribou). • Where mortality and/or population management are implemented, monitor boreal caribou local populations and consider monitoring the effects on other impacted species.
Hunting	Medium	Manage direct human-caused mortality of boreal caribou	• Determine the extent of current hunting, and the effects of hunting on boreal caribou local populations. • In consultation with Indigenous people, develop and implement harvest strategies, where required to achieve boreal caribou recovery. • Assess and address impacts of hunting regulations for all boreal caribou ranges that overlap with other legally hunted Woodland Caribou ecotypes. • Reduce illegal hunting through stewardship, education and enforcement.

Threat or Limitation	Priority[5]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Population Monitoring			
Knowledge gaps: Population dynamics (trends, size, structure, and distribution)	High	Conduct population studies to better understand population structure, trends and distribution	• Where necessary, refine understanding of the structure and functioning of boreal caribou local populations. • Monitor population size and/or trend, as well as changes in boreal caribou distribution over time and in relation to habitat condition and disturbance. • Coordinate data collection, data-sharing, and planning between or among neighbouring provincial and territorial jurisdictions to establish transboundary ranges where appropriate. • Revise boreal caribou range delineations based on updated population information from science and Indigenous Knowledge.
Knowledge gaps: boreal caribou health and condition	Low - Medium	Monitor boreal caribou health and condition	• Gather information, monitor and manage the health and body condition of individual boreal caribou.
Knowledge gaps: boreal caribou sensory disturbance	Low - Medium	Monitor and manage sensory disturbance of boreal caribou	• Assess the extent, distribution, and possible consequences of sensory disturbance (e.g. aircraft traffic, snowmobiles, all-terrain vehicles, tourism, research, and equipment associated with oil and gas or forestry) on boreal caribou, and where required reduce its effects, particularly during sensitive periods (e.g. calving). • Minimize disturbance to boreal caribou during monitoring and research programs, and select monitoring and research techniques that are the least intrusive.

[5] *Priority: reflects the level of priority of the broad strategy on a national level. This priority for each local population may differ.*

6.3 Narrative to Support the Recovery Planning Table

Recovery of boreal caribou will require the commitment, collaboration and cooperation among federal, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, local communities, landowners, industry and other interested parties. It will be important to monitor habitat conditions, size and/or trend, and the distribution of boreal caribou local populations so that the effectiveness of individual range management regimes can be evaluated, and adjusted as necessary. It should also be recognized that it takes time for the impact of human developments and natural disturbances on boreal caribou to become evident. Therefore, range plans and/or action plans must take into account the likelihood of a delayed boreal caribou population and distribution response to anthropogenic or natural habitat alterations.

6.3.1 Landscape Level Planning

As the range has been identified as the most relevant scale at which to plan for the conservation of boreal caribou, undertaking landscape level land and/or natural resource planning is appropriate for effective management of cumulative effects of habitat disturbance within boreal caribou ranges and for managing disturbance over time to ensure sufficient habitat is available for boreal caribou, both of which are more difficult in the context of individual project approvals. Range-level planning for boreal caribou should consider current and future human developments and determine detailed management activities that are tailored to the conditions of the range and the local population in question. Range plans and/or action plans should take into account natural disturbances and cumulative effects of development within and between boreal caribou ranges.

It will be important to undertake coordinated land and/or resource planning to ensure that development activities are planned and approved, taking into consideration the cumulative impacts of all current and future developments within a range. Assessing cumulative effects will require a different approach for large continuous ranges than for smaller discrete ranges. The impact of disturbance that may be concentrated in part of a large continuous range may be masked given the size of the range. Dividing the large areas into smaller management units may allow land managers to better understand where the disturbance is occurring and plan accordingly, in order to avoid irreversible range retraction and permanent breaks in range connectivity.

In light of the impacts that actions taken in neighbouring ranges have on boreal caribou, it will be important that provinces and territories take a collaborative approach to land and/or resource planning, particularly in ranges that are jointly managed (i.e. transboundary), to ensure an agreed upon direction to boreal caribou recovery is attained.

6.3.2 Habitat Management

Boreal caribou ranges will need to be managed to ensure their current and future ability to support self-sustaining local populations. The effectiveness of various management activities may vary between and within ranges due to differences in population condition and specific local conditions.

Management of the amount, type and distribution of human developments will be necessary. Both anthropogenic and natural disturbances will need to be monitored and measured. Methods may vary in accordance with the information and tools available to the provinces and territories. Anthropogenic disturbance (i.e. industrial and other human activities) will need to be managed in a manner consistent with land and/or resource planning that has taken into account the current and future habitat requirements of boreal caribou. Disturbed areas may need to be improved or restored to support population and distribution objectives within each boreal caribou range. Maintaining connectivity within and between habitat patches and ranges will be particularly important for boreal caribou. In certain cases, it may be necessary to identify and designate protected areas with biophysical attributes for boreal caribou. For ranges that are jointly managed by provinces and territories (i.e. transboundary), collaborative habitat management approaches will be necessary to ensure that equitable recovery efforts are underway. Though ranges may cross provincial and territorial boundaries, each jurisdiction remains accountable for activities carried out in their own range.

6.3.3 Mortality and Population Management

6.3.3.1 Manage Predators and Alternate Prey

Human-induced habitat alterations have upset the natural balance between boreal caribou and their predators, resulting in unnaturally high predation rates in some boreal caribou ranges. As a result, in some ranges, a population management approach involving management of other wildlife species (i.e. predators and alternate prey) may be required to stop boreal caribou declines and stabilize the local population in order to prevent their extirpation in the short-term. Where the condition of the local population warrants such measures, predator and in some cases alternate prey management may be applied as interim management tools, recognizing that a punctuated approach to mortality management may be necessary over a period of time while habitat conditions in the range recover. Where mortality management is applied, concurrent application of other management tools will be needed to achieve boreal caribou recovery. In particular, habitat restoration and management will be necessary to recover the range conditions to provide an adequate habitat supply system to support boreal caribou local populations. Predator and alternate prey management should be considered simultaneously. Alternate prey management applied in the absence of concurrent predator management has the potential to be harmful to boreal caribou conservation.

6.3.3.2 Manage Direct Human-Caused Mortality of Boreal Caribou

The extent of hunting and its effect on boreal caribou local populations is largely unknown across most of the distribution of boreal caribou. Therefore, it is important to first determine the level of hunting within a range in order to understand the potential impact of hunting on the viability of a local population. Attention should also be given to areas where boreal caribou ranges overlap with legally hunted caribou ecotypes, and hunting regulations for the legally hunted caribou ecotypes should be modified as appropriate. In areas where hunting is shown to have a negative effect on local population viability, harvest strategies should be developed, in consultation with Indigenous people, to achieve boreal caribou recovery.

6.3.4 Population Monitoring

6.3.4.1 Conduct Population Studies to Better Understand Boreal Caribou Population Structure, Trends and Distribution

There is considerable variation in the level of understanding of boreal caribou local population structure and trends across their distribution. While accurate population size and trend estimates are available for some local populations, for others, size and trend estimates are based primarily on professional judgement and limited data. For local populations where little is known, baseline population ecology studies such as boreal caribou collaring, aerial observations/counting, and on the ground monitoring activities are required to establish a baseline from which to plan and measure recovery progress. For all local populations, size and/or trend, and distribution should be monitored over time to test the efficacy of management actions and adapt those management actions as appropriate.

6.3.4.2 Monitor Boreal Caribou Health and Condition

Parasites and disease can affect individual boreal caribou and may have effects at the local population level in certain parts of the country. Pollution from oil and gas contaminated sites has also been shown to negatively affect the health of boreal caribou and may result in mortality if individuals consume toxins at waste sites. However, little is known about the severity of parasites, disease and pollution to individual boreal caribou or to boreal caribou local populations. Therefore, information on the health and body condition of boreal caribou should be monitored to better understand the relationship between these threats and the viability of local populations, and whether there is a need for additional recovery actions.

6.3.4.3 Monitor and Manage Sensory Disturbance of Boreal Caribou

The extent, distribution and effects of various sources of sensory disturbance (e.g. low-flying aircraft, snowmobiles, equipment associated with various industries) on individual boreal caribou and boreal caribou local populations should be assessed. Where required, management actions to reduce the effects of sensory disturbance on boreal caribou should be implemented and the effectiveness of the management actions should be monitored over time and adapted as necessary.

7 CRITICAL HABITAT

Under SARA, critical habitat is defined as “the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in the recovery strategy or in an action plan for the species”. For boreal caribou, critical habitat identification describes the habitat that is necessary to maintain or recover self-sustaining local populations throughout their distribution. In some of the areas identified as critical habitat, the quality of habitat will need to be improved for recovery to be achieved.

Boreal caribou shift in their use of range over space and time, in accordance with changes in the location of biophysical attributes within the range as areas of disturbed and undisturbed habitat cycle on the landscape. For a local population to be self-sustaining over time, this habitat supply system (i.e. critical habitat) must function perpetually.

7.1 Identification of Critical Habitat for Boreal Caribou

7.1.1 Critical Habitat for All Ranges Except the Boreal Shield Range

Based on the foregoing, critical habitat for boreal caribou is identified for all boreal caribou ranges, except for northern Saskatchewan’s Boreal Shield range (SK1), (see Figure 5) as:

- The area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat; and
- Biophysical attributes required by boreal caribou to carry out life processes (see Appendix H).

Based on methodology developed by Environment and Climate Change Canada (2011b), a disturbance management threshold of 65% has been identified, which provides a measurable probability (60%) for a local population to be self-sustaining (see Appendix E). The precise location of the 65% undisturbed habitat within the range will vary over time. The habitat within a range should exist in an appropriate spatial configuration such that boreal caribou can move throughout the range and access required habitat when needed. The key to this identification is achieving and maintaining an overall, ongoing range condition that allows for the dynamic habitat supply system, containing the biophysical attributes upon which boreal caribou depend, to operate. It is this dynamic habitat supply system within the range boundaries that is the habitat condition necessary for the recovery of boreal caribou.

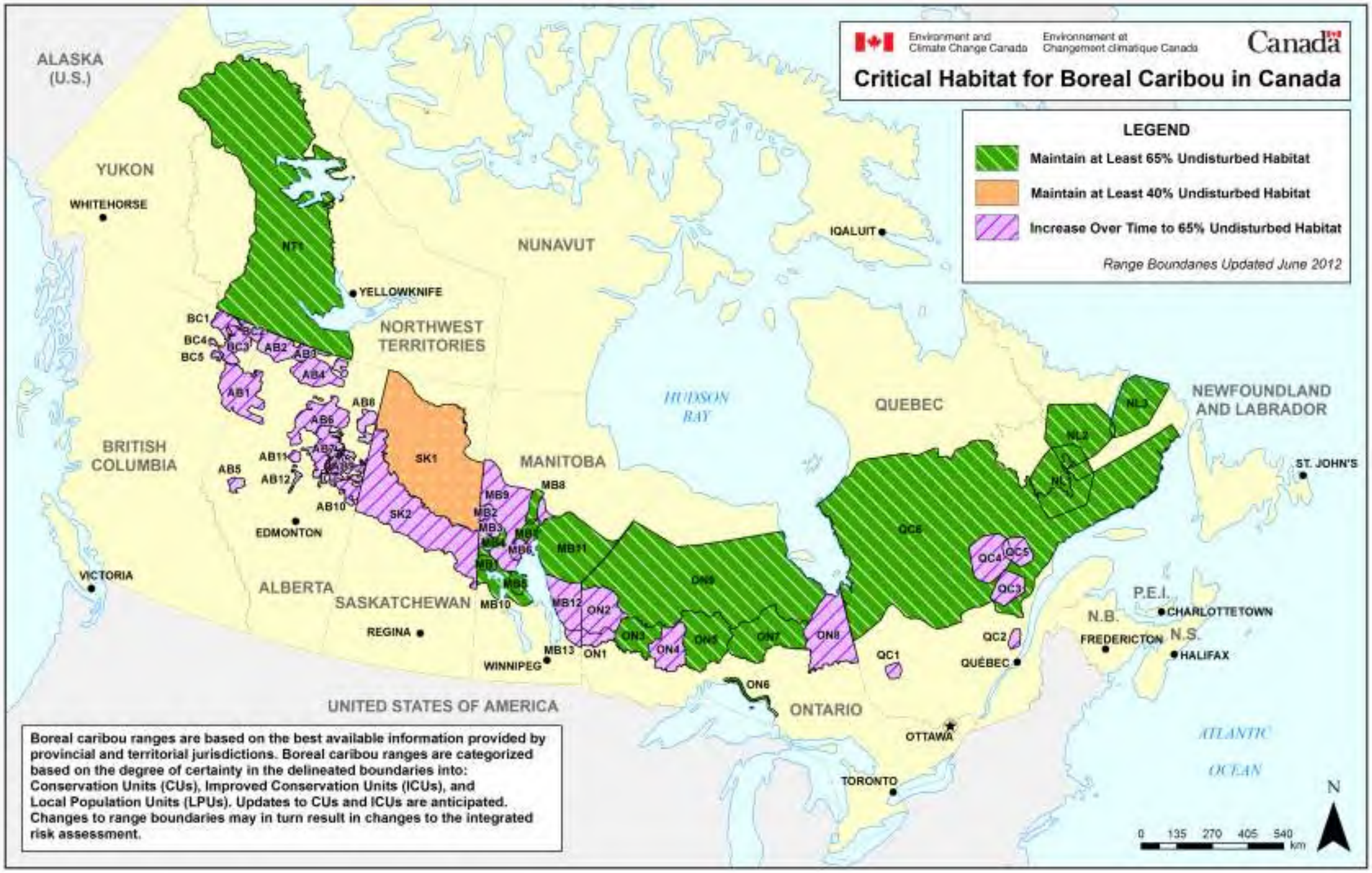

Figure 5. Critical habitat for boreal caribou in Canada as of 2019. Updated information includes the identification of critical habitat in SK1. MB6 and QC5 have also been updated from green to mauve based on habitat condition information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

7.1.2 Critical Habitat in Northern Saskatchewan's Boreal Shield Range (SK1)

Critical habitat was not identified in SK1 in the 2012 Recovery Strategy due to a lack of data on population size and trend, and the uniqueness of the disturbance regime (i.e. high fire and very low anthropogenic disturbance). As required under SARA, a schedule of studies was developed to identify critical habitat in SK1 and the schedule of studies is now complete (see Appendix D).

Critical habitat for boreal caribou in northern Saskatchewan's Boreal Shield range (SK1), (see Figure 5) is identified as:

- The area within the boundary of the SK1 boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 40% of the area as undisturbed habitat; and
- Biophysical attributes required by boreal caribou to carry out life processes (see Appendix H).

Based on three years of demographic data collected in SK1 between 2015 and 2017 by P.D. McLoughlin (University of Saskatchewan, personal communication), as part of the schedule of studies to identify critical habitat, additional analyses were completed by Environment and Climate Change Canada that indicate the SK1 local population is likely self-sustaining at current levels of disturbance (60% total disturbance), with a 71% probability of persistence (see Figure 3 and Appendix E). Environment and Climate Change Canada's analyses also show that the SK1 local population is sensitive to small increases in anthropogenic disturbance and sensitive to small decreases in adult survival. For these reasons, a higher probability of persistence was selected for critical habitat identification in SK1 (71%) than was selected for the other 50 ranges across Canada (60%) (Environment and Climate Change Canada, 2019).

The precise location of the 40% undisturbed habitat within the range will vary over time. The habitat within the SK1 range should exist in an appropriate spatial configuration such that boreal caribou can move throughout the range and access required habitat when needed. The key to this identification is achieving and maintaining an overall, ongoing range condition that allows for the dynamic habitat supply system, containing the biophysical attributes upon which boreal caribou depend, to operate. It is this dynamic habitat supply system within the SK1 range boundary that is the habitat condition necessary for the recovery of boreal caribou.

7.1.3 Components of Critical Habitat

The identification of critical habitat for boreal caribou is comprised of three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat. Appendix J provides critical habitat component information for each boreal caribou range.

Location

Location describes where critical habitat is found. For boreal caribou the relevant scale to identify critical habitat is the range, which delineates the area within which critical habitat is located. There are 51 ranges within the current distribution of the boreal caribou (see Figure 2 and Table 2).

Amount

Amount describes the quantity of critical habitat.

A strong relationship exists between habitat disturbance and whether a local population is stable, increasing or decreasing. As the quantity and/or severity of disturbance increases, there is increasing risk that a local population will be in decline (Environment Canada, 2011b), as further described in Appendix E.

Amount for all ranges except the Boreal Shield range: With the exception of the Boreal Shield range (SK1), this recovery strategy identifies a minimum of 65% undisturbed habitat in a range as the disturbance management threshold, which provides a measurable probability (60%) for a local population to be self-sustaining. This threshold is considered a minimum threshold because at 65% undisturbed habitat there remains a significant risk (40%) that local populations will not be self-sustaining.

Amount for the Boreal Shield range: For SK1, this recovery strategy identifies a minimum of 40% undisturbed habitat in the range as the disturbance management threshold, which provides a measurable probability (71%) for the local population to be self-sustaining. This threshold is considered a minimum threshold because at 40% undisturbed habitat there remains a risk (29%) that the local population will not be self-sustaining.

Habitat disturbance within a range needs to be managed by the responsible jurisdiction at a level that will allow for a local population to be self-sustaining. As there is variation in habitat and population conditions between boreal caribou local populations across their distribution, for some ranges it may be necessary to manage the range above the 65% undisturbed habitat threshold, while for other ranges, such as SK1, it may be possible to manage the range below the 65% undisturbed habitat threshold. However, there must be strong evidence, validated by Environment and Climate Change Canada, from population data collected over an extended period of time to support the management decision to establish a lower range-specific threshold (i.e. the lag effects of disturbance on a local population have been considered and accounted for).

In the absence of strong evidence to support lowering the undisturbed habitat threshold below 65%, the amount of critical habitat for all ranges, except SK1, is at least 65% undisturbed habitat. For management purposes, the amount of critical habitat may need to be maintained or restored, depending on the level of disturbance in a range.

- In ranges with undisturbed habitat below the threshold, initially, critical habitat is the existing habitat that over time would contribute to the attainment of 65% undisturbed habitat (40% undisturbed habitat for SK1).
- In ranges with undisturbed habitat equal to or above the threshold, critical habitat is at least 65% undisturbed habitat in a range (40% undisturbed habitat for SK1).
- The habitat that is included in the 65% undisturbed habitat (40% undisturbed habitat for SK1) will change over time given the dynamic nature of the boreal forest.

As previously reported in the 5-Year Progress Report, two ranges – the William Lake range (MB6) and the Manicouagan range (QC5) – changed from having greater than 65% undisturbed habitat to having less than 65% undisturbed habitat (Environment and Climate Change Canada, 2017). This change is reflected in both Figure 5 and Appendix J, where the amount of critical habitat for these two ranges changed from green ("maintain at least 65% undisturbed habitat") to mauve ("increase over time to 65% undisturbed habitat").

Section 4.2.1 describes the methodology used to measure disturbance for each range.

Type

Type describes the biophysical attributes of critical habitat.

Biophysical attributes are the habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. Biophysical attributes within and adjacent to core habitat areas of boreal caribou use will be more important to a local population than those that are isolated and less accessible to boreal caribou (i.e. spatially separated by a disturbance). The biophysical attributes for boreal caribou will vary over space and time with the dynamic nature of the boreal forest. In addition, particular biophysical attributes will be of greater importance to boreal caribou at different points in time. Certain biophysical attributes are required more by a local population during different life processes, seasons or at various times over the years.

Information from Indigenous Knowledge (Boreal Caribou ATK Reports, 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize the biophysical attributes necessary for boreal caribou. Results are categorized by the habitat type (e.g. calving habitat, winter habitat) and are provided by ecozone in order to capture the ecological variation across the current distribution of boreal caribou (see Appendix H). In addition to variation across ecozones, the biophysical attributes necessary for boreal caribou will vary both between and within ranges. For certain ranges, more specific information was made available to describe biophysical attributes and this has been included in Appendix H.

7.2 Activities Likely to Result in the Destruction of Critical Habitat

SARA requires that a recovery strategy identify examples of activities likely to destroy critical habitat. Destruction is determined on a case by case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by boreal caribou. Destruction may result from a single activity, multiple activities at one point in time, or from the cumulative effects of one or more activities over time.

Activities that are likely to result in the destruction of critical habitat, include, but are not limited to, the following:

- Any activity resulting in the direct loss of boreal caribou critical habitat. Examples of such activities include: conversion of habitat to agriculture, forestry cut blocks, mines, and industrial and infrastructure development.

- Any activity resulting in the degradation of critical habitat leading to a reduced, but not total loss of both habitat quality and availability for boreal caribou. Examples of such activities include: pollution, drainage of an area, and flooding.
- Any activity resulting in the fragmentation of habitat by human-made linear features. Examples of such activities include: road development, seismic lines, pipelines, and hydroelectric corridors.

7.2.1 Likelihood of Critical Habitat Destruction for All Ranges Except the Boreal Shield Range

The likelihood that critical habitat will be destroyed is increased if any one of the above activities, or combination thereof, were to occur in such a manner, place and time, that after appropriate mitigation techniques (see Appendix I) any one of the following were to occur:

- Compromise the ability of a range to be maintained at 65% undisturbed habitat;
- Compromise the ability of a range to be restored to 65% undisturbed habitat;
- Reduce connectivity within a range;
- Increase predator and/or alternate prey access to undisturbed areas; or
- Remove or alter biophysical attributes necessary for boreal caribou.

7.2.2 Likelihood of Critical Habitat Destruction for the Boreal Shield Range

For the Boreal Shield range (SK1), the likelihood that critical habitat will be destroyed is increased if any one of the above activities, or combination thereof, were to occur in such a manner, place and time, that after appropriate mitigation techniques (see Appendix I) any one of the following were to occur:

- Compromise the ability of the range to be maintained at 40% undisturbed habitat;
- Increase total anthropogenic disturbance within the range above 5% (while maintaining a minimum of 40% undisturbed habitat);
- Reduce connectivity within the range;
- Increase predator and/or alternate prey access to undisturbed areas; or
- Remove or alter biophysical attributes necessary for boreal caribou.

Based on Environment and Climate Change Canada's 5-Year Progress Report, and as reported in Appendix F, the SK1 range currently has 40% undisturbed habitat (or 60% disturbed habitat) (Environment and Climate Change Canada, 2017). The 60% total non-overlapping disturbance is comprised of 58% fire and 3% anthropogenic disturbance[4]. Analyses conducted by Environment and Climate Change Canada, using population data provided by the University of Saskatchewan, indicates that based on the three years of available population data there is a 71% probability that

[4] When calculating total disturbance for a range, anthropogenic disturbance and fire disturbance that overlap are not counted twice in the total.

the SK1 location population is self-sustaining at the current levels of disturbance (P.D. McLoughlin, University of Saskatchewan, personal communication; Environment and Climate Change Canada, 2019). Environment and Climate Change Canada's analyses also investigated the changes in the probability of persistence with increasing levels of anthropogenic disturbance in the range. Results show that with an additional 2.5–3.0% anthropogenic disturbance, the probability of persistence of the SK1 local population drops from 71% to 60%, and to 50% when the additional anthropogenic disturbance reaches 5% (Environment and Climate Change Canada, 2019). The analyses did not consider the additional effects of fire disturbance due to the difficulties in managing wildfires.

Additional analyses by Environment and Climate Change Canada (2019) demonstrated that anthropogenic disturbance is not equivalent to fire, with the former having a stronger negative effect on population condition. This result, coupled with the analyses that showed that the local population is sensitive to small increases in anthropogenic disturbance and sensitive to small decreases in adult survival, indicates that caution is warranted with respect to additional anthropogenic disturbance in this range (see Appendix D) (Environment and Climate Change Canada, 2019). Therefore, for SK1 critical habitat, activities that pertain specifically to increasing the level of anthropogenic disturbance in SK1 has been added to the list of factors that increase the likelihood that critical habitat will be destroyed.

7.2.3 Cumulative Effects

A single project/activity may or may not result in the destruction of critical habitat; however, when considered in the context of all current and future development activities within and among ranges, the cumulative impacts may result in the destruction of critical habitat.

Mitigation of adverse effects from individual projects/activities will require a coordinated approach and management of cumulative effects within and among ranges. A cumulative effects assessment is essential to position the proposed project/activity in the context of all current and future development activities. The cumulative effects assessment will:

- Assess the impact of all disturbances (anthropogenic and natural) at the range-scale;
- Monitor habitat conditions, including the amount of current disturbed and undisturbed habitat (see Section 4.2.1), and amount of habitat being restored;
- Account for planned disturbances; and
- Assess the distribution of disturbance in large ranges for risk of range retraction in parts of the range.

For large continuous ranges, a different approach for assessing cumulative effects will be required than for smaller discrete ranges. Dividing the large areas into smaller management units will allow land managers to understand where the disturbance is occurring and avoid irreversible range retraction and a permanent break in range connectivity.

Determination of whether an activity is likely to result in the destruction of critical habitat will be facilitated by a range plan. For example, a range plan would identify activities that are likely to result in direct loss, degradation, and/or fragmentation of habitat, relevant to specific local circumstances. Any development that does not align with the range plan would be considered an activity likely to destroy critical habitat.

7.3 Range Plans

Given the dynamic nature of boreal caribou habitat requirements, the landscape scale at which those requirements operate, and the highly variable present-day land management and ecological conditions that exist among all boreal caribou ranges, range-specific approaches to protecting critical habitat, and in many cases improving the condition of critical habitat for this species, are needed.

In light of jurisdictional responsibilities for land and natural resource management, it is expected that they will develop range plans. In areas where the responsibility for land and natural resource management varies, range plans will be developed collaboratively between all responsible authorities. Range plans may be stand-alone documents, or part of other planning documents including action plans. In September 2016, Environment and Climate Change Canada published the Range Plan Guidance for Woodland Caribou, Boreal Population to assist provincial and territorial jurisdictions in their preparation of range plans (Environment and Climate Change Canada, 2016). The Range Plan Guidance provides general guidance on the development of range plans and is consistent with the guidance provided in this recovery strategy.

Range plans will outline how the given range will be managed to maintain or attain a minimum of 65% undisturbed habitat in all ranges other than SK1, and 40% undisturbed habitat in the SK1 range, over time. Specifically each range plan should reflect disturbance patterns on the landscape, as measured and updated by the provinces and territories, and outline measures and steps that will be taken to manage the interaction between human disturbance and natural disturbance.

Difference between a range plan and an action plan

Action plans, which are required under SARA, provide the public and stakeholders with details on how the recovery strategy will be implemented. Action plans include a broad spectrum of subjects, such as: measures to address threats and to achieve population and distribution objectives; an evaluation of socio-economic costs and benefits to be derived from its implementation; and an approach for monitoring and reporting, etc. An action plan is not necessarily range-specific; it could cover multiple ranges or even specific recovery measures within a range. Range plans are documents that outline how a given range will be managed to ensure that critical habitat is protected from destruction.

Purpose of a range plan

The main purpose of a range plan is to outline how range-specific land and/or resource activities will be managed over space and time to ensure that critical habitat is protected from destruction. As such, each range plan should reflect disturbance patterns on the landscape, as measured and updated by the provinces and territories, and outline the measures and steps that will be taken to manage the interaction between human disturbance, natural disturbance, and the need to maintain or establish an ongoing, dynamic state of a minimum of 65% of the range as undisturbed habitat in all ranges other than SK1, and 40% undisturbed habitat in the SK1 range, at any point in time to achieve or maintain a self-sustaining local population. While the general ecological principles and critical habitat dynamics described in the recovery strategy apply to all ranges, individual ranges also possess a unique mix of ecological and land use conditions (e.g. population condition, habitat condition and configuration, social and legal arrangements) that must be factored into decision making.

The range plans, consistent with this recovery strategy, will be one factor considered by the Minister of Environment and Climate Change in forming an opinion on whether the laws of the province or territory effectively protect critical habitat within each boreal caribou range. As such, range plans should contain the background information necessary for the Minister of Environment and Climate Change to make an informed assessment of whether critical habitat protection is in place or is being realistically pursued throughout the range. Specifically, range plans should indicate what laws of the province or territory, legislative and/or regulatory provisions, licences or other instruments issued under an Act or regulation, or contractually binding agreements the jurisdiction intends to use to protect critical habitat. In the absence of range plans, the minister will use the best available information and consult with the jurisdiction to determine whether critical habitat is effectively protected. If the minister is of the opinion that there are no provisions in or measures under SARA or another Act of Parliament that protect the critical habitat (including a section 11 agreement) and the laws of the provinces and territories do not effectively protect their critical habitat, the Minister of Environment and Climate Change is required to recommend that a protection order be made to the to the Governor in Council.

Range plans may form part of an action plan under SARA. However, in order to be adopted in whole or in part as an action plan by the Minister of Environment and Climate Change, the range plan and the process used to develop it will need to meet the requirements of section 48 (cooperation) and section 49 (content) of SARA. In addition, range plans will be used to inform reporting that is required under SARA on implementation and progress toward meeting the population and distribution objectives of this recovery strategy. Finally, range plans may be used to inform decisions related to environmental assessments, issuance of permits (either under SARA or other applicable legislation), and other similar approval processes.

Process for developing a range plan

The development of each range plan will be led by the responsible provincial or territorial jurisdiction. In areas where the management responsibility for land and natural resource management varies, range plans will likely be multi-jurisdictional led between all responsible authorities. Range plans should be developed in a collaborative manner with directly affected stakeholders and should also engage local land users. Jurisdictions are encouraged to use Indigenous Knowledge when developing range plans and should also apply the appropriate level of cooperation with Indigenous peoples as they would in any other resource management planning process that is undertaken within their province or territory. The exact process of collaboration that is used is the responsibility of each jurisdiction and may vary between jurisdictions.

Range plans may be updated by the jurisdictions over time to reflect changes in habitat and population conditions for any given range. In particular, range plans should be updated following any significant natural disturbance event (e.g. forest fires).

Timelines for the development of range plans

Given the variation in management contexts, population and habitat information, and levels of risk across the geographic distribution of boreal caribou, the 2012 Recovery Strategy called for range plans to be completed by the responsible jurisdiction(s) within 3-5 years of the posting of the 2012 Recovery Strategy. Environment and Climate Change Canada continues to seek commitments to develop jurisdictional range plans or other similar documents through the development of conservation agreements.

For the Boreal Shield range (SK1), the Government of Saskatchewan should complete the range plan by June 2021.

What should be included in a range plan?

There is no single prescriptive approach to developing a range plan, and jurisdictions may select those approaches they consider most appropriate. Range plans should include such things as:

- Demonstration of how at least 65% undisturbed habitat (40% undisturbed habitat in SK1), will be achieved and/or maintained over time;
- For SK1, demonstration of how total anthropogenic disturbance in the range will be maintained at or below 5% (while maintaining a minimum of 40% undisturbed habitat) (see section 7.2.2);
- List of the laws of the province or territory (including any corresponding regulations, permits, licenses, etc.) and conservation measures (such as agreements, programs, compliance incentives, conservation leases, etc.) that will be used to prevent activities likely to destroy critical habitat;
    - include land tenure assessment for all areas of critical habitat within each range
    - where protection measures do not exist, the range plan should indicate the steps being taken to put them in place and the expected timeline for implementation
- Information on range-specific activities likely to destroy critical habitat within each range. This will involve identifying and assessing current projects/activities as well as any foreseeable future projects/activities, and should include a cumulative effects analysis;
- An approach for measuring disturbance to the landscape and monitoring critical habitat to ensure that protection mechanisms are in place and are working to prevent the destruction of boreal caribou critical habitat;
- An approach for monitoring population trends to ensure that local populations are responding positively to management techniques;
- An approach for monitoring natural disturbances, and habitat quality and quantity; and
- Identification of information needs and plans for addressing information gaps.

8 MEASURING PROGRESS

Under SARA, the competent minister must report on the implementation of a recovery strategy and the progress towards meeting its objectives every five years. Population and habitat conditions for boreal caribou will change over time given the changes to population demographics, the dynamic nature of the boreal ecosystem and the manner in which the species shifts in its use of the landscape over time. Accordingly, the five-year time frame for reporting on implementation allows for these changes to be included in an updated recovery strategy, and for subsequent range plans and action plans to be updated under an adaptive management framework.

Monitoring of boreal caribou local populations based on performance indicators will be essential to have the information necessary to evaluate the effectiveness of management actions and to make necessary adjustments through an adaptive management process over time.

8.1 Adaptive Management

The process of adaptive management planning and implementation acknowledges and supports the adjustment of management actions in light of new or more refined knowledge. Through adaptive management, knowledge gaps and uncertainties are identified, evaluated and reported as information needs, addressed through monitoring and research, and then implemented through revised and improved management actions.

The challenge of achieving the recovery goal of self-sustaining local populations of boreal caribou will vary by boreal caribou range given the habitat and population conditions and management context associated with each range. In order to ensure adaptive management is applied to boreal caribou recovery, cooperation with federal, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, and others involved in the conservation, survival and recovery of boreal caribou is required.

8.2 Performance Indicators

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

The ultimate performance indicator of boreal caribou recovery is self-sustaining local populations throughout the entirety of their distribution in Canada. Performance indicators for this recovery strategy are that the population and distribution objective is met for each boreal caribou range, and that boreal caribou become less at risk. Recovery of all boreal caribou local populations is technically and biologically feasible; however given the challenges of recovery for boreal caribou, some local populations that are currently not self-sustaining will likely require a number of decades to return to a recovered state.

The performance indicators described below are provided as national guidelines to gauge the successful implementation of the recovery strategy. More detailed performance indicators that reflect the specific local conditions (e.g. population condition, habitat condition, alternate prey/predator dynamics, mortality rates) of each boreal caribou range will need to be developed at the range plan and/or action plan stage.

General:

a) Complete range plans for each range within 3-5 years of the posting of the 2012 Recovery Strategy (see Section 7.3).

b) For SK1, complete the range plan by June 2021 (see Section 7.3).

Population Condition (population trend and size):

a) Maintain current distribution of boreal caribou across Canada.

b) Achieve and/or maintain a stable to increasing population trend as measured over five years (i.e. $\lambda \geq$ stable) or other empirical data that indicates population trend is stable or increasing.

c) Achieve a minimum of 100 animals[5] for boreal caribou ranges with population estimates of less than 100 animals, or show progress towards this goal every five years.

Habitat Condition (amount and type of undisturbed habitat):

a) For ranges that meet or exceed the undisturbed habitat threshold, maintain the undisturbed habitat that includes the biophysical attributes needed for boreal caribou to carry out life processes at a minimum of 65% (40% for SK1) of the total range.

b) For ranges below the 65% undisturbed habitat threshold (40% for SK1), identify in a range and/or action plan specific areas of existing undisturbed habitat, as well as those areas where future habitat is to be restored to an undisturbed condition over reasonable, gradual increments every five years.

c) Provide measurements of disturbance for each range that reflect the best available information, as provided by the provinces and territories, to update the recovery strategy accordingly every five years.

[5] 100 animals provides a 0.7 probability of not reaching a quasi-extinction threshold of less than 10 reproductively active females under stable conditions over 50 years (Environment Canada, 2011b).

9 STATEMENT ON ACTION PLANS

As required by SARA, the Minister of Environment and Climate Change published the Action Plan for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada – Federal Actions on the Species at Risk Public Registry on February 13, 2018 (Environment and Climate Change Canada, 2018). The Action Plan presents the recovery measures that the federal government is taking or plans to take to help achieve the recovery goal and population and distribution objectives for the species, as identified in the 2012 Recovery Strategy (Environment Canada, 2012a). In addition to this Action Plan, Parks Canada Agency site-specific Action Plans that address boreal caribou conservation and recovery efforts on lands administered by the Agency can be found on the SAR Public Registry.

Action plans provide information on recovery measures that should be taken by Environment and Climate Change Canada and other federal government departments and agencies including Parks Canada Agency, Crown-Indigenous Relations and Northern Affairs Canada, Department of National Defence and the Canadian Forces among others, provincial and territorial jurisdictions, wildlife management boards, Indigenous people, stakeholders and other organizations involved in the conservation, survival and recovery of boreal caribou. Action plans provide the public and stakeholders with details on how the recovery strategy will be implemented. Action plans include a broad spectrum of subjects, such as: measures to address threats and to achieve population and distribution objectives; an evaluation of socio-economic costs and benefits to be derived from its implementation; and, an approach for monitoring and reporting. An action plan is not necessarily range-specific; instead it could cover multiple ranges.

Range plans are documents that outline how the habitat condition within a given range will be managed over time and space to ensure that critical habitat for boreal caribou is protected from destruction and therein, that each local population will either continue to be self-sustaining or become self-sustaining over time. In September 2016, Environment and Climate Change Canada published the Range Plan Guidance for Woodland Caribou, Boreal Population to assist provincial and territorial jurisdictions in their preparation of range plans (Environment and Climate Change Canada, 2016).

The Minister of Environment and Climate Change may adopt or incorporate parts of a range plan, an existing provincial or territorial plan, or other relevant planning documents that meet the requirements of SARA as an action plan. Where the Minister of Environment and Climate Change proposes to adopt an existing plan or a portion of it as a SARA action plan, it will be posted on the Species at Risk Public Registry for the prescribed 60-day comment period. Within 30 days after the expiry of the comment period, and considering the comments received, the minister will publish a final action plan.

9.1 Coordinated Approach

9.1.1 Provincial and Territorial Jurisdictional Leadership

Provinces and territories have the primary responsibility for management of lands and wildlife within boreal caribou distribution, however this responsibility does vary in some parts of the country. For example, in the Northwest Territories, the Tłı̨chǫ Government manages land and resources (including wildlife) within Tłı̨chǫ Lands, as described in the Tłı̨chǫ Agreement (a combined comprehensive land claims and self-government agreement). There are also wildlife management boards that have been established under land claims agreements as the primary instrument for wildlife management in some regions of the country. In addition, Parks Canada Agency has a significant role to play where boreal caribou exist within national parks and historic sites.

Range plans and/or action plans inform broader land-use planning and decision making, and require substantial inter-agency communication and cooperation. Coordination is particularly important for range and/or action plans that address boreal caribou recovery in transboundary ranges, and for ensuring connectivity within ranges and across the species current distribution is maintained.

9.1.2 Indigenous Involvement

The Minister of Environment and Climate Change must cooperate with affected Indigenous organizations for recovery strategies and action plans. Across Canada, cooperation with Indigenous people is key to the success in developing and implementing action plans.

In acknowledgement of existing Aboriginal and treaty rights, to the extent possible, details of harvesting plans for local populations, consistent with the principles of conservation, will be addressed in range and/or action plans. When applicable, harvesting plans will follow the required process under Land Claim Agreements or provincial/territorial laws. Indigenous involvement will be required to determine population targets that ensure stable boreal caribou local populations are maintained and recovery of local populations that are not self-sustaining is achieved, while providing for traditional Indigenous harvesting practices consistent with conservation and existing Aboriginal and treaty rights. A description of Environment and Climate Change Canada's approach to engaging with Indigenous people in the development of both the 2012 Recovery Strategy and the 2020 Amended Recovery Strategy for boreal caribou is provided in Appendix B.

9.1.3 Stakeholder Engagement

Success in the recovery of this species depends on the commitment, collaboration, and cooperation of many different constituencies that are or will be involved in implementing the broad strategies and general approaches set out in this recovery strategy and will not be achieved by Environment and Climate Change Canada, or any other jurisdiction, alone. All stakeholders, including the industry sector, environmental organizations, and private landowners should be engaged where appropriate in developing and implementing action plans.

9.2 Range Specific Actions

The recovery of boreal caribou requires actions that will vary by individual boreal caribou range based on the population and habitat conditions. Each range will require a range-specific path forward for the recovery of boreal caribou. As described under Section 7.3, range plans and/or action plans are needed to guide protection and management of critical habitat, and overall recovery actions, in each boreal caribou range.

Range plans describe how critical habitat will be protected. The 2012 Recovery Strategy called for these jurisdictionally-led range plans to be produced for each range within 3-5 years of the posting of the 2012 Recovery Strategy. Environment and Climate Change Canada continues to seek commitments to develop jurisdictional range plans or other similar documents through the development of conservation agreements for the species.

For the Boreal Shield range (SK1), the Government of Saskatchewan should complete the range plan by June 2021.

In the absence of range plans, the Minister of Environment and Climate Change will use the best available information and consult with the jurisdiction to make a determination on the state of protection of critical habitat for boreal caribou.

9.2.1 Habitat and Population Management

The broad strategies and general approaches to meet the population and distribution objectives (see Section 6), as set out in this recovery strategy, will inform the development of range plans and action plans, where detailed local-level planning will occur to guide the implementation of recovery actions.

The broad strategies and general approaches are designed to guide range and action planning based on the state of each boreal caribou range. Many approaches and strategic directions are inter-related and should be implemented as described in the range plans and action plans. Generally, for self-sustaining local populations, minimal management actions may be necessary, and strategically planned development could take place without threatening boreal caribou and the status of the local population. Where local populations are not self-sustaining, specific management action is needed, in some cases for many decades, until sufficient habitat is restored and the population condition is improved. Mortality management, including predator and alternate prey management, may be needed to help prevent extirpation of a boreal caribou local population in the interim while habitat management efforts are underway to restore the ecological conditions of the range necessary to support a self-sustaining local population.

Jurisdictions are accountable for the long-term planning and management of boreal caribou ranges with the implementation of different habitat and population management tools available at their discretion, depending on the specific local conditions. The implementation of habitat management practices, such as fire suppression, and mortality management practices, such as predator control, are at the discretion of jurisdictions, and the application of these tools will vary in accordance with jurisdictional policies and procedures.

10 GLOSSARY

Note: The following terms are defined in accordance with their use in this document.

Anthropogenic: caused by human activity.

Biological feasibility: recovery is determined to be biologically feasible under the following circumstances: individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance; sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration; and primary threats to the species or its habitat can be avoided or mitigated.

Biophysical attributes: habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery (see Appendix H).

Current distribution (extent of occurrence): the area that encompasses the geographic distribution of all known boreal caribou ranges, based on provincial and territorial distribution maps developed from observation and telemetry data, local knowledge (including in some cases Indigenous Knowledge), and biophysical analyses.

Disturbance management threshold: at the scale of boreal caribou range, the habitat disturbance point below which conditions are such that the recovery goal will likely be met (i.e. acceptable level of risk), and above which the outcome is either highly uncertain or unacceptable.

Disturbed habitat: habitat showing: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction (without buffer).

Existing habitat: the entire boreal caribou range area minus permanent alterations. See also *permanent alterations.*

Indigenous Knowledge (IK): IK includes, but is not limited to, the knowledge Indigenous peoples have accumulated about wildlife species and their environment. Much of this knowledge has accumulated over many generations.

Local population: a group of boreal caribou occupying a defined area distinguished spatially from areas occupied by other groups of boreal caribou. Local population dynamics are driven primarily by local factors affecting birth and death rates, rather than immigration or emigration among groups.

In this recovery strategy, “local population” refers to a group of boreal caribou occupying any of the three types of boreal caribou ranges (i.e. conservation unit, improved conservation unit, local population unit). See also *range*.

Not self-sustaining local population: in the population and distribution objectives "not self-sustaining local population" includes both the local populations assessed as "as likely as not self-sustaining" and those assessed as "not self-sustaining".

Permanent alterations: existing features found within a range, such as industrial and urban developments, permanent infrastructure, and graded or paved roads that do not currently possess or have the potential to possess the biophysical attributes of critical habitat for boreal caribou.

Quasi-extinction: a population with less than 10 reproductively active females.

Range: the geographic area occupied by a group of individuals that are subject to similar factors affecting their demography and used to satisfy their life history processes (e.g. calving, rutting, wintering) over a defined time frame. Environment and Climate Change Canada (2011b) identified three types of boreal caribou ranges categorized based on the degree of certainty in the delineated range boundaries (i.e. conservation unit, improved conservation unit, local population unit).

Range plan: a document that demonstrates how the habitat condition within a given range will be managed over time and space to ensure that critical habitat for boreal caribou is protected from destruction and therein, that each local population will either continue to be self-sustaining or become self-sustaining over time.

Self-sustaining local population: a local population of boreal caribou that on average demonstrates stable or positive population growth over the short-term (≤20 years), and is large enough to withstand stochastic events and persist over the long-term (≥50 years), without the need for ongoing active management intervention.

Technical feasibility: recovery is determined to be technically feasible when recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

To the extent possible: current evidence supports the conclusion that the recovery of all local populations is technically and biologically feasible. There may be situations where recovery of a particular local population proves to be, over time and through unforeseen circumstances, not biologically or technically feasible and as such may affect the likelihood of achieving the population and distribution objectives for some local populations.

Undisturbed habitat: habitat not showing any: i) anthropogenic disturbance visible on Landsat at a scale of 1:50,000, including habitat within a 500 m buffer of the anthropogenic disturbance; and/or ii) fire disturbance in the last 40 years, as identified in data from each provincial and territorial jurisdiction(without buffer). Disturbance within the 500 m buffer would result in a reduction of the undisturbed habitat.

11 REFERENCES

Adams, L.G., B.W. Dale, and L.D. Mech. 1995. Wolf predation on caribou calves in Denali National Park, Alaska. *In* Carbyn, L.N., S.H. Fritts and D.R. Seip (editors). Ecology and Conservation of Wolves in a Changing World. Canadian Circumpolar Institute, Occasional Publication no. 35, Edmonton, Alberta.

Badiou, P., S. Boutin, M. Carlson, M. Darveau, P. Drapeau, J. Jacobs, C. Johnson, J. Kerr, M. Manseau, P. McLoughlin, G. Orians, S. Pimm, P. Raven, D. Roberts, T. Root, N. Roulet, J. Schaefer, D. Schindler, M. St-Laurent, J. Strittholt, N. Turner, A. Weaver, and J. Wells. 2011. Keeping woodland caribou in the boreal forest: Big challenge, immense opportunity. International Boreal Conservation Science Panel. 12 pp.

Banfield, A.W.F. 1974. Mammals of Canada. University of Toronto Press. Toronto, Ontario. 438 pp.

Bergerud, A.T. 1967. Management of Labrador caribou. *Journal of Wildlife Management* 31: 626-642.

Bergerud, A.T. 1974. Decline of caribou in North America following settlement. *Journal of Wildlife Management* 38:757-770.

Bergerud, A.T. 1978. The status and management of Woodland Caribou in British Columbia. Report to Fish and Wildlife Branch, Government of British Columbia. Victoria, British Columbia. 138 pp.

Bergerud, A.T. 1980. A review of the population dynamics of caribou and wild reindeer in North America. *In* D. Reimers, E. Gaare, and S. Skenneberg (editors). Proceedings of the 2nd International Reindeer/Caribou Symposium, Roros, Norway.

Bergerud, A.T. 1988. Caribou, wolves and man. *Trends in Ecology & Evolution* 3:68-72.

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics: have we got it right yet? *Rangifer Special Issue* No. 9. pp. 95–115.

Bergerud, A.T. 2000. Caribou. In S. *Demarais and P.R. Krausman (Editors). Ecology and Management of Large Mammals in North America*. Prentice Hall, Upper Saddle River, New Jersey.

Bergerud, A.T., R.D. Jakimchuk, and D.R. Carruthers. 1984. The buffalo of the north: caribou (*Rangifer tarandus*) and human developments. *Arctic* 37: 7-22.

Bergerud, A.T., and J.P. Elliot. 1986. Dynamics of caribou and wolves in northern British Columbia. *Canadian Journal of Zoology* 64: 1515-1529.

Bergerud, A.T., and R.E. Page. 1987. Displacement and dispersal of parturient caribou at calving as antipredator tactics. *Canadian Journal of Zoology* 62: 1566-1575.

Bergerud, A.T., R.S. Ferguson, and H.E. Butler. 1990. Spring migration and dispersion of Woodland Caribou at calving. *Animal Behaviour* 39: 360-368.

Boertje, R.D., P. Valkenburg, and M.E. McNay. 1996. Increases in moose, caribou, and wolves following wolf control in Alaska. *Journal of Wildlife Management* 60: 474-489.

Boreal Caribou Aboriginal Traditional Knowledge (ATK) Reports. 2010-2011. Compiled June 2011. Ottawa: Environment Canada.

Bradshaw, C.J.A., D. M. Hebert, A.B. Rippin, and S. Boutin. 1995. Winter peat land habitat selection by Woodland Caribou in northeastern Alberta. *Canadian Journal of Zoology* 73: 1567-1574.

Bradshaw, C.J.A., S. Boutin, and D.M. Hebert. 1998. Energetic implications of disturbance caused by petroleum exploration to Woodland Caribou 76: 1319-1324.

Brown, G.S., F.F. Mallory, and W.J. Rettie. 2003. Range size and seasonal movement for female Woodland Caribou in the boreal forest of northeastern Ontario. *Rangifer Special Issue* No. 14: 227-233.

Brown, G.S., W.J. Rettie, R.J. Brooks, and F.F. Mallory. 2007. Predicting the impacts of forest management on woodland caribou habitat suitability in black spruce boreal forest. *Forest Ecology and Management* 245: 137-147.

Brown, W.K., J. Huot, P. Lamothe, S.N. Luttich, M. Pare, G. St.Martin, and J.B. Theberge. 1986. The distribution and movement patterns of four Woodland Caribou herds in Québec and Labrador. *Rangifer Special Issue* No. 1: 43-49.

Brown, W.K., and J.B. Théberge. 1990. The effect of extreme snow cover on feeding-site selection by Woodland Caribou. *Journal of Wildlife Management* 54: 161-168.

Brown, W.K., and D.P. Hobson. 1998. Caribou in west-central Alberta - information review and synthesis. Terrestrial & Aquatic Environmental Managers, Calgary, Alberta.

Callaghan, C., S. Virc, and J. Duffe. 2010. Woodland Caribou, boreal population, trends in Canada. Technical Thematic Report No. 11. In *Canadian Biodiversity: Ecosystem Status and Trends 2010.*

Caughley, G. 1994. Directions in conservation biology. *Journal of Animal Ecology* 63: 15-244.

Caughley, G., and A. Gunn. 1996. Conservation Biology in Theory and Practice. Blackwell Science, Cambridge, Massachusetts, USA. 459 pp.

Chabot, A. 2011. Suivi télémétrique et stratégie générale d’aménagement de l’habitat des caribous forestiers du Nitassinan de la Première Nation innue d’Essipit. Rapport du Groupe-Conseil AGIR inc., présenté au Conseil de la Première Nation innue d’Essipit. 43 p. et 1 annexe.

Chubbs, T.E., L.B. Keith, S.P. Mahoney, and M.J. McGrath. 1993. Response of Woodland Caribou (*Rangifer tarandus*) to clear-cutting in east-central Newfoundland. *Canadian Journal of Zoology* 71: 487-493.

COSEWIC. 2011. Designatable Units for Caribou (*Rangifer tarandus*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 88 pp.

COSEWIC. 2014. COSEWIC assessment and status report on the Caribou Rangifer tarandus, Newfoundland population, Atlantic-Gaspésie population and Boreal population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiii + 128 pp. (https://wildlife-species.canada.ca/species-risk-registry/document/default_e.cfm?documentID=2769)

Courbin, N., D. Fortin, C. Dussault, and R. Courtois. 2009. Landscape management for Woodland Caribou: the protection of forest blocks influences wolf-caribou co-occurrence. *Landscape Ecology* 24: 1375-1388.

Courtois, R. 2003. La conservation du caribou forestier dans un contexte de perte d'habitat et de fragmentation du milieu. Ph.D. thesis, Université du Québec à Rimouski. 350 pp.

Courtois, R., L. Bernatchez, J.-P. Ouellet, and L. Breton. 2003. Significance of caribou (*Rangifer tarandus*) ecotypes from a molecular genetics viewpoint. *Conservation Genetics* 4: 393-364.

Courtois, R., and J.-P. Ouellet. 2007. Modeling the impact of moose and wolf management on persistence of Woodland Caribou. *Alces* 43: 13-27.

Courtois, R., J.P. Ouellet, L. Breton, A. Gingras, and C. Dussault. 2007. Effects of forest disturbance on density, space use, and mortality of woodland caribou. *Écoscience*, 14: 491–498.

Creel, S., J.E. Fox, A. Hardy, J. Sands, B. Garrott, and R.O. Peterson. 2002. Snowmobile activity and glucocorticoid stress responses in wolves and elk. *Conservation Biology* 16(3): 809-814.

Cumming, H.G. 1992. Woodland Caribou: facts for forest managers. *Forestry Chronicles* 68: 481-491.

Cumming, H.G., and B.T. Hyer. 1998. Experimental log hauling through a traditional caribou wintering area. *Rangifer Special Issue* No. 10: 241-258.

Dale, B. W., L.G. Adams, and R.T. Bowyer. 1994. Functional response of wolves preying on barren-ground caribou in a multiple-prey ecosystem. *Journal of Animal Ecology* 63(3): 644-652.

Darby, W.R., and W.O. Pruitt, Jr. 1984. Habitat use, movements and grouping behaviour of Woodland Caribou, *Rangifer tarandus caribou*, in southeastern Manitoba. *Canadian Field Naturalist* 98: 184-190.

DeMars, C., C. Thiessen, and S. Boutin. 2011. Assessing Spatial Factors Affecting Predation Risk to Boreal Caribou Calves: Implications for Management. University of Alberta and BC Ministry of Natural Resource Operations 1-35.

Dunford, J.S., P.D. McLoughlin, F. Dalerum, and S. Boutin. 2006. Lichen abundance in the peatlands of Northern Alberta: implications for boreal caribou. *Ecoscience* 13:469–474.

Dyer, S.J., J.P. O'Neill, S.M. Wasel, and S. Boutin. 2001. Avoidance of industrial development by Woodland Caribou. *Journal of Wildlife Management* 65: 531-542.

Dyer, S.J., J.P. O'Neill, S.M. Wasel, and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female Woodland Caribou in northeastern Alberta. *Canadian Journal of Zoology* 80: 839-845.

Dzus, E. 2001. Status of the Woodland Caribou (*Rangifer tarandus caribou*) in Alberta. Alberta Environment, Fisheries and Wildlife Division, and Alberta Conservation Association. Wildlife Status Report no. 30. Edmonton, Alberta. 47 pp.

Dzus, E., J. Ray, I. Thompson, and C. Wedeles, C. 2010. Caribou and the National Boreal Standard: Report of the FSC Canada Science Panel. Toronto, ON, Forest Stewardship Council of Canada.

Edmonds, E.J. 1988. Population status, distribution, and movements of Woodland Caribou in west central Alberta. *Canadian Journal or Zoology* 66: 815-826.

Environment Canada. 2008. Scientific Review for the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada. August 2008. Ottawa: Environment Canada. 72pp. plus 80 pp Appendices.

Environment Canada. 2010. Planning for a Sustainable Future: a Federal Sustainable Development Strategy for Canada. Ottawa: Environment Canada. 75pp.

Environment Canada. 2011a. Round 1: Report on the Engagement Process with Aboriginal Communities and Stakeholders in the Development of the Proposed Recovery Strategy for Boreal Caribou. Unpublished. Ottawa: Environment Canada. 62pp.

Environment Canada. 2011b. Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 Update. Ottawa, ON. 102pp. plus appendices.

Environment Canada. 2012a. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.

Environment Canada. 2012b. What People Have Said on the Proposed Recovery Strategy for Boreal Caribou: A summary of the engagement process, comments received and changes made. Ottawa: Environment Canada. 5pp.

Environment and Climate Change Canada. 2016. Range Plan Guidance for Woodland Caribou, Boreal Population. *Species at Risk Act:* Policies and Guidelines Series. Environment and Climate Change Canada, Ottawa. 26p.

Environment and Climate Change Canada. 2017. Report on the Progress of Recovery Strategy Implementation for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population in Canada for the Period 2012-2017. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. ix + 94pp.

Environment and Climate Change Canada. 2018. Action Plan for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population in Canada – Federal Actions. *Species at Risk Act* Action Plan Series. Environment and Climate Change Canada, Ottawa. xi + 28pp.

Environment and Climate Change Canada. 2019. Boreal Caribou Science to Inform Recovery: Science Summary Sheet #1. Ottawa, Ontario, Canada. 10p.

Festa-Bianchet, M., J.C. Ray, S. Boutin, S.D. Côté, and A. Gunn. 2011. Caribou conservation in Canada: an uncertain future. *Journal of Canadian Zoology* 89: 419-434.

Fortin, D., F. Barnier, P. Drapeau, T. Duchesne, C. Dussault, S. Heppell, M.-C. Prima, M.-H. St-Laurent and G. Szor. 2017. Forest productivity mitigates human disturbance effects on late-seral prey exposed to apparent competitors and predators. *Scientific Reports*. 7(6370):1-12.

Gillett, N.P., A.J. Weaver, F.W. Zwiers, and M.D. Flannigan. 2004. Detecting the effect of climate change on Canadian forest fires. *Geophysical Research Letters* 31 (18).

Gustine, D.D., K.L. Parker, R.J. Lay, N.P. Gillingham, and D. Heard. 2006. Calf survival of woodland caribou in a multipredator ecosystem. *Wildlife Monographs* 165:1–32

Harrington, F.H., and A.M. Veitch. 1991. Short-term impacts of low-level jet fighter training on caribou in Labrador. *Arctic* 44: 318-327.

Hummel, M. and J.C. Ray. 2008. Caribou and the North: a shared future. Dundurn. 288 pp.

James, A.R.C., and A.K. Stuart-Smith. 2000. Distribution of caribou and wolves in relation to linear features. *Journal of Wildlife Management* 64: 154-159.

Johnson, C.J., K. L. Parker, and D.C. Heard. 2001. Foraging across a variable landscape: behavioural decisions made by Woodland Caribou at multiple special scales. *Oecologia* 127(4): 590 – 602.

Johnston, M. 2009. Vulnerability of Canada's Tree Species to Climate Change and Management Options for Adaptation: An Overview for Policy Makes and Practitioners. Canadian Council of Forest Ministers. 44 pp.

Johnston, M. 2010. Tree Species Vulnerability and Adaptation to Climate Change: Final Technical Report. Saskatchewan Research Council, June 2010.

Kelsall, J.P. 1968. The migratory barren-ground caribou of Canada. Monograph no.3, Canadian Wildlife Service, Indian Affairs and Northern Development. Queen's Printer, Ottawa, Ontario. 339 pp.

Lander, C.A. 2006. Distribution and movement of Woodland Caribou on disturbed landscapes in Manitoba. M.Sc. Thesis, Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba.

Mahoney, S.P., and J.A. Schaefer. 2001. Hydroelectric development and the disruption of migration in caribou. Abstract, 9th North American Caribou Workshop. Kuujjuaq, Quebec, April 23-27, 2001.

McCarthy, S.C., R.B. Weladji, C. Doucet, and P. Saunders. 2011. Woodland caribou calf recruitment in relation to calving/post-calving landscape composition. *Rangifer Special Issue* 31: 35-47.

McLoughlin, P.D., D. Paetkau, M. Duda, and S. Boutin. 2004. Genetic diversity and relatedness of boreal caribou populations in western Canada. *Biological Conservation* 118: 593-598.

Moreau, G., D. Fortin, S. Couturier, and T. Duchesne. 2012. Multi-level functional responses for wildlife conservation: the case of threatened caribou in managed boreal forests. *Journal of Applied Ecology* 49: 611-620.

Nagy, J.A., D.L. Johnson, N.C. Larter, M.W. Campbell, A.E. Derocher, A. Kelly, M. Dumond, D. Allaire, and B. Croft. 2011. Subpopulation structure of caribou (Rangifer tarandus L.) in arctic and subarctic Canada. *Ecological Applications* 21:2334–2348.

Neufeld, L.M. 2006. Spatial dynamics of wolves and Woodland Caribou in an industrial forest landscape in west-central Alberta. M.Sc. Thesis. University of Alberta, Edmonton, Alberta.

Ontario Woodland Caribou Recovery Team. 2008. Woodland Caribou (*Rangifer tarandus caribou*) (Forest-dwelling, Boreal Population) in Ontario. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. 93pp.

Pinard, V., C. Dussault, J. Ouellet, D. Fortin, and R. Courtois. 2012. Calving rate, calf survival rate, and habitat selection of forest-dwelling caribou in a highly managed landscape. *The Journal of Wildlife Management* 76: 189-199.

Pither, R., M. Manseau, J. Clark, M. Ball, P. Wilson, and A. Arsenault. 2006. Relating the population genetic structure of Woodland Caribou to landscape connectivity. 11th North American Caribou Workshop. Jasper, Alberta, Canada. April 23-27, 2006.

Pitt, W.C., and R.A. Jordan. 1994. A survey of the nematode parasite *Parelaphostrongylus tenuis* in the white-tailed deer, *Odocoileus virginianus*, in a region proposed for caribou, *Rangifer tarandus caribou*, re-introduction in Minnesota. *Canadian Field-Naturalist* 108: 341-346.

Podur, J., D. L. Martell, and K. Knight. 2002. Statistical quality control analysis of forest fire activity in Canada. *Canadian Journal of Forest Research* 32: 195- 205.

Racey, G.D. 2005. Climate change and Woodland Caribou in northwestern Ontario: A risk analysis. *Rangifer Special Issue* No. 16: 123-136.

Racey, G.D., and T. Armstrong. 2000. Woodland Caribou range occupancy in northwestern Ontario: past and present. *Rangifer Special Issue* No. 12:153-184.

Ray, J. 2011. Biological Considerations for Recovery Objectives for Boreal caribou in Canada. Wildlife Conservation Society Canada, Toronto, Ontario.

Redford, K.H., G. Amato, J. Baillie, P. Beldomenico, E.L. Bennett, N. Clum, R. Cook, G. Fonseca, S. Hedges, F. Launay, S. Lieberman, G.M. Mace, A. Murayama, A. Putnam, J.G. Robinson, H. Rosenbaum, E.W. Sanderson, S.N. Stuart, P. Thomas, and J. Thorbjarnarson. 2011. What does it mean to successfully conserve a (vertebrate) species? *BioScience* 61(1): 39-48.

Rettie, W.J., and F. Messier. 1998. Dynamics of Woodland Caribou populations at the southern limit of their range in Saskatchewan. *Canadian Journal of Zoology* 76:257-259.

Rettie, W.J., and F. Messier. 2000. Hierarchical habitat selection by Woodland Caribou: its relationship to limiting factors. *Ecography* 23: 466-478.

Rettie, W.J., and F. Messier. 2001. Range use and movement rates of Woodland Caribou in Saskatchewan. *Canadian Journal of Zoology* 79:1933-1936.

Richie, C. 2008. Management and challenges of the mountain pine beetle infestation in British Columbia. *Alces* 44: 127-135.

Saher, D.J., and F.K.A. Schmiegelow. 2005. Movement pathways and habitat selection by woodland caribou during spring migration. *Rangifer Special Issue* No.16: 143-154.

Sapolsky, R. 1992. Neuroendocrinology of the stress response. Pages 287-324 *in* J.B. Becker, S. M. Breedlove and D. Crews (Editors). *Behavioural Endocrinology*. MIT Press, Cambridge, Massachusetts.

Schaefer, J.A. 2003. Long-term range recession and the persistence of caribou on the taiga. *Conservation Biology* 15: 1435-1439.

Schaefer, J.A., and W.O. Pruitt, Jr. 1991. Fire and Woodland Caribou in southwestern Manitoba. *Wildlife Monographs* 116: 1-39.

Schaefer, J.A., A.M. Veitch, F.H. Harrington, W.K. Brown, J.B. Theberge, and S.N. Luttich. 1999. Demography of decline of the Red Wine Mountain caribou herd. *Journal of Wildlife Management* 63(2): 580-587.

Schmelzer, I., J. Brazil, T. Chubbs, S. French, B. Hearn, R. Jeffery, L. LeDrew, H. Martin, A. McNeill, R. Nuna, R. Otto, F. Phillips, G. Mitchell, G. Pittman, N. Simon, and G. Yetman. 2004. Recovery Strategy for Three Woodland Caribou Herds (*Rangifer tarandus caribou*;

Boreal Population) in Labrador. Newfoundland and Labrador Department of Environment and Conservation, Corner Brook, Newfoundland and Labrador.

Schwartz C.C., and A.W. Franzmann. 1989. Bears, wolves, moose, and forest succession, some management considerations on the Kenai Peninsula, Alaska. *Alces* 25: 1-10.

Seip, D.R. 1991. Predation and caribou populations. *Rangifer Special Issue* No.11: 46-52.

Seip, D.R. 1992. Factors limiting Woodland Caribou populations and their interrelationships with wolves and moose in southeastern British Columbia. *Canadian Journal of Zoology* 70: 1494-1503.

Skinner, W. R., B. J. Stocks, D. L. Martell, and A. Shabbar. 1999. The association between circulation anomalies in the mid-troposphere and area burned by wildland fire in Canada, *Theoretical and Applied Climatology* 63: 89-105.

Skinner, W. R., M. D. Flannigan, B. J. Stocks, D.L. Martell, B.M. Wotton, J.B. Todd, J.A. Mason, K.A. Logan, and E.M. Bosch. 2002. A 500 hPa synoptic wildland fire climatology for large Canadian forest fires, 1959– 1996. *Theoretical and Applied Climatology* 71: 157-169.

Smith, K.G., E.J. Ficht, D. Hobson, T.C. Sorensen, and D. Hervieux. 2000. Winter distribution of Woodland Caribou in relation to clear-cut logging in west-central Alberta. *Canadian Journal of Zoology* 78: 1433-1436.

Stocks, B.J., J. A. Mason, J. B. Todd, E. M. Bosch, B. M. Wotton, B. D. Amiro, M. D. Flannigan, K. G. Hirsch, K. A. Logan, D. L. Martell, and W. R. Skinner. 2003. *Journal of Geophysical Research* 108 (D1), 8149, doi:10.1029/ 2001JD000484.

Stuart-Smith, A.K, C.J.A. Bradshaw, S. Boutin, D.M. Hebert, and A.B. Rippin. 1997. Woodland Caribou relative to landscape pattern in northeastern Alberta. *Journal of Wildlife Management* 61: 622-633.

Telfer, E.S. 1978. Cervid distribution, browse and snow cover in Alberta. *Journal of Wildlife Management* 42: 352-361.

Thomas, D.C., and H.J. Armbruster. 1996. Woodland Caribou Habitat Studies in Saskatchewan: Second Annual Report Including Some Preliminary Recommendations. Environment Canada, Canadian Wildlife Service, Edmonton, Alberta.

Thomas, D.C., and D.R. Gray. 2002. Update COSEWIC status report on the Woodland Caribou *Rangifer tarandus caribou* in Canada, in COSEWIC assessment and update status report on the Woodland Caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-98 pp.

Toupin, B., J. Huot, and M. Manseau. 1995. Effect of insect harassment on the behaviour of the Rivière George caribou. *Arctic* 49(4): 375-382.

Tyler, N.C. 1991. Short-term behavioural responses of Svalbard reindeer (*Rangifer tarandus*) to direct provocation by a snowmobile. *Biological Conservation* 56: 159-194.

Vandal, D., and C. Barrette. 1985. Snow depth and feeding interaction at snow craters in Woodland Caribou. Pages 199–212 *in* T.C. Meredith and A.M. Martell (editors). Proceedings of the Second North American Caribou Workshop, Val Morin, Quebec, 15–20 October 1984. McGill Subarctic Research Papers no. 36, Centre for Northern Studies and Research, McGill University, Montreal, Quebec.

Van Wagner, C. E. 1988. The historical pattern of annual burned area in Canada. *Forestry Chronicle* 64: 182-185.

Vors, L.S., J.A. Schaefer, B.A. Pond, A.R. Rogers, and B.R. Patterson. 2007. Woodland Caribou extirpation and anthropogenic landscape disturbance in Ontario. *Journal of Wildlife Management* 71:1249-1256.

Vors, L.S., and M.S. Boyce. 2009. Global declines of caribou and reindeer. *Global Change Biology* 15: 2626-2633.

Weckworth, B.V., M. Musiani, A.D. McDevitt, M. Hebblewhite, and S. Mariani. 2012. Reconstruction of caribou evolutionary history in western North America and its implications for conservation. *Molecular Ecology* 21(14): 3610-3624.

Weclaw, P., and R.J. Hudson. 2004. Simulation of conservation and management of Woodland Caribou. *Ecological Modelling* 157: 75-94.

Whitefeather Forest. 2006. Keeping Woodland Caribou on the land: Cross-cultural research in the Whitefeather forest. Whitefeather Forest Management Corporation. Draft Report: June 16, 2006. pp.43.

Whittington, J., M. Hebblewhite, N.J. DeCesare, L. Neufeld, M. Bradley, J. Wilmshurst, and M. Musiani. 2011. Caribou encounters with wolves increase near roads and trails: a time-to-event approach. *Journal of Applied Ecology* 48**:** 1535–1542.

Wittmer, H.U., B.N. McLellan, D.R. Seip, J.A.Young, T.A. Kinley, G.S. Watts, and D. Hamilton. 2005. Population dynamics of the endangered mountain ecotype of Woodland Caribou (*Rangifer tarandus caribou*) in British Columbia, Canada. *Canadian Journal of Zoology* 83: 367-418.

APPENDIX A: EFFECTS ON THE ENVIRONMENT AND OTHER SPECIES

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals.* The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making, and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the *Federal Sustainable Development Strategy's* (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that certain strategies may also inadvertently lead to environmental effects beyond the intended benefits, or have negative impacts upon other species. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

Boreal caribou are an umbrella species for the older-growth boreal forest at large. There are many species that share the same habitat requirements as boreal caribou and will benefit from the recovery actions outlined in this recovery strategy. This recovery strategy will benefit the environment and biodiversity as a whole by promoting the recovery of boreal caribou and by protecting and enhancing habitat.

The management measures outlined in this recovery strategy are those required to halt boreal caribou local population declines and to assist in stabilizing and recovering local populations. With respect to broader environmental impacts, certain management tools, most notably predator (e.g. wolves, bears) and alternate prey (e.g. moose, deer) management, may be required in areas with unnaturally high rates of predation on boreal caribou.

Short-term (i.e. 5–10 years) predator and alternate prey suppression has been used in wildlife management across North America over the past decades, with predator and alternate prey species generally demonstrating fairly rapid recovery once the measures have ceased.

The recovery strategy acknowledges that predator and alternate prey management may be required in some ranges to help stop boreal caribou declines and stabilize local populations that are at risk of extirpation. Where applied, predator and alternate prey management should be used as an interim management tool, in conjunction with other management tools (e.g. habitat restoration and management) to prevent extirpation and achieve population growth. Effective indirect predator management techniques (such as actions to limit the access of predators to boreal caribou) should be considered prior to undertaking direct predator and alternate prey management. When a predator or alternate prey management program is being planned, the conservation status of all affected species must be considered. Where implemented, the effects of mortality management activities on boreal caribou local populations should be monitored.

APPENDIX B: ENGAGEMENT WITH INDIGENOUS PEOPLE IN THE DEVELOPMENT OF THE RECOVERY STRATEGY FOR BOREAL CARIBOU

Once a species is listed as extirpated, endangered or threatened under SARA, a recovery strategy must be developed. Recognizing the important traditional, cultural, and spiritual role of boreal caribou in the lives of Indigenous people, Environment and Climate Change Canada sought engagement and input from Indigenous communities in the development of both the 2012 Recovery Strategy and the 2020 Amended Recovery Strategy for boreal caribou.

2012 Recovery Strategy (2009-2012)

Two rounds of engagement were undertaken, with a focus on seeking input and sharing information with Indigenous communities. In addition, Environment and Climate Change Canada supported processes to gather Indigenous Knowledge (see Appendix C). These two components were essential in the development of the 2012 Recovery Strategy. Nationally, Environment and Climate Change Canada contacted over 260 Indigenous communities located within and adjacent to the current distribution of boreal caribou during both rounds of engagement to invite them to participate in Environment and Climate Change Canada's process to develop the recovery strategy for boreal caribou.

Round 1 Meetings (2009-2011)

In the first round of engagement on the recovery strategy, Environment and Climate Change Canada contacted 271 Indigenous communities and 161 of them participated. Engagement at this early stage in the development of the recovery strategy provided Indigenous communities the opportunity to share comments, opinions, and information about boreal caribou. Environment and Climate Change Canada used this information to inform the development of the key elements of the recovery strategy, including: i) population and distribution objectives for boreal caribou; ii) threats to boreal caribou and their habitat; and iii) identification of boreal caribou critical habitat.

The information that Environment and Climate Change Canada received from Indigenous communities and from stakeholder meetings, meetings with the provinces and territories, scientific studies, and Indigenous Knowledge studies were used to draft the proposed recovery strategy (Environment Canada, 2011a).

Round 2 Meetings (2011-2012)

In the second round of engagement, Environment and Climate Change Canada contacted 265 [1] Indigenous communities and 87 of those participated; in addition, Environment and Climate Change Canada received 25 formal submissions from Indigenous communities and organizations. This round of engagement provided the opportunity for comments and dialogue

[1] During the first round of engagement, 6 Indigenous communities indicated they did not require any further follow-up throughout this process. This accounts for the discrepancy in the number of Indigenous communities contacted during round 1 and 2.

on the proposed recovery strategy that was posted on the Species at Risk Public Registry on August 26, 2011. The required 60-day public comment period was extended by an additional 120 days until February 22, 2012 to allow time for Indigenous communities to better participate in the engagement process and provide comments on the proposed recovery strategy prior to finalization.

Environment and Climate Change Canada considered all feedback received from Indigenous communities, along with the over 19,000 comments received from government, industry, environmental organizations, and the public when finalizing the 2012 Recovery Strategy (Environment Canada, 2012b). Changes made to the proposed recovery strategy were a direct result of the feedback received during the public comment period, including the input received from Indigenous communities and organizations.

2020 Amended Recovery Strategy (2018 – 2019)

Environment and Climate Change Canada contacted 34 Indigenous communities and 31 Indigenous organizations/governments located within and adjacent to northern Saskatchewan's Boreal Shield range (SK1) to invite them to participate in the process to develop an amendment to the 2012 Recovery Strategy for boreal caribou to identify critical habitat in SK1. At the time of posting the proposed amendment to the recovery strategy on the Species at Risk Public Registry, 11 communities and five organizations/governments participated in information sessions and/or meetings. This engagement provided the opportunity for participating groups to share information, comments, and dialogue on the draft amendment to the recovery strategy.

APPENDIX C: INDIGENOUS KNOWLEDGE SUMMARY REPORTS ON BOREAL CARIBOU

SARA specifies that "... the traditional knowledge of the Aboriginal peoples of Canada should be considered (...) in developing and implementing recovery measures." In the summer of 2009, Environment and Climate Change Canada made a commitment to ensure that Indigenous Knowledge from across the range of boreal caribou would inform the development of the recovery strategy. This commitment came from the recognition that Indigenous people possess significant and unique knowledge about boreal caribou biology, population trends, distribution, and threats facing the species, which could support recovery planning.

Environment and Climate Change Canada staff in each province/territory within the boreal caribou range began the process to have Indigenous Knowledge inform the recovery strategy by contacting Indigenous provincial and territorial organizations, Tribal Councils, and Indigenous consultants/facilitators to determine their interest in helping to gather Indigenous Knowledge. Additionally, each Indigenous community within and adjacent to the range of boreal caribou was contacted and followed up with, inviting them to participate in the process of developing the recovery strategy. As a result of these efforts, one of three basic processes was followed in the participating communities:

1. Local or regional Indigenous organizations interviewed knowledge holders;
2. Regional or local workshops coordinated by Indigenous facilitators were held; or
3. Indigenous Knowledge sharing was done in partnership with other initiatives (e.g. projects funded by Aboriginal Funds for Species at Risk).

All Indigenous contractors/communities/organizations that participated prepared summary reports based on interviews with knowledge holders. Environment and Climate Change Canada's Boreal Caribou Working Group received all summary reports and reviewed these in detail to highlight information that could inform the recovery strategy. Knowledge provided that would be more applicable at the action planning stage was also identified and flagged by Environment and Climate Change Canada's Boreal Caribou Working Group. The purpose of this step was to identify where and how the Indigenous Knowledge could support the recovery strategy and the subsequent range and/or action plans.

Each Indigenous Knowledge summary report received contains unique and geographically specific information that is representative of the knowledge and experiences shared by knowledge holders (Boreal Caribou ATK Reports, 2010-2011). Indigenous Knowledge with respect to boreal caribou life history, habitat use, population status, threats facing the species, and conservation measures was used to inform the recovery strategy. In addition, Indigenous Knowledge holders shared considerable detailed local knowledge about boreal caribou, which may be used to support range and/or action plans, if and where consent for such use is granted. In all cases, Environment and Climate Change Canada reconfirmed the intention of the use of Indigenous Knowledge in this document with knowledge holders.

APPENDIX D: SCIENTIFIC ASSESSMENTS OF CRITICAL HABITAT FOR BOREAL CARIBOU

2008 Scientific Review

In 2007, Environment and Climate Change Canada launched a science-based review with the mandate to identify boreal caribou critical habitat to the extent possible, using the best available information, and/or prepare a schedule of studies to complete this task. The results were summarized in a report entitled *Scientific Review for the Identification of Critical Habitat for Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* (hereinafter referred to as the 2008 Scientific Review).

Identifying critical habitat for boreal caribou was framed as an exercise in decision analysis and adaptive management. Establishment of a systematic, transparent and repeatable process was central to the approach. The resultant Critical Habitat Framework was anchored by synthesis and analysis of available quantitative data and published scientific information on boreal caribou population and habitat ecology.

The 2008 Scientific Review established boreal caribou ranges as the appropriate scale at which to identify critical habitat, and applied a probabilistic approach to assessing the adequacy of the current range conditions to support a self-sustaining local population based on three lines of evidence: percent total disturbance, local population growth and local population size. Of the 57 local populations or units of analysis delineated at the time, 30 were assessed as 'Not Self-Sustaining' (integrated probability of less than 0.5), 17 as 'Self-Sustaining' (integrated probability of greater than 0.5), and 10 as "as likely as not self-sustaining" (integrated probability equal to 0.5).

Additional Scientific Activities

The 2008 Scientific Review established a foundation for the assessment of critical habitat; however, Environment and Climate Change Canada identified key areas for further exploration to improve the science foundation to inform the identification of critical habitat:

1. Implications to critical habitat identification of variation in approaches applied by provincial and territorial jurisdictions to delineate ranges.
2. Relative impacts of different disturbances and habitat types, and their configurations, on the ability of ranges to support self-sustaining local populations, and resultant critical habitat identification.
3. Identification of disturbance management thresholds for self-sustaining local populations.
4. Influence of future range conditions on disturbance management thresholds given the dynamic nature of disturbance in a given range.

The purpose of addressing these knowledge gaps was to further inform the identification of critical habitat for boreal caribou, using the best available information. To this end, Environment and Climate Change Canada undertook the work presented in the Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou *(Rangifer tarandus caribou),* Boreal Population, in Canada: 2011 Update (herein referred to as the 2011 Scientific Assessment).

2011 Scientific Assessment: Concepts and Methodology

Similar to the 2008 Scientific Review, the 2011 Scientific Assessment was designed to provide a probabilistic evaluation of critical habitat relative to the set of conditions (demographic and environmental) for each range. The framework and components developed in the 2008 Scientific Review were expanded and enhanced through a suite of scientific activities including: enhanced disturbance mapping; habitat selection analysis; buffer analysis; meta-analysis of boreal caribou local population and habitat conditions; assessment of current conditions to support self-sustaining boreal caribou local populations using indicators of two ecological components of sustainability (stable or positive population growth and long-term persistence); representation of future conditions through application of a simple habitat dynamics model; and development of a methodology for establishing risk-based, range-specific disturbance management thresholds based on best available information.

Information to Support the Identification of Critical Habitat

The information to inform the identification of boreal caribou critical habitat provided in the 2011 Scientific Assessment for each range consists of the following four components:

1. The delineation and location of the range, and certainty in range delineation.
2. An integrated risk assessment based on multiple lines of evidence from three indicators, and application of hierarchical decision rules to evaluate the probability that current conditions on a range will support a self-sustaining local population. The result is expressed as a likelihood statement relative to achieving the population and distribution objectives.
3. Information to support the identification of disturbance management thresholds. Specifically, a consistent methodology for deriving such thresholds is provided, along with examples of their potential application, and discussion of their interpretation relative to the criteria and indicators evaluated.
4. A description of the biophysical attributes, defined as the habitat characteristics required by boreal caribou to carry out life processes necessary for survival and recovery. The results from the habitat selection analyses and other published reports were used to summarize biophysical attributes by ecozone.

The related goals of assessing the ability of ranges to support self-sustaining local populations, and establishment of disturbance management thresholds, must acknowledge uncertainties arising from the availability and reliability of information about current local population condition, as well as how local populations might respond to additional and often interacting stressors. The probabilistic approach applied in the 2011 Scientific Assessment explicitly incorporated the effects of uncertainties and data quality in the assessment process. This approach is consistent with the concept of adaptive management, which expresses probable outcomes as hypotheses. Monitoring and evaluation of realized outcomes informs adaptations of management strategies over time.

Key Findings

The information and analyses presented in the 2011 Scientific Assessment addresses limitations identified with implementation of the work presented in the 2008 Scientific Review. However, neither the approach nor the results of the 2011 assessment represent a fundamental shift from the 2008 Scientific Review's conclusion that range is the appropriate geographic delineation for critical habitat description. Further, the amount of total disturbance within a range remains the primary criteria for identifying critical habitat to meet a goal of self-sustaining local populations of boreal caribou.

Highlights of the application of the conceptual framework and associated analyses supporting the 2011 assessment include:

1. Nearly 70% of the variation in boreal caribou recruitment across 24 study areas spanning the full range of boreal caribou distribution and range condition in Canada was explained by a single composite measure of total disturbance (fire + buffered anthropogenic), most of which could be attributed to the negative effects of anthropogenic disturbance.
2. Of the 57 identified boreal caribou ranges in Canada at the time, 17 (30%) were assessed in the 'self-sustaining' category, 7 (12%) in the "as likely as not self-sustaining category", and 33 (58%) in the 'not self-sustaining' category.
3. Range-specific disturbance management thresholds can be derived from a generalized disturbance-population growth function in conjunction with range-specific information. A methodology was developed to extend the critical habitat description for consideration of disturbance management thresholds when acceptable risks are defined by managers.

In addition to these highlights, several important observations related to the availability of information emerged, and recommendations related to these are advanced:

1. Most boreal caribou ranges in Canada have not been fully described owing to a lack of standardized animal location data and poor understanding of movement within and between ranges. While a total of 57 ranges were still recognized at the time by provincial and territorial jurisdictions in Canada, changes to the delineation of boreal caribou ranges have been made since the 2008 Scientific Review, by various jurisdictions, based on different criteria. The issue of appropriate delineation of transboundary ranges remains unresolved.
2. Demographic data are lacking for many boreal caribou ranges in Canada. Monitoring and assessment programs to provide data on local population size, local population trend, recruitment and adult mortality are required to improve understanding of factors affecting boreal caribou survival and recovery, to increase certainty in assessment results, and to monitor response of local populations to recovery actions and to assess progress towards meeting the population and distribution objectives for boreal caribou across Canada.

In conclusion, significant advances were made to the conceptual and methodological design in the 2011 Scientific Assessment to address some key uncertainties or limitations identified in the 2008 Scientific Review. These advances improved the robustness of the results with respect to providing a scientific basis to inform the identification of critical habitat for boreal caribou across Canada.

Scientific Research to Inform Critical Habitat in Saskatchewan's Boreal Shield Range

The 2012 Recovery Strategy used the scientific foundation of the 2008 Scientific Review and 2011 Scientific Assessment as the basis for critical habitat identification for all boreal caribou ranges in Canada, except for northern Saskatchewan's Boreal Shield range (SK1) (Environment Canada, 2008; Environment Canada, 2011b; Environment Canada, 2012a). Critical habitat for SK1 was not identified in 2012 because population size and trend were unknown, and the high fire (55%) and low anthropogenic (3%) disturbance represented conditions not well represented in the data used to identify 65% undisturbed habitat in each range as the disturbance management threshold. The 2012 Recovery Strategy identified this knowledge gap in the schedule of studies.

Since the 2012 Recovery Strategy, three years of demographic data have been collected for SK1 and a number of other jurisdictions have also acquired additional recruitment and adult survival data, with better representation of the spectrum of combinations between anthropogenic disturbance and fire. Environment and Climate Change Canada also updated the disturbance mapping, based on 2015 imagery, facilitating temporal correspondence with the new demographic data. This new and larger dataset facilitated additional scientific analysis including (Environment and Climate Change Canada, 2019):

1. An evaluation of a subset of the 2011 recruitment models to distinguish the effects of buffered anthropogenic disturbance from the effects of fire.
2. An evaluation of the newly collected demographic data from SK1 in the context of the national models that predict recruitment as a function of disturbance.
3. An evaluation of the subset of 2011 models to investigate the potential influence of anthropogenic disturbance and fire on adult female survival.
4. A scenario analysis exploring the potential impacts of additional levels of buffered anthropogenic disturbance using updated information.

Key Findings (Environment and Climate Change Canada, 2019)

1. The model separating the effects of anthropogenic disturbance (buffered by 500m) from fire received the highest level of support explaining 39% of the variation in recruitment. Both anthropogenic disturbance and fire had significant negative effects; however, anthropogenic disturbance had a larger effect.
2. Both the total disturbance model (top model in 2011) and the model separating anthropogenic disturbance from fire adequately predict recruitment for SK1 (average observed recruitment falls within 95% confidence intervals).
3. In the evaluation of adult female survival, the top model included anthropogenic disturbance (buffered by 500m) only, explaining about 12% of the variation. Additional analysis are required to understand other potential factors that may be influencing adult female survival. Currently, SK1 has one of the highest rates of boreal caribou adult female survival reported in Canada. Additional analyses indicate that the probability of maintaining a self-sustaining population in SK1 is sensitive to decreases in adult female

survival. For example, the probability that SK1 is self-sustaining would drop to less than 20% if adult female survival fell from 0.91 to 0.87 (assuming no change in recruitment).

4. At current disturbance levels, the probability that SK1 is self-sustaining is 71%; the probability is based on the three years of recruitment and adult survival collected for SK1. The scenario analyses suggest that SK1 would fall to 60% chance of maintaining a self-sustaining population with an additional 2.5-3.0% anthropogenic disturbance. Continued population monitoring will be important in order to reduce uncertainty in population condition over the longer term and to monitor population response to future landscape change.

APPENDIX E: IDENTIFYING DISTURBANCE MANAGEMENT THRESHOLDS

This Appendix is derived from Environment and Climate Change Canada's Scientific Assessment (2011b), and has been adapted for the purposes of this recovery strategy. A methodology was developed for consideration of disturbance management thresholds (Environment Canada, 2011b) and is herein described. Establishing disturbance management thresholds requires a recovery goal and an acceptable level of risk from a management perspective.

The recovery goal for boreal caribou is to achieve self-sustaining local populations in all boreal caribou ranges throughout their current distribution in Canada, to the extent possible. Environment and Climate Change Canada (2011b) expressed this recovery goal as the likelihood of observing a mean lambda (population growth) over a 20-year period of a stable or increasing population and the likelihood of the population size remaining above a quasi-extinction threshold of 10 reproductively active females over a 50 year period. The likelihood of the population remaining stable or increasing over 20 years was based on two indicators: population trend and disturbance level within a boreal caribou range. In order to assess the influence of disturbance level on the population trend, a study was completed to develop a relationship that expresses the probability of a population being stable or increasing at varying levels of total range disturbance (see Figure E-1). This relationship was derived by combining information on the negative effects of disturbance on boreal caribou recruitment with a national mean annual adult survival rate for mature females. This relationship was used to inform the range condition required to meet the recovery goal which is a core element of the identification of critical habitat in this recovery strategy.

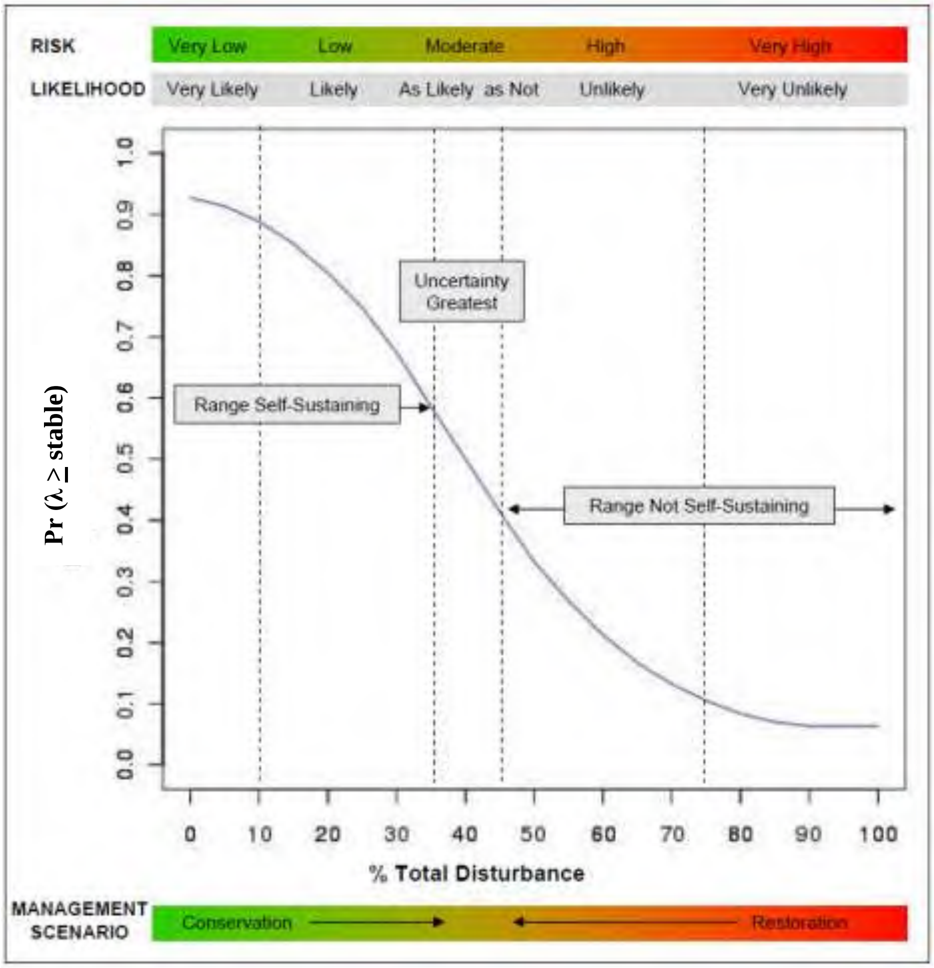

Figure E-1. Disturbance management thresholds: The probability of observing stable or positive growth ($\lambda \geq$ stable) of boreal caribou local populations over a 20-year period at varying levels of total range disturbance (fires $\leq$ 40 years + anthropogenic disturbances buffered by 500 m). Certainty of outcome, ecological risk, and management scenarios are illustrated along a continuum of conditions.

The disturbance values associated with the likelihood of achieving a self-sustaining local population can be used to express the relative risk of not achieving a self-sustaining local population (see Table E-1). At this point, a given management objective or target must be specified in order to determine what is an acceptable level of risk from a management perspective.

Table E-1. Intervals of total range disturbance associated with varying levels of certainty in outcome and assigned risk relative to achieving stable or positive population growth.

Probability of Sustained Stable or Positive Growth[1]	Likelihood of Desired Outcome	Disturbance Interval	Level of Risk
≥ 90%	Very Likely	≤ 10%	Very Low
< 90 to ≥ 60%	Likely	> 10 to 35%	Low
< 60 to ≥ 40%	As Likely as Not	> 35 to 45%	Moderate
< 40 to ≥ %10	Unlikely	> 45 to 75%	High
< 10%	Very Unlikely	>75%	Very High

[1] Intervals adapted from the International Panel on Climate Change 2005; time frame for assessing mean growth rate is 20 years.

A disturbance management threshold marks the point below which (i.e. at lower levels of disturbance) range conditions are likely to meet the recovery goal with an acceptable level of risk, and above which the outcome is either highly uncertain or unacceptable. In this recovery strategy a 0.6 or 60% probability of self-sustainability (i.e. population growth is stable/increasing) is applied resulting in a maximum disturbance management threshold of 35% total disturbance (or 65% undisturbed habitat as referenced throughout the recovery strategy) (see Figure E-1). A probability of 1.0 or 100 % is ideal, however, unrealistic since 0% total disturbance is virtually impossible even without anthropogenic disturbances. The maximum disturbance management threshold of 35% at 0.6 or 60% probability of self-sustainability is a reasonable starting point providing a likely certainty of recovery, given the available information on boreal caribou at this time. It is important to emphasize that this is a maximum disturbance management threshold because there is still a risk (0.4 or 40%) that local populations will not be self-sustaining. Local populations that have greater than 35% total disturbance (or less than 65% undisturbed habitat) will first be recovered to the 35% disturbance management threshold (i.e. to achieve 65% undisturbed habitat). The disturbance management threshold may be altered in the future as more information becomes available on the associated level of risk for boreal caribou local populations to meet the recovery goal outlined in this strategy.

For SK1, a minimum of 40% undisturbed habitat in the range is identified as the disturbance management threshold, which provides a measurable probability of 71% for the local population to be self-sustaining. Given that the analyses conducted by Environment and Climate Change Canada indicate that the population is sensitive to small increases in anthropogenic disturbance and sensitive to small decreases in adult survival, a higher probability of persistence was selected for critical habitat identification in SK1 (71%) than was selected for the other 50 ranges across Canada (60%) (Environment and Climate Change Canada, 2019). Continued population monitoring will be needed to reduce uncertainty in population condition over the longer term, particularly in light of future changes in range condition (e.g. increased fires associated with climate change).

APPENDIX F: SUMMARY OF BOREAL CARIBOU LOCAL POPULATION CONDITION AND HABITAT CONDITION

Table F-1 provides a summary of boreal caribou local population condition and habitat condition for each of the 51 boreal caribou ranges. Boreal caribou distribution (see Figure 2) and population and habitat condition information is based on the best available information including observational and telemetry data, and biophysical analyses, provided by provincial and territorial jurisdictions (Environment and Climate Change Canada, 2017). As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As more refined information is being continually collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges. The assessment of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions. In some cases, local population size estimates and trend data are based primarily on professional judgment and limited data, and not on rigorously collected field data.

The Range Type lists the different classification of local populations based on June 2012 range boundaries for boreal caribou provided by jurisdictions, which were subsequently classified into three types reflecting the level of certainty in range boundaries: Conservation Units (CU - low certainty), Improved Conservation Units (ICU- medium certainty), and Local Population (LP - high certainty).

Risk assessment is the status of self-sustainability of the local populations where SS=self-sustaining; NSS = not self-sustaining; NSS/SS = as likely as not self-sustaining.

Further explanation on disturbance is provided in Section 4.2.1.

Table F-1. Boreal caribou local population condition and habitat condition information. The population condition and habitat condition have been updated in this amended recovery strategy based on information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
Northwest Territories								
NT1	Northwest Territories	ICU	≥ 100[6]	not available[7]	28	9	35	SS
British Columbia								
BC1	Maxhamish	LP	≥ 100	stable[8]	2	67	68	NSS
BC2	Calendar	LP	≥ 100	stable[8]	16	53	61	NSS

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
BC3	Snake-Sahtahneh	LP	≥ 100	stable[8]	5	77	79	NSS
BC4	Parker	LP	< 100	declining[8]	3	57	57	NSS
BC5	Prophet	LP	< 100	declining[8]	10	78	78	NSS
Alberta								
AB1	Chinchaga (incl. BC portion)	LP	≥ 100	declining	9	79	80	NSS
AB2	Bistcho	LP	≥ 100	declining	40	58	75	NSS
AB3	Yates	LP	≥ 100	stable	42	20	55	NSS
AB4	Caribou Mountains	LP	≥ 100	declining	46	27	62	NSS
AB5	Little Smoky	LP	≥ 100	stable[9]	0.4	96	96	NSS
AB6	Red Earth	LP	≥ 100	declining	40	48	72	NSS
AB7	West Side Athabasca River	LP	≥ 100	declining	5	70	72	NSS
AB8	Richardson	LP	≥ 100	stable	74	23	88	NSS
AB9	East Side Athabasca River	LP	≥ 100	declining	28	78	84	NSS
AB10	Cold Lake	LP	≥ 100	declining	33	76	87	NSS
AB11	Nipisi	LP	< 100	not available[10]	9	75	77	NSS
AB12	Slave Lake	LP	< 100	not available[10]	39	74	87	NSS
Saskatchewan								
SK1	Boreal Shield	CU	≥ 100[11]	stable	58	3	60	SS
SK2	Boreal Plain	CU	≥ 100	not available[12]	30	20	45	NSS/SS
Manitoba								
MB1	The Bog	ICU	≥ 100[13]	not available[14]	6	14	19	NSS/SS
MB2	Kississing	ICU	≥ 100[13]	not available[14]	39	15	54	NSS
MB3	Naosap	ICU	not available[15]	not available[15]	28	28	52	NSS
MB4	Reed	ICU	not available[15]	not available[15]	7	20	26	SS

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
MB5	North Interlake	ICU	< 100	not available[14]	4	14	18	NSS/SS
MB6	William Lake	ICU	< 100	not available[14]	25	17	36	NSS
MB7	Wabowden	ICU	≥ 100	not available[14]	10	20	28	SS
MB8	Wapisu	ICU	not available[15]	not available[15]	11	13	24	SS
MB9	Manitoba North	CU	not available[15]	not available[15]	23	11	33	NSS/SS
MB10	Manitoba South	CU	not available[15]	not available[15]	4	12	16	SS
MB11	Manitoba East	CU	not available[15]	not available[15]	26	3	29	SS
MB12	Atikaki-Berens	ICU	not available[15]	not available[15]	29	6	34	SS
MB13	Owl-Flinstone	LP	< 100	not available[14]	25	18	39	NSS/SS
Ontario								
ON1	Sydney	ICU	< 100	declining	27	25	49	NSS
ON2	Berens	ICU	≥ 100	declining	31	6	37	NSS/SS
ON3	Churchill	ICU	≥ 100	declining	8	28	34	SS
ON4	Brightsand	ICU	≥ 100	declining	19	26	41	NSS/SS
ON5	Nipigon	ICU	≥ 100	declining	7	25	30	SS
ON6	Coastal	CU	≥ 100	declining	0	15	15	SS
ON7	Pagwachuan	ICU	≥ 100	stable	0.7	27	27	SS
ON8	Kesagami	ICU	≥ 100	declining	3	37	40	NSS
ON9	Far North	CU	≥ 100[16]	declining[16]	15	1	16	SS
Quebec								
QC1	Val d'Or	LP	< 100	declining	0.2	65	65	NSS
QC2	Charlevoix	LP	< 100	declining	4	80	82	NSS
QC3	Pipmuacan	ICU	≥ 100	declining	11	60	68	NSS

Range Identification	Range Name	Range Type	Population Estimate relative to 100[1] (≥ 100, or < 100)	Population Trend	Disturbed Habitat (%)			Risk Assessment[5]
					Fire[2]	Anthropogenic[3]	Total[4]	
QC4	Manouane	ICU	≥ 100	stable	18	26	41	NSS/SS
QC5	Manicouagan	ICU	≥ 100[17]	stable[17]	3	36	37	SS
QC6	Quebec	CU	≥ 100[17]	not available[18]	20	13	32	SS
Newfoundland and Labrador[19]								
NL1	Lac Joseph	LP	≥ 100	not available[20]	12	2	14	NSS/SS
NL2	Red Wine Mountain	LP	≥ 100[21]	not available[22]	7	3	9	NSS
NL3	Mealy Mountain	LP	≥ 100	not available[23]	1	1	2	NSS/SS

[1] A minimum of 100 animals was used in the 2011 Scientific Assessment to evaluate when local populations might be vulnerable to extinction from stochastic events due to small size (Environment Canada, 2011b).
[2] Fire disturbance is any area where a fire has occurred in the past 40 years (without buffer).
[3] For anthropogenic disturbance, a 500 meter buffer is applied to all linear and polygonal disturbances.
[4] For total disturbance, both anthropogenic and fire disturbances that overlap are not counted twice in the total.
[5] With the exception of the Boreal Shield range (SK1), the integrated risk assessments have not been updated in this amended recovery strategy.
[6] The population size estimate for NT1 is 6000 to 7000 individuals.
[7] Sub-regional collar-based monitoring programs, and traditional and community knowledge, suggests that boreal caribou population trends differ in various part of NT1. Generally speaking, population trends seem to be increasing or stable in northern NT1, and stable or decreasing in southern NT1. More information is available in the Northwest Territories' Recovery Strategy published in 2017(http://www.nwtspeciesatrisk.ca/sites/default/files/nwt_boreal_caribou_recovery_strategy_2017_final_0.pdf).
[8] In 2013-2014 there was a bacterial pathogen outbreak which caused local population declines in BC. Parker and Prophet ranges have not recovered from the outbreak. The other local populations have been recovering, but the current trend information may not reflect equilibrium conditions for these populations.
[9] AB5 is stable in response to delivery of an annual wolf population reduction program.
[10] Population trend is not available for AB11 and AB12 due to low collared female sample size, resulting in unreliable estimates of annual adult female survival.
[11] The population size estimate for SK1 is >5000 individuals.
[12] Monitoring data are insufficient in SK2 to establish a population trend.
[13] The increase to ≥ 100 reflects an increased survey effort and does not necessarily indicate an improvement in overall status.
[14] Population trend data for Manitoba ranges are under review by the province of Manitoba and were not available to be included in this amended recovery strategy.
[15] The province of Manitoba delineated new range boundaries in 2015 (https://www.gov.mb.ca/sd/wildlife/sar/pdf/cariboustrategy_octfall2015.pdf). As a result, there are no updated population data available for these ranges. Population data for Manitoba's new provincial ranges are presented in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).
[16] ON9 was delineated into 6 new ranges by the province of Ontario in 2013 (https://www.ontario.ca/document/range-management-policy-support-woodland-caribou-conservation-and-recovery). Population data for these new provincial ranges are presented in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

[17] The province of Quebec is in the process of updating range and population condition metrics for QC5 and QC6. Preliminary data are available in the 5-Year Progress Report for areas defined by Fortin et al. (2017) (Environment and Climate Change Canada, 2017).
[18] It is not possible to estimate population trend for QC6 as a whole because of insufficient survey data across the range. Preliminary population trends are available in the 5-Year Progress Report for areas defined by Fortin et al. (2017) that fall within the QC6 range (Environment and Climate Change Canada, 2017).
[19] The province of Newfoundland and Labrador is in the process of updating population condition metrics as part of an updated provincial recovery plan. The future reporting of survey results will be dependent on ongoing exercises to delineate subpopulations in Labrador.
[20] A recent survey was conducted in the NL1 range, but the data could not be analyzed in time for this amended recovery strategy.
[21] The understanding of population structure for NL2 has changed since the 2012 Recovery Strategy. The increase to ≥ 100 animals is due to a shift from minimum population counts (associated with collar deployment and other field activities) to systematic surveys in portions of the range.
[22] Preliminary data and expert opinion suggests that population trends in NL2 are generally increasing in the southern part of the range and declining in the northern part of the range.
[23] The understanding of population structure for NL3 has changed since the 2012 Recovery Strategy. A survey of NL3 is tentatively being planned during the next five years with Parks Canada Agency.

APPENDIX G: DETAILS ON THE IDENTIFICATION OF CRITICAL HABITAT FOR BOREAL CARIBOU

Table G-1 provides a summary of boreal caribou habitat condition for each of the 51 boreal caribou ranges. Boreal caribou distribution (see Figure 2) and habitat condition information is based on the best available information including observational and telemetry data, and biophysical analyses, provided by provincial and territorial jurisdictions (Environment Canada, 2011b). As a result of limited information on many of the ranges in Canada, only three transboundary ranges (a range that extends across a provincial or territorial boundary) have been defined: Northwest Territories range (NT1), Chinchaga range (AB1), and Lac Joseph range (NL1). As more refined information is being continually collected by jurisdictions, range delineation and population demographic information will be updated and may result in revisions to range boundaries and possibly more transboundary ranges. The assessment of self-sustainability may change when ranges that cross jurisdictional boundaries are combined. Range boundaries and integrated risk assessments will be updated annually based on new or more refined evidence provided by the provincial and territorial jurisdictions.

As described in Section 7.1, the identification of critical habitat for boreal caribou is comprised of three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

Table G-1. Boreal caribou critical habitat information. The habitat condition has been updated in this amended recovery strategy based on information previously published in the 5-Year Progress Report (Environment and Climate Change Canada, 2017).

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%): Fire[1]	Disturbed Habitat (%): Anthropogenic[2]	Disturbed Habitat (%): Total[3]	Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
Northwest Territories							
NT1	Northwest Territories	44,166,546	28	9	35	65	Taiga Plain Boreal Plain Southern Arctic Taiga Cordillera
British Columbia							
BC1	Maxhamish	710,105	2	67	68	32	Taiga Plain
BC2	Calendar	496,393	16	53	61	39	Taiga Plain
BC3	Snake-Sahtahneh	1,198,752	5	77	79	21	Taiga Plain
BC4	Parker	75,222	3	57	57	43	Taiga Plain
BC5	Prophet	119,396	10	78	78	22	Taiga Plain
Alberta							
AB1	Chinchaga (incl. BC portion)	3,162,612	9	79	80	20	Taiga Plain Boreal Plain

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
AB2	Bistcho	1,436,555	40	58	75	25	Taiga Plain
AB3	Yates	523,094	42	20	55	45	Taiga Plain
AB4	Caribou Mountains	2,069,000	46	27	62	38	Taiga Plain Boreal Plain
AB5	Little Smoky	308,606	0.4	96	96	4	Montane Cordillera Boreal Plain
AB6	Red Earth	2,473,729	40	48	72	28	Boreal Plain
AB7	West Side Athabasca River	1,572,652	5	70	72	28	Boreal Plain
AB8	Richardson	707,350	74	23	88	12	Boreal Shield (West) Boreal Plain
AB9	East Side Athabasca River	1,315,980	28	78	84	16	Boreal Plain
AB10	Cold Lake	672,422	33	76	87	13	Boreal Plain
AB11	Nipisi	210,771	9	75	77	23	Boreal Plain
AB12	Slave Lake	151,904	39	74	87	13	Boreal Plain
Saskatchewan							
SK1	Boreal Shield	18,034,870	58	3	60	40	Taiga Shield Boreal Shield (West)
SK2	Boreal Plain	10,592,463	30	20	45	55	Boreal Plain
Manitoba							
MB1	The Bog	446,383	6	14	19	81	Boreal Plain
MB2	Kississing	317,029	39	15	54	46	Boreal Shield (West)
MB3	Naosap	456,977	28	28	52	48	Boreal Shield (West) Boreal Plain
MB4	Reed	357, 425	7	20	26	74	Boreal Shield (West) Boreal Plain
MB5	North Interlake	489,680	4	14	18	82	Boreal Plain
MB6	William Lake	488,219	25	17	36	64	Boreal Plain
MB7	Wabowden	628,938	10	20	28	72	Boreal Shield (West) Boreal Plain
MB8	Wapisu	565,044	11	13	24	76	Boreal Shield (West)

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
MB9	Manitoba North	6,205,520	23	11	33	67	Boreal Shield (West) Boreal Plain
MB10	Manitoba South	1,867,255	4	12	16	84	Boreal Plain
MB11	Manitoba East	6,612,782	26	3	29	71	Boreal Shield (West and West Central)
MB12	Atikaki-Berens	2,387,665	29	6	34	66	Boreal Shield (West Central)
MB13	Owl-Flinstone	363,570	25	18	39	61	Boreal Shield (West Central)
Ontario							
ON1	Sydney	753,001	27	25	49	51	Boreal Shield (West Central)
ON2	Berens	2,794,835	31	6	37	63	Boreal Shield (West Central)
ON3	Churchill	2,150,490	8	28	34	66	Boreal Shield (West Central)
ON4	Brightsand	2,220,921	19	26	41	59	Boreal Shield (West Central)
ON5	Nipigon	3,885,026	7	25	30	70	Boreal Shield (West and West Central)
ON6	Coastal	376,598	0	15	15	85	Boreal Shield (West Central and Central)
ON7	Pagwachuan	4,542,918	0.7	27	27	73	Hudson Plain Boreal Shield (West, West Central and Central)
ON8	Kesagami	4,766,463	3	37	40	60	Hudson Plain Boreal Shield (Central)
ON9	Far North	28,265,143	15	1	16	84	Hudson Plain Boreal Shield (West and West Central)
Quebec							
QC1	Val d'Or	346,861	0.2	65	65	35	Boreal Shield (Central)
QC2	Charlevoix	312,803	4	80	82	18	Boreal Shield (Southeast)

Range Identification	Location	Amount					Type
	Range Name	Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Biophysical Attributes (see corresponding ecozone table in Appendix H)
			Fire[1]	Anthropogenic[2]	Total[3]		
QC3	Pipmuacan	1,376,899	11	60	68	32	Boreal Shield (East)
QC4	Manouane	2,716,449	18	26	41	59	Boreal Shield (East)
QC5	Manicouagan	1,134,129	3	36	37	63	Boreal Shield (East)
QC6	Quebec	62,156,186	20	13	32	68	Boreal Shield (Central, East and Southeast) Taiga Shield Hudson Plain
Newfoundland and Labrador							
NL1	Lac Joseph	5,802,491	12	2	14	86	Taiga Shield Boreal Shield (East)
NL2	Red Wine Mountain	5,838,594	7	3	9	91	Taiga Shield Boreal Shield (East)
NL3	Mealy Mountain	3,948,463	1	1	2	98	Taiga Shield Boreal Shield (East)

[1] Fire disturbance is any area where a fire has occurred in the past 40 years (without buffer).
[2] For anthropogenic disturbance, a 500 meter buffer is applied to all linear and polygonal disturbances.
[3] For total disturbance, both anthropogenic and fire disturbances that overlap are not counted twice in the total.

APPENDIX H: BIOPHYSICAL ATTRIBUTES FOR BOREAL CARIBOU CRITICAL HABITAT

Biophysical Attributes

Indigenous Knowledge (Boreal Caribou ATK Reports, 2010-2011), habitat selection analyses, and scientific published reports (Environment Canada, 2011b) were used to summarize biophysical attributes required by boreal caribou to carry out life processes necessary for survival and recovery. Results are provided by ecozone and ecoregion in order to capture the ecological variation across the distribution of boreal caribou.

Boreal Caribou Ranges by Ecozone and Ecoregion

Boreal caribou are distributed in the boreal forest across eight ecozones in Canada including: Taiga Plain, Montane Cordillera, Taiga Shield, Boreal Plain, Boreal Shield, Hudson Plain, Southern Arctic, and Taiga Cordillera. The largest ecozone, Boreal Shield, is further divided into five ecoregions: Boreal Shield West, Boreal Shield West Central, Boreal Shield Central, Boreal Shield East, and Boreal Shield South East (see Figure H-1).

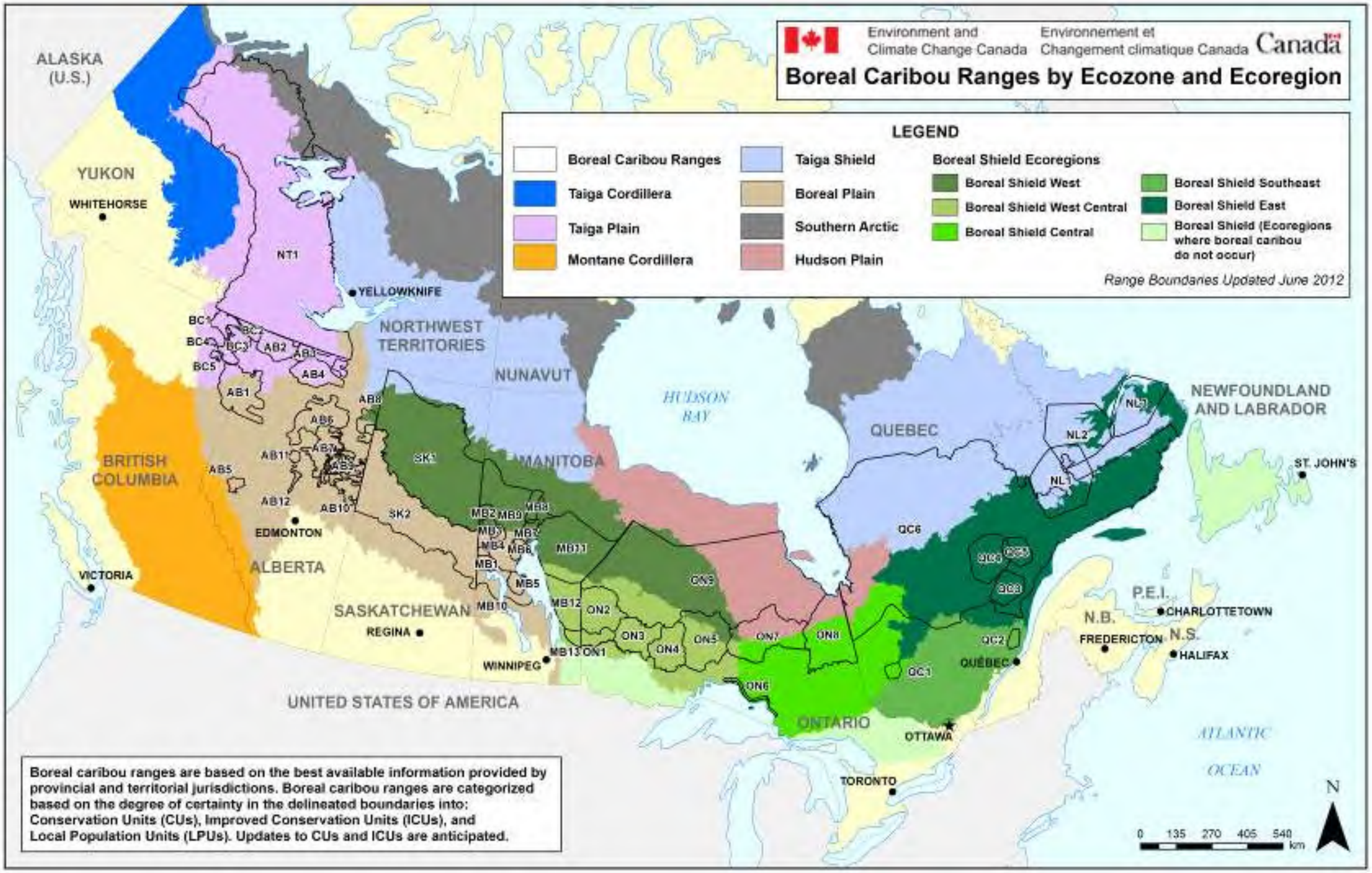

Figure H-1. Boreal caribou distribution across ecozones and ecoregions in Canada.

Biophysical Attribute Descriptions

The biophysical attributes for boreal caribou critical habitat are categorized by the types of habitat used by boreal caribou in accordance with seasonal and life-stage activity which include broad scale, calving, post-calving, rutting, wintering, and travel. This information is provided in the following tables by ecozone and ecoregion.

Biophysical attributes will vary both between and within boreal caribou ranges. As the biophysical attributes presented in this recovery strategy were developed at a national scale by ecozone and ecoregion, and not by local population, it is anticipated that each provincial and territorial jurisdiction may have or will develop over time, a more refined description of the biophysical attributes required for each range. Biophysical attributes specific to boreal caribou ranges in Labrador have been provided by the jurisdiction and are included in Table H-6 below.

Table H-1. Biophysical attributes for boreal caribou critical habitat in the Taiga Plain ecozone.

Type of habitat	Description
Broad scale	Mature forests (jack pine, spruce, and tamarack) of 100 years or older, and open coniferous habitat. Large areas of spruce peat land and muskeg with preference for bogs over fens and upland and lowland black spruce forests with abundant lichens, and sedge and moss availability. Flatter areas with smaller trees and willows, hills and higher ground.
Calving	Open coniferous forests, tussock tundra, low shrub, riparian, recent burned areas, south and west aspects and hills and higher locations. Muskegs, marshes, staying close to water sources. Caribou observed on small islands of mature black spruce or mixed forests within peat lands, in old burns at the edge of wetlands, in alder thickets with abundant standing water and on lake shores.
Post-calving	Muskegs or areas with access to muskegs, open meadows on higher ground, close to water (lakes and rivers) and mixed bush areas. Open coniferous forests with abundant lichens, low shrub, riparian, tussock tundra, sparsely vegetative habitat, recent burns and west aspects. Old burns and neighbouring remnant unburned forests selected in late spring and early summer.
Rutting	Open coniferous and mixed wood forests, low shrub, riparian, tussock tundra, recent burns and west aspect. Still use muskegs that harbor ground lichen and sedges, mixed bush areas, areas of higher ground. Regenerating burns and sparsely vegetated habitat.
Winter	Open coniferous forests (black spruce and pine) that provide adequate cover with abundant lichens, riparian areas. Caribou observed in muskeg areas in early winter. Spruce-lichen forests, fire regenerated, sparsely vegetated habitat, herbaceous and tall shrub habitat and sphagnum moss with scattered spruce. As snow depth increases, they remain more often in areas of dense pine or thickly wooded black spruce, with hanging lichen and remains access to open, mixed vegetation for ground forage.
Travel	Females show high fidelity to calving sites among years (i.e. within 14.5 km). Many caribou shift the pattern of use based on seasonal preferences, in large multi-habitat areas. Rates of movement increase during the rut and are greatest in winter.

Table H-2. Biophysical attributes for boreal caribou critical habitat in the Montane Cordillera ecozone.

Type of habitat	Description
Broad scale	Upland lodge pole pine, mixed conifer lodgepole pine/black spruce and treed muskeg areas with abundant lichens. Open, pine dominated stands of 80 years or more.
Calving	Areas closer to cut-blocks with a high proportion of larch are selected during calving. Lower mountain peaks.
Post-calving	Homogeneous areas of conifer dominated stands.
Rutting	No information on rutting habitat currently available.
Winter	Caribou use areas with a high proportion of larch and pine forests during winter.

Table H-3. Biophysical attributes for boreal caribou critical habitat in the Taiga Shield ecozone (see Table H-6 for biophysical attributes more specific to Labrador ranges).

Type of habitat	Description
Broad scale	Upland tundra dominated by ericaceous shrubs (*Ericaceae* spp.), lichen, grasses and sedges. Lowland tundra composed of peat land complexes (muskeg and string bogs), wetlands (swamps, marshes), lakes, rivers and riparian valleys. Dense mature jack pine and black spruce stands with balsam fir and tamarack present and open conifer forests with abundant lichens.
Calving	String bogs, treed bogs, small open wetlands (< 1 km^2), large muskeg, marshes along water bodies. Barren grounds. Calving on peninsulas and islands increases with amount of open water.
Post-calving	Forested wetlands. Hilly areas, coastal sites, along shorelines of water bodies (rivers, lakes, creeks), marshes with lichen availability.
Rutting	Open wetlands, swamps. Mature forests, mountainous terrain with forests of black spruce, tamarack and pine trees with abundant lichen.
Winter	Forested areas are used in years of low snow accumulation; otherwise winter habitat selection reflects general avoidance of deep snow, including use of tundra habitat at higher elevations in mountainous regions and bogs along lakes or oceans. Forested wetlands. Tundra uplands and sand flats in proximity to water. Barren grounds. Bog edges, glacial erratics and bedrock erratics with lichen and lakes. Some use of mature white spruce and fir stands as alternative to habitat with arboreal lichens. Mix of mature forest stands, mountainous terrain with forests of black spruce, tamarack and jack pine with abundant lichen.
Travel	Connectivity between selected habitat types important given reported patterns of movement among caribou. Some animals have been reported to travel up to distances of approximately 200 km, although the majority of animals appear to move shorter distances. Females show fidelity to post-calving sites returning to within 6.7 km of a given location in consecutive years.

Table H-4. Biophysical attributes for boreal caribou critical habitat in the Boreal Plain ecozone.

Type of habitat	Description
Broad scale	Late seral-stage (> 50 years old) conifer forest (jack pine, black spruce, tamarack), treed peat lands, muskegs or bogs, use dry islands in the middle of muskegs, with abundant lichens. Hilly or higher ground and small lakes. Restricted primarily to peat land complexes. Higher elevations (~1135 m). Selected old (>40 years) burns.
Calving	Bogs and mature forests selected for calving as well as islands and small lakes. Peat lands and stands dominated by black spruce and lowland black spruce stands within muskeg are used for calving.
Post-calving	Forest stands older than 50 yrs. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands and muskeg are also selected during summer. Use lichen and low muskeg vegetation. In some areas, sites with abundant arboreal lichen are selected during summer.
Rutting	Mature forests. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands and muskeg during summer.
Winter	Treed peat lands, treed bog and treed fen and open fen complexes with > 50% peat land coverage with high abundance of lichens. Use of small lakes, rock outcrops on lakes for lichen access. Mature forest > 50 years old. Upland black spruce/jack pine forests, lowland black spruce, young jack pine and open and treed peat lands.

Table H-4a. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield West ecoregion.

Type of habitat	Description
Broad scale	Conifer/tamarack-dominated peat land complexes, muskegs or bogs, use dry islands in the middle of muskegs and upland moderate to dense mature conifer forests (jack pine, black spruce, tamarack) with abundant lichens. Hilly or higher ground, lots of smaller lakes in area.
Calving	Peat lands, stands dominated by black spruce, mature forest stands and treed muskeg all used for calving. Caribou will use islands, small lakes, lakeshores during calving.
Post-calving	Wooded lakeshores, islands, sparsely treed rock, upland conifer-spruce and treed muskeg are used in summer. Sites with a high abundance of arboreal lichen are important for foraging in some areas. Dense conifer and mixed forest are also used.
Rutting	Dense and sparse conifer and mixed forests. Open riparian habitats are also used during the rut.
Winter	Mature upland spruce, pine stands and treed muskeg. Jack pine dominated forests. Caribou select sparse and dense conifer, mixed forests and treed bogs. In some areas caribou will select habitat with greater visibility and further away from forest edges.
Travel	Some males move > 100 km during the rutting season. Traditional travel routes between summer and winter ranges occur in large peat land complexes. Caribou migrate in a north to south pattern.

Table H-4b. Biophysical attributes of boreal caribou habitat in the Boreal Shield West Central ecoregion.

Type of habitat	Description
Broad scale	Mature conifer uplands and conifer/tamarack dominated lowlands. Conifer/tamarack-dominated peat lands, muskegs with abundant arboreal lichens, upland mature conifer forests stands with abundant terrestrial lichen and rocky areas with sparse trees. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Forested wetlands/treed bog, old burns, sparse conifer and dense spruce. Need lichen availability. Peat lands, raised hillrocks with large muskeg areas, forested islands and shorelines of large lakes selected during calving. Jack pine or jack pine/black spruce forests also used for calving.
Post-calving	Peat land with forested islands, islands, and shorelines selected during summer. Mature, dense forest stands.
Rutting	Semi-open and open bogs and mature conifer uplands selected during rutting. Terrestrial lichens and arboreal lichens, sedges and bog ericoids (*Andromeda glaucophylla, Chamaedaphne calyculata, Kalmia polifolia,* and *Ledum groenlandicum*) are important sources of forage.
Winter	Mature coniferous stands. Areas with a high proportion of lakes (> 5-100 ha) with convoluted shorelines. Caribou forage in areas with high lichen abundance and fewer shrubs in jack pine and black spruce stands with low tree densities, low basal areas and short heights. Caribou select open bogs, intermediate to mature jack pine rock ridges, jack pine habitats with lichens and lakes, but move to jack pine ridges in mature conifer stands with lichen when winter conditions prevent foraging in bogs. Arboreal lichens, terrestrial lichens, sedges and ericaceous species are an important source of forage.
Travel	Travel mainly in conifer forests, avoiding open habitats (e.g. lakes, disturbed areas, etc.) when migrating from summer to winter habitat. Use frozen lakes for travel during winter/spring, in some instances to reach islands for calving. Spring migration is not restricted to specific travel routes. Some move at a range of 100 km during the rutting season. Caribou moved 8-60 km away after logging operations were begun.

Table H-4c. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield Central ecoregion.

Type of habitat	Description
Broad scale	Late seral-stage black spruce-dominated lowlands and jack pine dominated uplands. Open black spruce lowlands. Low-density late seral-stage jack pine or black spruce forests and black spruce/tamarack-dominated peat lands with abundant terrestrial and moderate arboreal lichens. Caribou also use areas with dry to moist sandy to loamy soils and shallow soils over bedrock. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Open canopies of mature black spruce and mesic peat land with ericaceous species for calving are selected for calving in the Claybelt region. Females with calves selected areas with more abundant ericaceous shrubs and terrestrial lichens during the summer compared to females without calves.
Winter	Large areas of contiguous forests dominated by black spruce. Open conifer forests or forests with lower tree densities where terrestrial and arboreal lichen are abundant and there is significant less snow (e.g. shorelines) are also selected.

Table H-4d. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield East ecoregion (see Table H-6 for biophysical attributes more specific to Labrador ranges).

Type of habitat	Description
Broad scale	Conifer-feather moss forests on poorly-drained sites and mature conifer uplands with abundant terrestrial lichen. Black spruce, jack pine and balsam fir stands present with abundant lichen. Water bodies and wetlands (swamps, marshy areas with tamarack). Mountains or rolling hills. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Calving	Open wetlands, peninsulas and islands. Sedges, ericaceous species, bryophytes, alder and larch selected in spring. Balsam fir, dense black spruce stands, spruce-fir forests older than 40 years, and dry bare land with high lichen densities. Mature conifer stands, as well as wetlands (marshes, peat moss areas). Higher altitudes used for calving in this area rather than lake or water bodies.
Post-calving	Open and forested wetlands (marshes, swamps), and continued use of peninsulas and islands. Hilly areas, coastal sites, shorelines (rivers, lakes, creeks). Aquatic plants, dwarf birch (*Betula glandulosa*), deciduous shrubs, ericaceous species and moss.
Rutting	Open wetlands selected, swamps. Terrestrial and arboreal lichens, forbs, sedges, mosses and coniferous and deciduous shrubs. Balsam fir stands, dense spruce stands, mature and regenerating conifer stands, other forest stands (tamarack, pine) with abundant lichens, wetlands (swamps) and dry bare lands.
Winter	Forested wetlands. Some use of upland-tundra for loafing. Mountainous terrain. Dry bare land, wetlands, mature conifer forests with lichen, balsam fir stands, dense spruce stands, and mixed spruce-fir forests older than 40 years selected in southern areas. Observed along frozen bodies of water. Use of mature forests protected from harvesting increases probability of encounters with wolves that select the same habitats in winter. Shallow snow depths selected in late winter.
Travel	Caribou move greater distances during the rutting season.

Table H-4e. Biophysical attributes for boreal caribou critical habitat in the Boreal Shield Southeast ecoregion.

Type of habitat	Description
Broad scale	Late seral-stage black spruce-dominated lowlands and jack pine-dominated uplands, Balsam fir stands, marshlands and abundant lichen.
Calving	Open, medium-closed conifer forests. Elevations of 300 m. Intermediate values of Normalized Difference Vegetation Index[1]. Selection for old (>40 years) burns.
Rutting	Dense and open mature conifer forests of spruce, tamarack, jack pine and young conifer forests between 30 – 50 years old.
Winter	Open stands of balsam fir, balsam fir-black spruce, black spruce, black-spruce-tamarack and jack pine stands older than 70 yrs. Dry bare lands, 30-50 year old stands of balsam fir or fir-black spruce, as well as 50 year old jack pine stands, and arboreal and terrestrial lichens.

Table H-5. Biophysical attributes for boreal caribou critical habitat in the Hudson Plain ecozone.

Type of habitat	Description
Broad scale	Habitats selected generally to reduce predation risk. Shrub rich treed muskeg and mature conifer forests abundant in lichens. Shorelines of deep lakes and rivers (birch trees). Poorly drained areas dominated by sedges, mosses and lichens, as well as open black spruce and tamarack forests. Elevations of 150m. Intermediate levels of ruggedness[1] and Normalized Difference Vegetation Index[2].
Calving	Mature conifer stand with and without lichens and muskegs. Preference for higher altitudes compared to habitat use during other periods.
Post-calving	Fens, bogs and lakes.
Rutting	Wetlands and conifer stands with lichen. Mature and regenerating conifer stands are also used, albeit to a lesser degree. Caribou use hills in the lowlands, treed islands in muskegs with several different tree species.
Winter	Dense and mature conifer forests with lichens and wetlands. Peat lands dominated by open bogs and terrestrial lichens. Large patches of intermediate and mature black spruce, shrub-rich treed muskeg and mixed conifer stands all used in late winter.
Travel	Movements greatest in fall/winter when caribou transition from calving to winter habitat. Long range movements are greater in areas with high moose densities, presumably to reduce predation risk.

[1] Vector ruggedness is a metric used to capture variability in slope and aspect.
[2] Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of comparing vegetation greenness between satellite images.

NOTE: A small portion of boreal caribou critical habitat in the northern portion of the Northwest Territories range falls within the Southern Arctic ecozone and the Taiga Cordillera ecozone. Currently, there is no information available on boreal caribou habitat use or biophysical attributes in either of these ecozones. Biophysical attributes in the Taiga Plain ecozone are used to describe the type of habitat needed for the identification of critical habitat for boreal caribou in the Southern Arctic and Taiga Cordillera ecozones.

Biophysical attributes specific to Labrador ranges, containing detailed information as made available by the jurisdiction.

Table H-6. Biophysical attributes of boreal caribou critical habitat in the Taiga Shield ecozone and Boreal Shield East ecoregion, specific to Labrador ranges.

Type of habitat	Description
Broad scale	Subarctic and boreal forests. Tundra and low shrubs at high elevations. Numerous lakes, peatlands (string, plateau and basin bogs, ribbed and ladder fens) and peatland complexes of several wetland types adjacent and contiguous to each other, broad river valleys. Lichen woodlands, new and regenerating burns. Intermediate values of Normalized Difference Vegetation Index[1]. <u>Lac Joseph (NL1)</u> Mid and low subarctic forests characterized by open coniferous forests, eskers and upland plateaus. Black spruce dominant; jackpine and trembling aspen occur sporadically. Poorly-drained sites characterized by extensive ribbed fen-string bog complexes bordered by black-spruce sphagnum stands. Well drained sites and river uplands often containing open lichen woodlands. Lakes comprising approximately 15%of range, including Lac Joseph, Lake Ashuanipi and Atikonak Lakes. <u>Red Wine Mountain (NL2)</u> High boreal forest and alpine areas in addition to low subarctic forest. Boreal forest portions contain productive, close-canopied boreal forests, with deep river valleys. Black spruce predominant, while some balsam fir, white birch, and trembling aspen also occur. Dominant topographical feature are the Red Wine Mountains (600m- 900m asl), and an extensive upland boreal plateau consisting of a mosaic of extensive string bogs and open conifer forest (400 m asl). Alpine areas with tundra vegetation; larch and black spruce on lower valley slopes. <u>Mealy Mountain (NL3)</u> Extensive tree-less coastal barrens and offshore islands with tundra-like vegetation, and extensive string bogs and open pools of water, with hummocks dominated by scrub spruce and Labrador tea on the Eagle River Plateau. Mid-boreal forest characterized by closed-canopied black spruce and balsam fir forests. Eskers which occasionally support ribbons of lichen woodland. Dominant topographical feature is the Mealy Mountain range (1000m asl), containing alpine areas with tundra vegetation.
Calving	Muskegs, lakes and islands, peninsulas of large lakes, or combinations of these features. Mature, dense conifer stands (>90 years) with a sphagnum, forb or shrub understory, particularly when in proximity to wetlands or lakes.
Post-calving and summer	Immediately post calving: wetlands and areas with open water, and adjacent areas of mature, dense coniferous forest. Summer (July through September) and early fall: broader array of vegetation communities in the vicinity of their calving areas, including mature coniferous forests with a shrub or moss/forb understory, treed bogs and some open-canopied woodlands with an extensive shrub understory. Open and forested wetlands (muskeg, treed bogs) and continued use of peninsulas and islands, shorelines (rivers, lakes, creeks). Riparian plants, dwarf birch (*Betula glandulosa*), willow, ericaceous shrubs, forbs grasses and sedges for forage.

Type of habitat	Description
Rutting	Wetlands and areas with open water, and adjacent areas of mature, dense coniferous forest. Mature coniferous forests with a shrub or moss/forb understory, treed bogs and some open-canopied woodlands with an extensive shrub understory. Open and forested wetlands (muskeg, treed bogs) and continued use of peninsulas and islands, shorelines (rivers, lakes, creeks). Riparian plants, dwarf birch (*Betula glandulosa*), willow, ericaceous shrubs, forbs and sedges for forage.
Winter	Early winter (November through January): lichen woodlands and lichen-shrub woodlands. Occasional use of wetlands. Late winter: lichen woodlands, ice-covered water bodies (for rest and as a refuge), and regenerating burns (with shrub and Cladina mitis understory) in some cases. Extensive use of coastal barrens in Mealy Mountain range. Some use of Alpine areas in Red Wine Mountain and Mealy Mountain range.
Travel	During spring and fall migration, select open habitats that are easy to travel through. In particular, during spring migration select for (frozen) wetlands and burns, and during fall migration added open lichen woodlands to the latter cover classes. Most females travel up to 20 km from winter areas to calving sites, but can move by as much as 120 km.

[1] Normalized Difference Vegetation Index (NDVI) is an index that provides a standardized method of comparing vegetation greenness between satellite images.

APPENDIX I: MITIGATION TECHNIQUES TO AVOID DESTRUCTION OF CRITICAL HABITAT

Mitigation of the adverse effects that may result from a proposed project on boreal caribou could include different techniques. These techniques include avoiding destruction of undisturbed habitat or biophysical attributes necessary for the species to carry out life processes, reducing noise or pollution, or minimizing disturbance by adapting its shape or adjusting the timing of the disturbance. Table I-1 provides examples of considerations and possible mitigation techniques when planning development within a boreal caribou range.

Table I-1. Examples of considerations when planning development within a boreal caribou range and possible mitigation techniques.

Considerations when planning development	Examples of possible mitigation techniques
Threshold of disturbance in the short- and long-term	Minimize the footprint of development, consider locations where habitat is already disturbed; restore habitat to provide continual availability of undisturbed habitat over time.
Ecological factors	Avoid destruction of biophysical attributes (see Appendix H).
Spatial configuration	Minimize disturbance by adapting its shape (small polygon vs. linear).
Sensory disturbances	Mitigation of noise, light, smells, vibrations to prevent harassment of boreal caribou.
Pollution	Mitigate pollution through scrubbers or other techniques. Some types of pollution may be especially of concern (e.g. air pollution that increases acidity may affect lichens on which boreal caribou depend for food).
Timing of disturbance	Certain types of disturbance could occur only in seasons when boreal caribou are not using the area or do not respond negatively to the activity.
Induced effects	New access roads in previously undisturbed areas may induce further disturbance by opening territory to more development, recreational users, etc. This could be prevented by an access management plan that could include limiting access, decommissioning roads, etc.
Corridors that support predator movement	Impact may be reduced by using techniques that prevent use of corridor by predators (no compaction of snow, immediate replanting of trees, etc.).
Increases in predator and/or alternate prey populations	Mortality management techniques may be considered where the killing of predators would be a final, necessary option implemented temporarily, along with habitat restoration.

APPENDIX J: CRITICAL HABITAT FACTSHEETS

Illustration © Judie Shore

CRITICAL HABITAT FACTSHEETS: NORTHWEST TERRITORIES

Critical Habitat Identification: Northwest Territories Range (NT1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

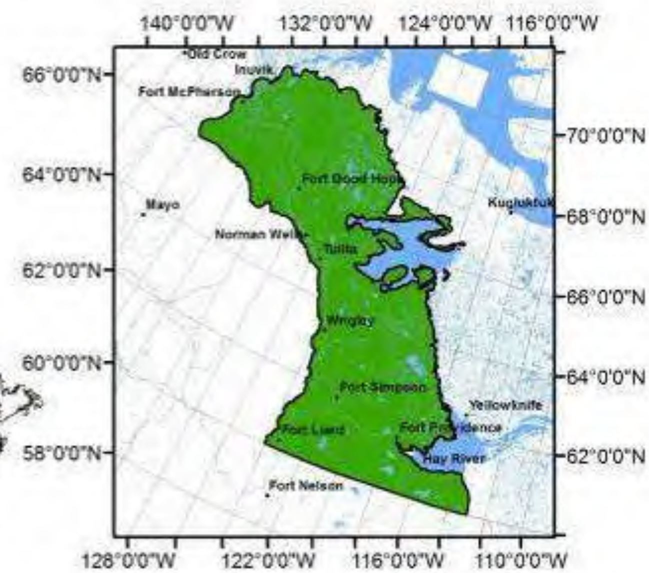

Figure J-1. Key map of the general location of the range.

Figure J-2. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
44,166,546	28	9	35	65	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain
	Southern Arctic
	Taiga Cordillera

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: BRITISH COLUMBIA

Critical Habitat Identification: Maxhamish Range (BC1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-3. Key map of the general location of the range.

Figure J-4. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
710,105	2	67	68	32	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Calendar Range (BC2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-5. Key map of the general location of the range.

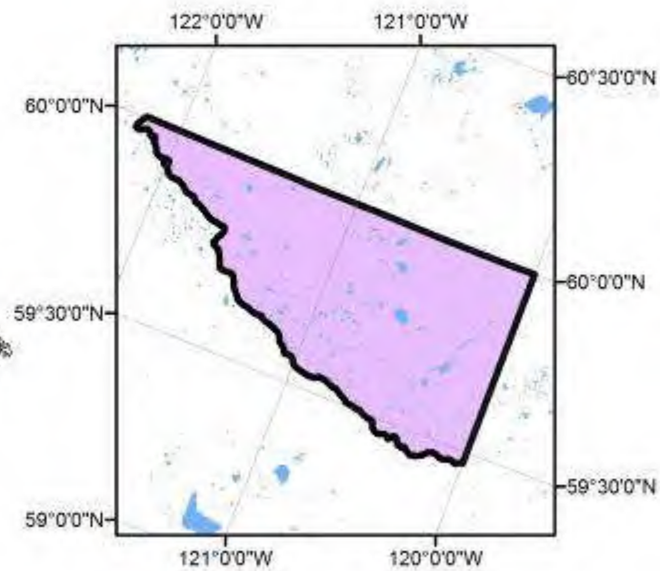

Figure J-6. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
496,393	16	53	61	39	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Snake-Sahtahneh Range (BC3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

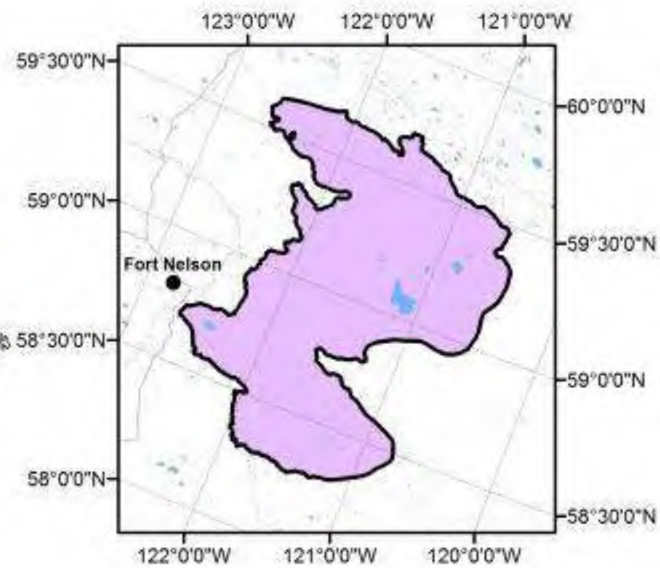

Figure J-7. Key map of the general location of the range.

Figure J-8. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,198,752	5	77	79	21	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Parker Range (BC4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-9. Key map of the general location of the range.

Figure J-10. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
75,222	3	57	57	43	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Prophet Range (BC5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-11. Key map of the general location of the range.

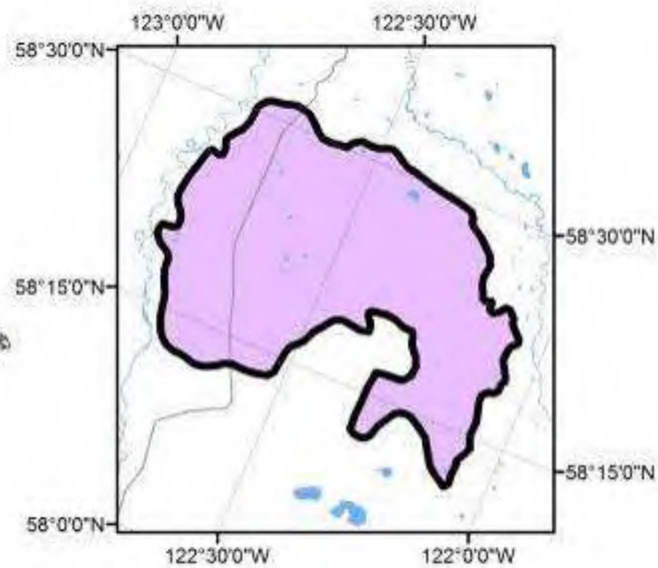

Figure J-12. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
119,396	10	78	78	22	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: ALBERTA

Critical Habitat Identification: Chinchaga Range (incl. BC portion) (AB1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

Figure J-13. Key map of the general location of the range.

Figure J-14. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,162,612	9	79	80	20	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Bistcho Range (AB2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-15. Key map of the general location of the range.

Figure J-16. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,436,555	40	58	75	25	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Yates Range (AB3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-17. Key map of the general location of the range.

Figure J-18. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
523,094	42	20	55	45	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain

[1] *See Appendix H*

Critical Habitat Identification: Caribou Mountains Range (AB4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-19. Key map of the general location of the range.

Figure J-20. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,069,000	46	27	62	38	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Plain
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Little Smoky Range (AB5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-21. Key map of the general location of the range.

Figure J-22. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
308,606	0.4	96	96	4	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Montane Cordillera
	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Red Earth Range (AB6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-23. Key map of the general location of the range.

Figure J-24. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,473,729	40	48	72	28	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: West Side Athabasca River Range (AB7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-25. Key map of the general location of the range.

Figure J-26. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,572,652	5	70	72	28	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Richardson Range (AB8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-27. Key map of the general location of the range.

Figure J-28. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
707,350	74	23	88	12	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: East Side Athabasca River Range (AB9)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-29. Key map of the general location of the range.

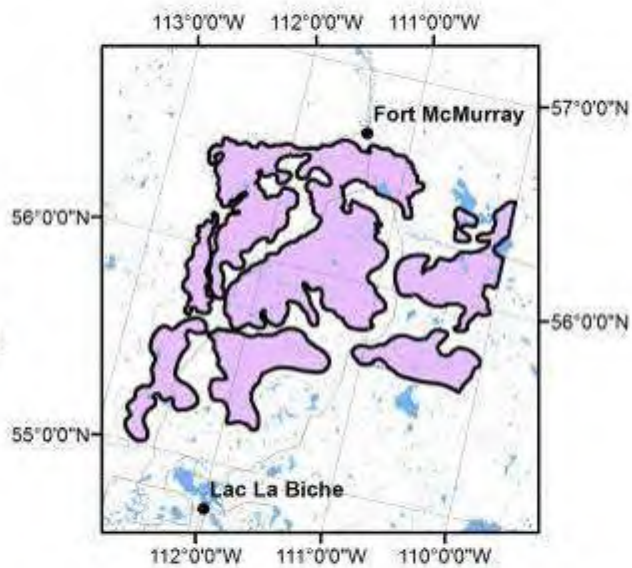

Figure J-30. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,315,980	28	78	84	16	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Cold Lake Range (AB10)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-31. Key map of the general location of the range.

Figure J-32. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
672,422	33	76	87	13	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Nipisi Range (AB11)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-33. Key map of the general location of the range.

Figure J-34. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
210,771	9	75	77	23	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Slave Lake Range (AB12)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-35. Key map of the general location of the range.

Figure J-36. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
151,904	39	74	87	13	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: SASKATCHEWAN

Critical Habitat Identification: Boreal Shield Range (SK1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

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i) Location: Where critical habitat is found.

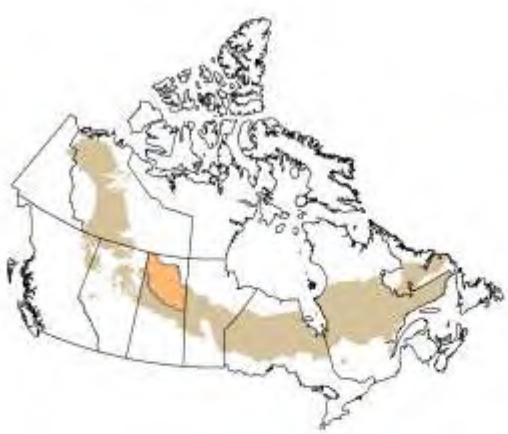

Figure J-37. Key map of the general location of the range.

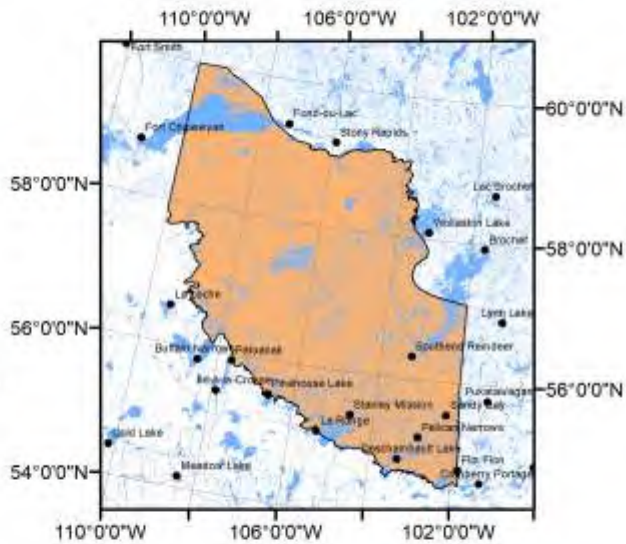

Figure J-38. The geographic boundary within which critical habitat is located.

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ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
18,034,870	58	3	60	40	At least 40% undisturbed habitat

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iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Boreal Plain Range (SK2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-39. Key map of the general location of the range.

Figure J-40. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
10,592,463	30	20	45	55	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: MANITOBA

Critical Habitat Identification: The Bog Range (MB1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-41. Key map of the general location of the range.

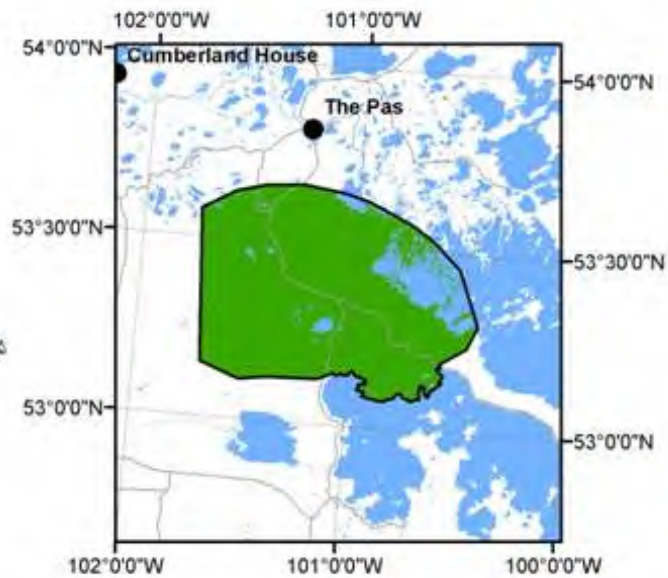


Figure J-42. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
446,383	6	14	19	81	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] See Appendix H

Critical Habitat Identification: Kississing Range (MB2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-43. Key map of the general location of the range.

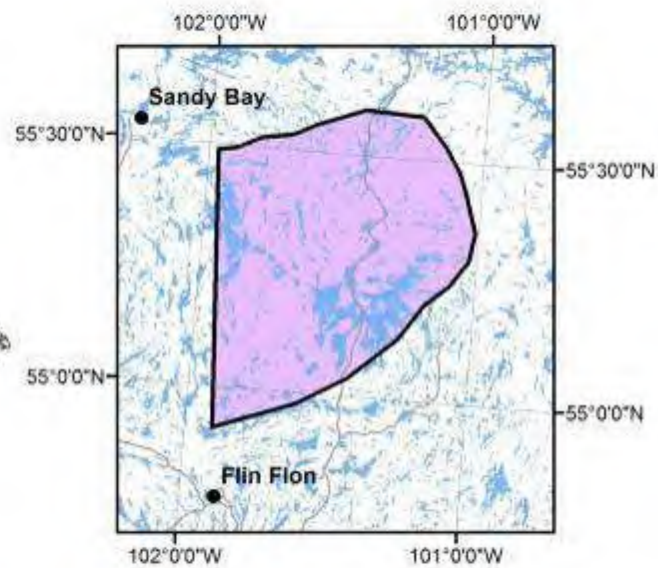


Figure J-44. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
317,029	39	15	54	46	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Naosap Range (MB3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

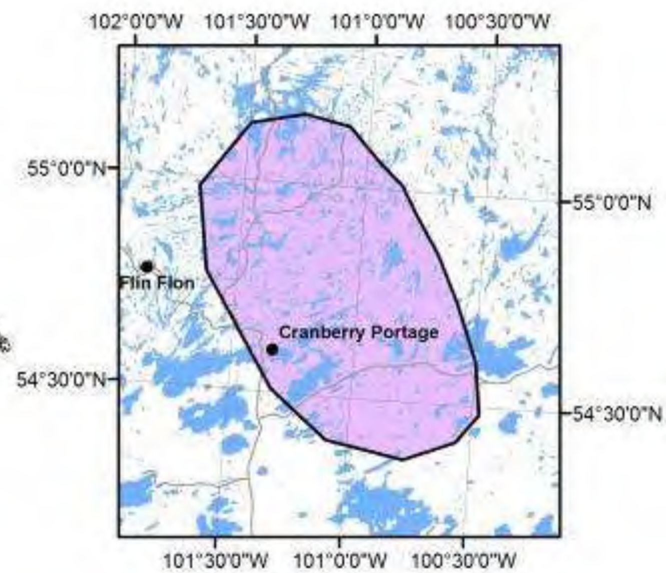


Figure J-45. Key map of the general location of the range.

Figure J-46. The geographic boundary within which critical habitat is located

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
456,977	28	28	52	48	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Reed Range (MB4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-47. Key map of the general location of the range.

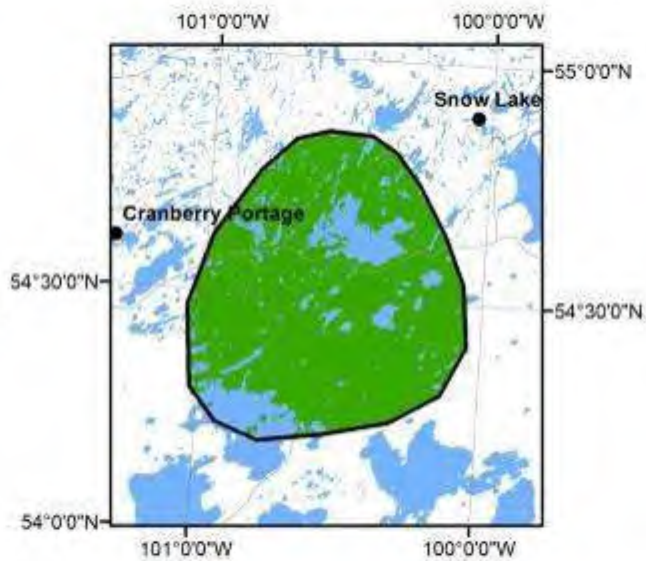


Figure J-48. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
357, 425	7	20	26	74	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: North Interlake Range (MB5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-49. Key map of the general location of the range.

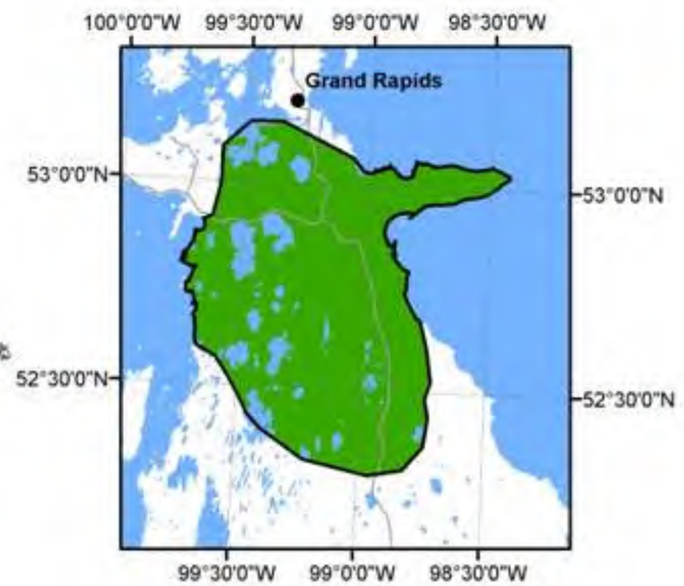


Figure J-50. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Critical Habitat Undisturbed
	Fire	Anthropogenic	Total		
489,680	4	14	18	82	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: William Lake Range (MB6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-51. Key map of the general location of the range.

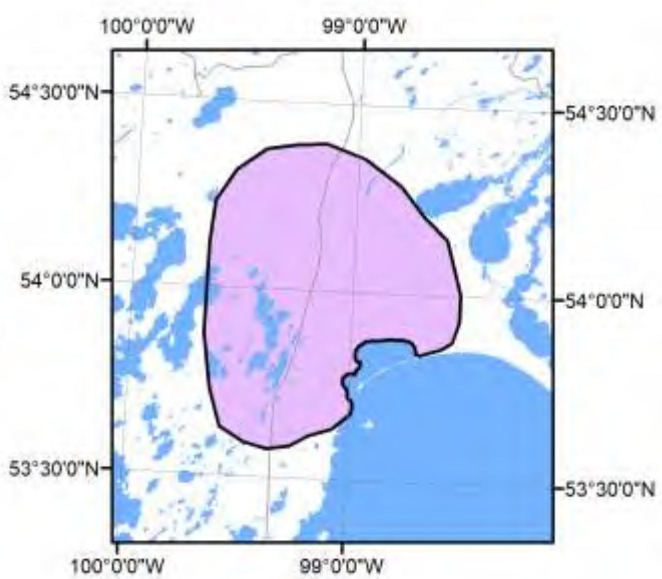


Figure J-52. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
488,219	25	17	36	64	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Wabowden Range (MB7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-53. Key map of the general location of the range.

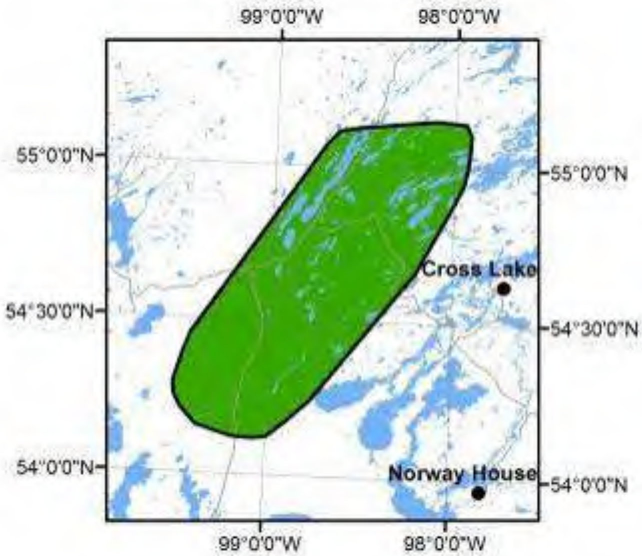


Figure J-54. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
628,938	10	20	28	72	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozones(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Wapisu Range (MB8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-55. Key map of the general location of the range.

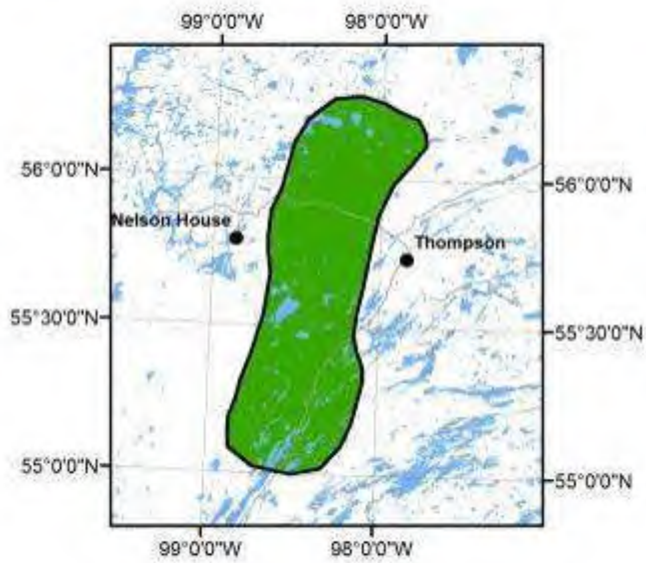


Figure J-56. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
565,044	11	13	24	76	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Manitoba North Range (MB9)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-57. Key map of the general location of the range.

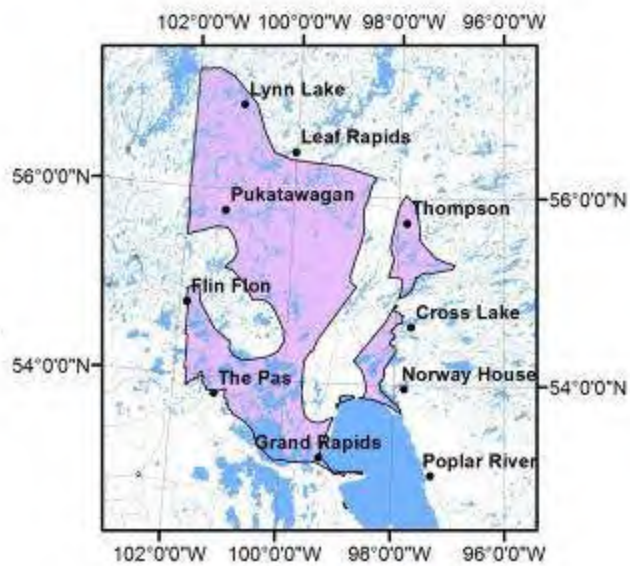


Figure J-58. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
6,205,520	23	11	33	67	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
	Boreal Plain
Ecoregion(s)[1]:	Boreal Shield (West)

[1] *See Appendix H*

Critical Habitat Identification: Manitoba South Range (MB10)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

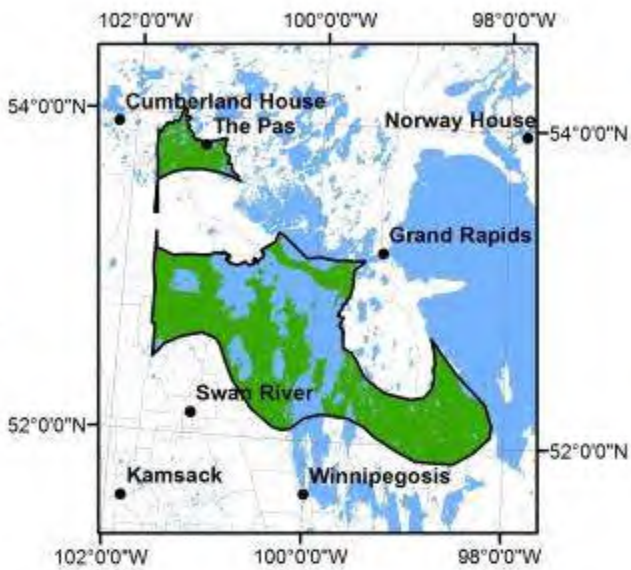


Figure J-59. Key map of the general location of the range.

Figure J-60. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,867,255	4	12	16	84	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Plain

[1] *See Appendix H*

Critical Habitat Identification: Manitoba East Range (MB11)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-61. Key map of the general location of the range.

Figure J-62. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
6,612,782	26	3	29	71	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Atikaki-Berens Range (MB12)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-63. Key map of the general location of the range.

Figure J-64. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,387,665	29	6	34	66	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Owl-Flinstone Range (MB13)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-65. Key map of the general location of the range.

Figure J-66. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
363,570	25	18	39	61	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: ONTARIO

Critical Habitat Identification: Sydney Range (ON1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-67. Key map of the general location of the range.

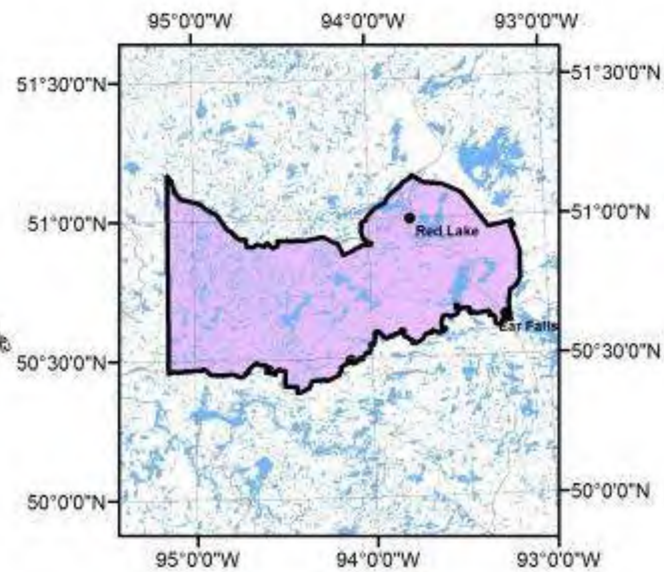


Figure J-68. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
753,001	27	25	49	51	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Berens Range (ON2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-69. Key map of the general location of the range.

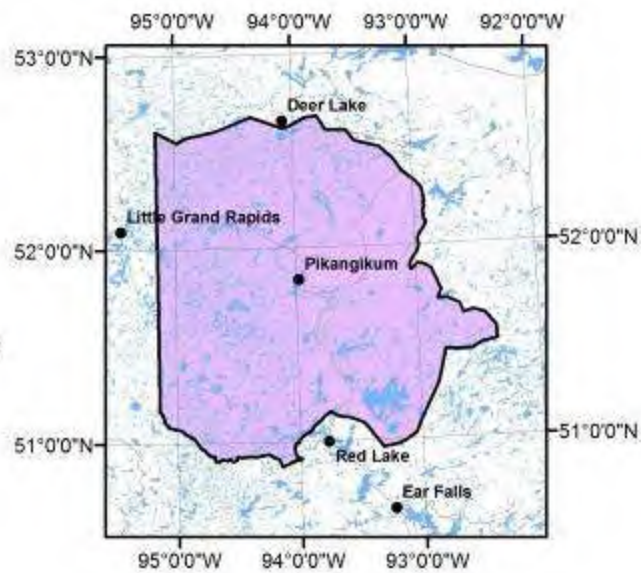


Figure J-70. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,794,835	31	6	37	63	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Churchill Range (ON3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-71. Key map of the general location of the range.

Figure J-72. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,150,490	8	28	34	66	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Brightsand Range (ON4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-73. Key map of the general location of the range.

Figure J-74. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,220,921	19	26	41	59	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Nipigon Range (ON5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-75. Key map of the general location of the range.

Figure J-76. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,885,026	7	25	30	70	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *See Appendix H*

Critical Habitat Identification: Coastal Range (ON6)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-77. Key map of the general location of the range.

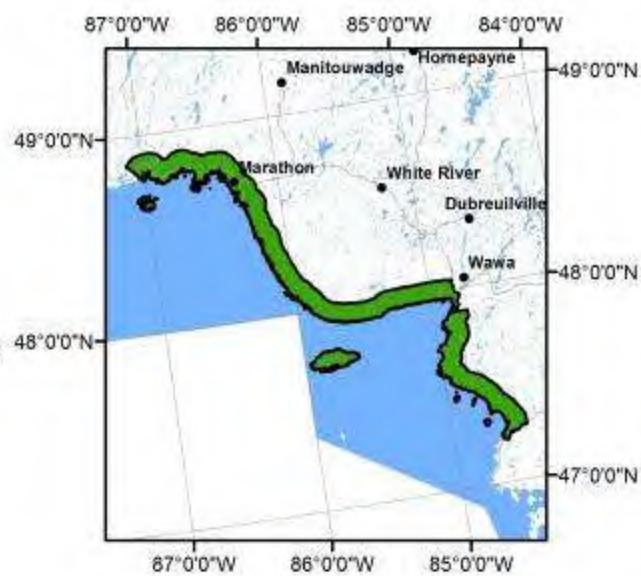


Figure J-78. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
376,598	0	15	15	85	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West Central)
	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Pagwachuan Range (ON7)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-79. Key map of the general location of the range.

Figure J-80. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
4,542,918	0.7	27	27	73	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (West)
	Boreal Shield (West Central)
	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Kesagami Range (ON8)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-81. Key map of the general location of the range.

Figure J-82. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
4,766,463	3	37	40	60	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Far North Range (ON9)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-83. Key map of the general location of the range.

Figure J-84. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
28,265,143	15	1	16	84	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Hudson Plain
	Boreal Shield
Ecoregion(s)[2]:	Boreal Shield (West)
	Boreal Shield (West Central)

[1] *The ON9 range was delineated into six new ranges by the province of Ontario in 2013 (https://www.ontario.ca/document/range-management-policy-support-woodland-caribou-conservation-and-recovery).*

[2] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: QUEBEC

Critical Habitat Identification: Val d'Or Range (QC1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-85. Key map of the general location of the range.

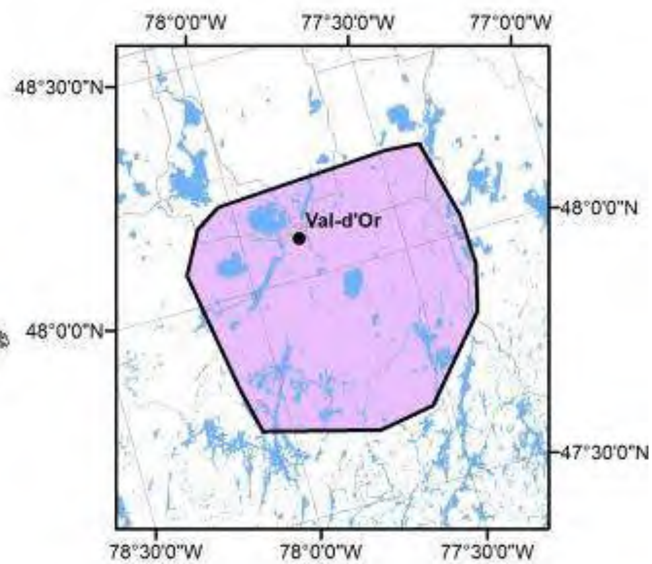


Figure J-86. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
346,861	0.2	65	65	35	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Central)

[1] *See Appendix H*

Critical Habitat Identification: Charlevoix Range (QC2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-87. Key map of the general location of the range.

Figure J-88. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
312,803	4	80	82	18	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (Southeast)

[1] *See Appendix H*

Critical Habitat Identification: Pipmuacan Range (QC3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-89. Key map of the general location of the range.

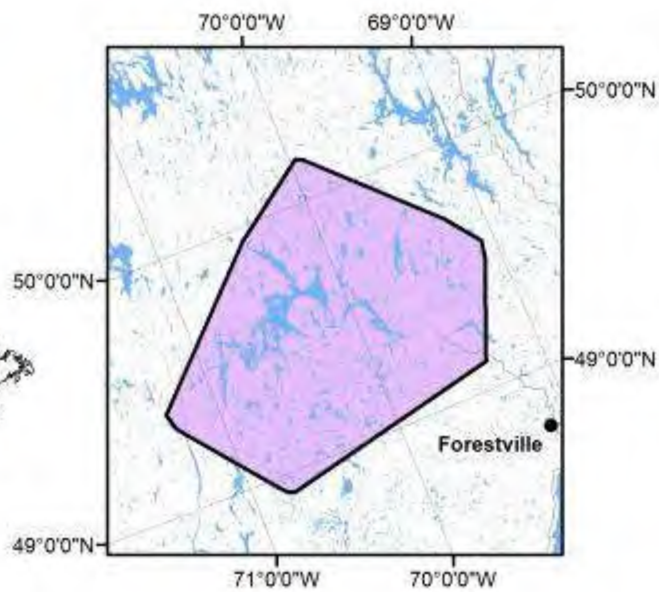


Figure J-90. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,376,899	11	60	68	32	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Manouane Range (QC4)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-91. Key map of the general location of the range.

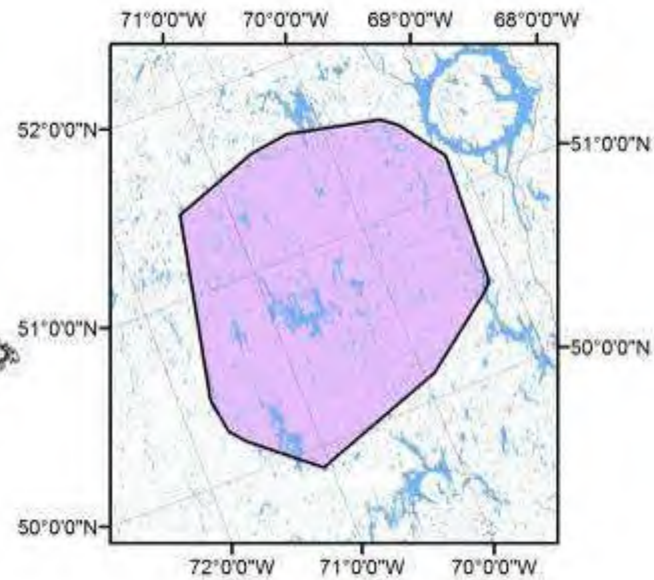


Figure J-92. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
2,716,449	18	26	41	59	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Manicouagan Range (QC5)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-93. Key map of the general location of the range.

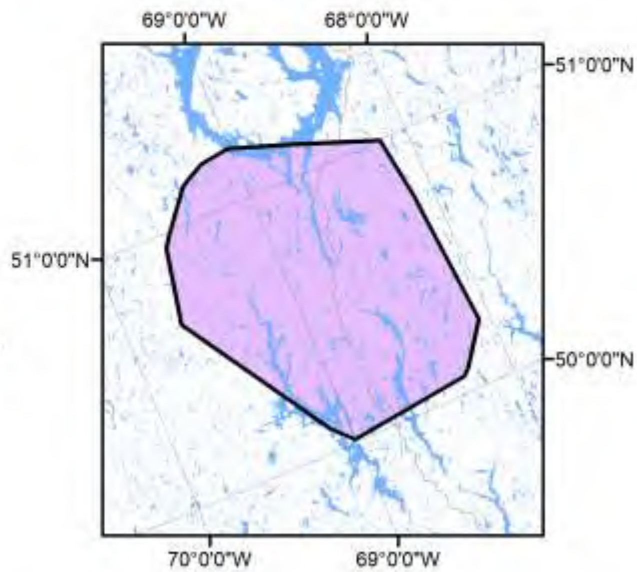


Figure J-94. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
1,134,129	3	36	37	63	Existing habitat that would contribute to at least 65% undisturbed habitat over time.

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Quebec Range (QC6)[1]

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-95. Key map of the general location of the range.

Figure J-96. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
62,156,186	20	13	32	68	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[2]:	Boreal Shield
	Taiga Shield
	Hudson Plain
Ecoregion(s)[2]:	Boreal Shield (Central)
	Boreal Shield (East)
	Boreal Shield (Southeast)

[1] *The range is likely made up of several populations for which the self-sustainability status may vary. New data are currently being collected by the provincial jurisdiction for this range. This may result in an update to the range delineation and/or the identification of new ranges, as well as a revision of their self-sustainability status following integrated risk assessment of new ranges or new range boundaries.*

[2] *See Appendix H*

CRITICAL HABITAT FACTSHEETS: NEWFOUNDLAND AND LABRADOR

Critical Habitat Identification: Lac Joseph Range (NL1)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-97. Key map of the general location of the range.

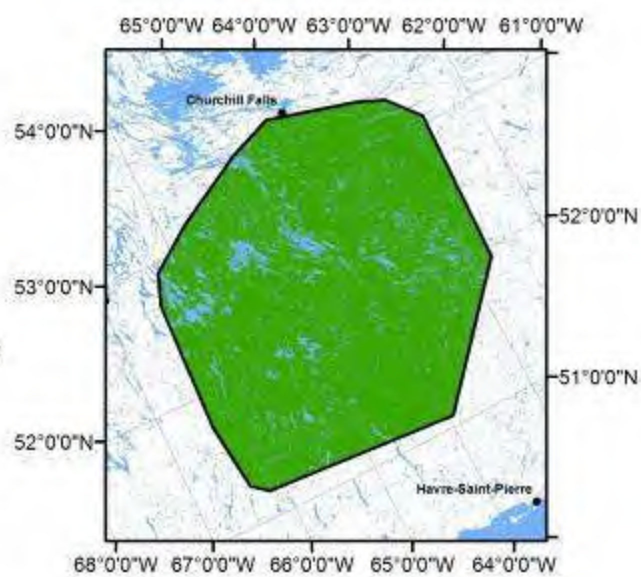


Figure J-98. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
5,802,491	12	2	14	86	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Red Wine Mountain Range (NL2)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-99. Key map of the general location of the range.

Figure J-100. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
5,838,594	7	3	9	91	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Critical Habitat Identification: Mealy Mountain Range (NL3)

The identification of critical habitat for boreal caribou is described by three components for each range: i) Location of habitat; ii) Amount of habitat; and iii) Type of habitat.

i) Location: Where critical habitat is found.

Figure J-101. Key map of the general location of the range.

Figure J-102. The geographic boundary within which critical habitat is located.

ii) Amount: Quantity of critical habitat.

Total Range Area (ha)	Disturbed Habitat (%)			Total Undisturbed Habitat (%)	Amount of Critical Habitat
	Fire	Anthropogenic	Total		
3,948,463	1	1	2	98	At least 65% undisturbed habitat

iii) Type: Biophysical attributes of critical habitat.

Ecozone(s)[1]:	Taiga Shield
	Boreal Shield
Ecoregion(s)[1]:	Boreal Shield (East)

[1] *See Appendix H*

Species Conservation Rankings

The Saskatchewan Conservation Data Centre is responsible for evaluating and assigning a conservation rank to each taxon, resident or transient, found in the province. The process of conservation ranking involves the review of information housed in the SKCDC database as well as scientific and government literature, natural history publications, consultations with recognized experts and highly knowledgeable amateur naturalists as well as field work. The goal of this process is to arrive at a subnational or S-rank, based on the best available information, that best characterizes the extirpation risk of an element in the province. This subnational or S-rank serves to focus conservation concerns.

Ranks are calculated using a standardized procedure set forth by NatureServe, which allows the SKCDC to follow a standardized, repeatable, and transparent procedure for categorizing the province’s flora and fauna.

Each species assessment considers not just rarity, but also trends and threats:

Rarity factors include:

- population size
- range extent
- area of occupancy
- number of occurrences
- number of occurrences or percent of area occupied with good viability/ecological integrity
- environmental specificity

Trend factors in population size or area include:

- long-term trends (ca. 200 years)
- short-term trends (10 years or 3 generations for species, whichever is longer, up to a maximum of 100 years; or 50 years for ecosystems)

Threats factors include:

- assigned overall threat impact based on the scope, severity, and timing in eleven categories:
- residential and commercial development
- agriculture and aquaculture
- energy production and mining
- transportation and service corridors
- biological resource use
- human intrusions and disturbance
- natural systems modifications
- invasive and other problematic species and genes
- pollution
- geological events
- climate change and severe weather
- intrinsic vulnerability (i.e., any specific habitat requirements or other factors specific to the ecology of the species that may affect the risk of extirpation).

A minimum number of factors, and a minimum of certain types of factors, are needed to calculate a rank. The factors are scaled and weighted according to their impact on risk, and points are used to score the contribution of each factor to the risk. The final overall score is equated with a rank.

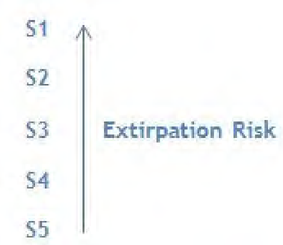
Did you know?

Narrow-leaved Prairie Coneflower is an important nectar source for Dakota Skipper in Saskatchewan, where the skipper inhabits upland dry mixed prairie of the Souris River Region.

Interpreting Conservation Ranks

Ranks are given as the letter that represents the geographic scale followed by a number that represents the taxon's risk of extirpation. A **higher S-rank** (e.g., S5) indicates that a species is more common, more stable, and less threatened than a species with a **lower S-rank** (e.g., S1), which would indicate that a species is rarer, declining, facing a high threat level, or a combination of these factors.

1	Critically Imperiled/ Extremely rare	At very high risk of extinction or extirpation due to extreme rarity, very steep declines, high threat level, or other factors.
2	Imperiled/Very rare	At high risk of extinction or extirpation due to a very restricted range, very few populations, steep declines, threats, or other factors.
3	Vulnerable/Rare to uncommon	At moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors.
4	Apparently Secure	Uncommon but not rare; some cause for long-term concern due to declines or other factors.
5	Secure/Common	Demonstrably secure under present conditions; widespread and abundant; low threat level.



Species with a low S Rank are at a higher risk of extirpation.

A **range rank** (such as S3S4) is used when the taxon straddles the criteria for more than one rank (i.e., S3 and S4). Letters in the rank are referred to as modifiers and can have various meanings:

- **A -** accidental or causal in the province, including species recorded infrequently that are far outside their range (birds and butterflies)
- **B –** for a migratory species, applies to the breeding population in the province
- **N –** for a migratory species, applies to the non-breeding population in the province
- **M –** for a migratory species, rank applies to the transient (migrant) population
- **H –** historical occurrence of the taxon, without recent verification (e.g., 20-40 years or older)
- **U –** status is uncertain in Saskatchewan because of limited or conflicting information (unrankable)
- **X –** believed to be extinct or extirpated from the province
- **NR –** rank is not yet assigned, or species has not yet been assessed (not ranked)
- **NA –** conservation status is not applicable to the species (e.g., it may have been determined to have been introduced in Saskatchewan)

A "**?**" following a rank means that there is some uncertainty associated with it. For example, a rank of S3? means that it is believed to be most likely an S3, but there is a significant chance that it could be an S2 or S4.

The SKCDC prioritizes taxa for ranking based on a five-year rotation. Information on each taxon is gathered and compiled prior to assessing the rank factors. Once a rank is calculated, it is reviewed by SKCDC staff and other experts (e.g., members of the Botanical Assessment Working Group for plants), and can be adjusted if the reviewers feel that it is necessary. The ranks are only as good as the information that is put into the calculator, so it is important for the SKCDC to have all the most up-to-date information on a taxon before ranking it. External data may play a role in adjusting the rank, but, if possible, the SKCDC will incorporate such data into its database prior to the rank calculation.

Where data is scarce, the SKCDC may rely on expert opinion to inform a conservation rank.

Why are these ranks important? Conservation activities are focused on taxa that have a rank of S1, S2 or S3. Taxa with a rank including S3 or less are tracked by the SKCDC and locations of conservation significance are mapped. Locations of these species are made available through websites such as HABISask for uses that include project planning of developments on the landscape. Taxa that are not ranked S1, S2 or S3 may still be tracked if special circumstances warrant.

Accessing Species Conservation Rankings

Species conservation rankings (S-Ranks) can be found in any of the SKCDC's species lists.

General Status of Wild Species in Canada

Many of the subnational and national conservation ranks in the SKCDC's database have been assessed/reassessed as a result of the General Status of Species in Canada program. The National General Status Working Group, comprised of government representatives as well as Conservation Data Centre specialists and ex officio members, contracts experts to review the statuses of specific taxon groups. These taxon groups can include any wild species – bees, flowers, slime molds, you name it! Every five years, the General Status of Species in Canada program releases a Wild Species report that provides a snapshot of the status of wild species in Canada.

These reports can be downloaded from the Wild Species website.

Related Resources:

Identifying At-Risk Species and Ecosystems - An overview of methods at NatureServe.org

NatureServe Conservation Status Assessments: Methodology for Assigning Ranks - NatureServe Report

NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk - NatureServe Report

Last updated 11/12/20258/6/2025

Guidelines to avoid harm to migratory birds

Information on the risk your activities might pose to migratory birds, and guidelines to avoid causing harm to migratory birds, as well as to their nests when they are protected.

On this page

Disclaimer

This information provides an overview of your obligations and does not replace relevant laws and regulations. You must adhere to all federal, provincial and/or territorial laws, regulations and conditions of permits.

We do not have the authority to prescribe or recognize specific avoidance or mitigation measures for specific circumstances or activities. It is your responsibility to determine the most appropriate avoidance or mitigation measures required.

Please contact us for further information.

Migratory birds, their nests or eggs can be harmed as a result of many activities. Activities that do not primarily target a bird, but which may cause harm, include:

- clearing trees or other vegetation
- draining or flooding land
- using fishing gear

Causing harm to migratory birds can have long-term negative effects on bird populations. This is especially true if there are many incidents that harm birds.

We work with the public, governments and industries to help:

- reduce the risk of harm to migratory birds
- ensure the laws and regulations are followed
- maintain healthy populations of birds

Your role and responsibilities

To prevent harming migratory birds, nests and eggs, you should:

- understand how migratory birds and their nests are legally protected
- consult the nesting calendars when planning your activities
- plan your activity ahead of time, evaluate if the activity may cause harm to migratory birds, and determine what measures can be taken to avoid causing this harm
- develop and implement preventive and mitigation measures, such as beneficial management practices

Prohibitions on causing harm to migratory birds, their eggs and nests

The MBR 2022 protect migratory birds, their eggs and their nests, by prohibiting activities that can cause them harm.
Unless a person has a permit, or the regulations authorize them to do so, they are prohibited from doing the following activities:

- capture, kill, take, injure or harass a migratory bird or attempt to do so
- destroy, take or disturb an egg; and
- damage, destroy, remove or disturb a nest, nest shelter, eider duck shelter or duck box, unless the following exceptions apply
  - the nest does not contain a live migratory bird or a viable egg; and
  - the nest was not built by a species that is listed in Schedule 1

The nests of species listed in Schedule 1 are protected at all times, unless the following conditions are met:

- a notification of the unoccupied nest has been submitted/received through the Abandoned Nest Registry; and

- the wait time designated in the regulations has passed, and during this time the nest was not occupied by a migratory bird

The following is a list of the 18 species whose nests are protected year round as well as the designated waiting period before the nest can be disturbed, damaged, removed or destroyed

Species of migratory bird	Waiting Period (months)	Species of migratory bird	Waiting Period (months)
Pigeon Guillemot	12	Cassins̀ Auklet	12
Rhinoceros Auklet	12	Ancient Murrelet	12
Atlantic Puffin	12	Great Blue Heron	24
Tufted Puffin	12	Great Egret	24
Horned Puffin	12	Cattle Egret	24
Manx Shearwater	12	Green Heron	24
Northern Gannet	12	Snowy Egret	24
Fork-tailed Storm Petrel	12	Black-crowned Night Heron	24
Leach’s Storm Petrel	12	Pileated Woodpecker	36

Useful Links

- Fact sheet: Nest Protection under the *Migratory Birds Regulations, 2022*

- Frequently Asked Questions: *Migratory Birds Regulations, 2022*

Determining the risk to migratory birds

When planning your activities, you should assess the risk your activity might pose to migratory birds, and take measures to avoid this risk.

Key factors associated with higher risk to birds include:

- seasonal factors, such as:
  - breeding season and migration periods
  - post-breeding moult period and wintering stages for some species
- location factors, such as:
  - migratory bird breeding colonies
  - feeding areas around colonies
  - migration staging sites
- type of potentially disruptive activities

In the case of bird collisions with structures, higher risk factors include:

- site sensitivity, such as:
  - areas of bird concentration and migratory pathways
  - surrounding landscaping and habitat type
  - meteorological conditions like fog
- structure design and size, such as:
  - reflectivity of glass panels
  - lighting
  - use of guy wires
  - height

Related links

- Wind turbines and birds: a guidance document for environmental assessment
- General nesting periods of migratory birds in Canada
- Bird collisions with glass windows

Determining the presence of occupied nests

The nests of all species of migratory birds are protected when they are occupied, that is they contain a live migratory bird or viable egg (so generally during the breeding season). When determining if occupied migratory birds nests are likely to be present, you must consider:

- the available bird habitats
- the migratory bird species likely to be encountered in such habitats
- the time periods when they would likely be present.

For example, “point counts” (a technique to locate singing territorial males) may provide a good indication of the possible presence of songbirds nesting in an area.

In most cases, active nest search techniques are not recommended, because:

- the ability to detect nests is very low while the risk of disturbing or damaging active nests is high
- flushing nesting birds increases the risk of predation of the eggs or young, or may cause the adults to abandon the nest or the eggs
- disturbing or damaging nests is still likely to occur during disruptive activities even when active nest searches are conducted prior to these activities

Nest surveys to determine nest occupancy may be appropriate when all these conditions are met:

- conducted by skilled and experienced observers
- using appropriate methodology
- only a few nesting spots or a small community of migratory birds is expected
- the activities will take place in simple habitats, such as:
    - an urban park consisting mostly of lawns with a few isolated trees
    - a vacant lot with few possible nest sites
    - a previously cleared area which might attract ground nesters
    - a structure such as a bridge, a beacon, a tower or a building
    - snags that can often contain primary and secondary cavity nesters
    - colonial-breeding species that can often be located from a distance (such as a colony of terns or gulls)

Please contact us for further technical information about investigation methods for non-song bird species (notably, waterfowl, waterbirds and shorebirds).

Detection of an occupied migratory bird's nest

If you discover or realize that you have disturbed a nest containing a migratory bird or eggs, you should:

- halt all disruptive activities in the nesting area
- move away as quickly and quietly as possible
    - avoid disturbing the surrounding vegetation, and avoid making a trail to and from the nest
- protect the nest with a buffer zone

- avoid the immediate area until the young have naturally left the vicinity of the nest

If there are occupied migratory bird nests where you plan to work, activities that could disturb or destroy nests should be avoided, adapted, rescheduled or relocated. The best way to avoid disturbing or destroying active nests is to avoid conducting harmful activities during the breeding season.

Establishing buffer zones and setback distances

Any occupied nest found should be protected with a buffer zone until the young have permanently left the vicinity of the nest.
It is **not** recommended to mark nests using flagging tape or similar material. This may increase the risk of predators finding the nest. If necessary, flagging tape can be placed at the limits of the buffer zone.

A **buffer zone** is determined by a setback distance which varies greatly according to:

- degree of tolerance of the species
- previous exposure of birds to disturbance
- level of disturbance
- landscape context

Appropriate **setback distances** are determined on a case-by-case basis based on:

- distance at which nesting birds react to human disturbance
- expert opinion, which is often used to supplement scientific data

There are two benchmark measurements to determine an effective setback distance.

- **Alert distance** is the distance at which the bird adopts an alert posture or emits alarm calls. Birds usually perceive humans as potential predators. They may leave their nests in response to being approached, or abort nesting because of stressful situations.
- **Flush distance** is the distance at which a bird:
  - takes flight or moves away from a threat
  - performs distraction displays (such as feigning a broken wing or sitting down on a non-nesting site to draw attention away from the nest)
  - actively defends the nest

Setback distances should be adjusted to the activities causing the greater amounts of disturbance. Significant sources of disturbance include:

- removal of vegetation and/or soil operations
- drilling, loud noise, vibration (for example, seismic blasting from operations)
- regular approach by humans or vehicles
- noise exceeding 10 decibels (dB) above ambient noise levels in the natural environment
- noise greater than about 50 dB

A higher minimum setback distance is required in some circumstances:

- rural or natural habitats compared to urban backyards
- most waterfowl nests compared to nests of songbirds and other small birds
- presence of sensitive species or species at risk

For guidance regarding seabird and waterbird colonies, please refer to Guidelines to avoid disturbance to seabird and waterbird colonies in Canada.

Determining the presence of nests of Schedule 1 listed species

As well as looking for nest occupancy, those conducting nest surveys should also be looking for and recording the nests of Schedule 1 species (occupied or not occupied), so that they may plan ahead and exercise caution when they conduct their activity as not to disturb or destroy these nests at any time, as they are protected year round. The nests of many Schedule 1 species are conspicuous, such as heron and Pileated Woodpecker nests for Pileated Woodpecker cavity identification guide, or they occur in specific locations (coastal seabirds).

Destroying or removing an unoccupied migratory bird nest

The nests of most migratory bird species may be destroyed, damaged, disturbed or removed when they do not contain a migratory bird or viable egg.

For most migratory bird species, removing the nest when it does not contain a migratory bird or viable egg (generally after the breeding season) will have no effect on the ability of those birds to nest again. The great majority build or occupy new nests each year. However, some species may reuse the same nest structure year after year, and the loss of these nests could have a negative effect on future nesting success. The nests of the 18 species, listed in Schedule 1 of the MBR 2022, are protected year round and cannot be damaged, destroyed, removed or disturbed, even when they are unoccupied, unless the conditions of the regulations have been met.

ECCC encourages practices that will ensure the long-term conservation of migratory bird populations locally, including the retention of sufficient high quality habitat. For cavity nesting species, this may mean the retention of dying and dead standing trees in forest stands, whether or not they contain the nesting cavity of the Pileated Woodpecker.

Permits to relocate or destroy unoccupied nest of Schedule 1 species

In certain situations, it may be possible to obtain a permit to relocate or destroy the unoccupied nest of a Schedule 1 species. Please refer to Migratory Birds Permits for more information.

Managing exposed soil banks

When nests contain migratory birds or eggs (generally during the breeding season), it is important that you do not disturb these nests. You should take particular care when:

- selecting erosion prevention and control measures.
- managing stockpiles of overburden.
- managing exposed soil banks in sand pits or quarries.

Regulating water levels

The management and maintenance of dams and project construction may require modifications to water levels in reservoirs, ponds or other wetlands. When planning activities, you should:

- determine if birds are or will likely be nesting in or near the wetland
- avoid regulating water levels that could result in flooding or drying out nests until birds have raised their young
- identify nests of species listed under Schedule 1 and take care not to damage or destroy them at any time of the year.

Water level modifications may, for example, be scheduled prior to or after the breeding season.

Other regulatory protections

Remember that some provincial, territorial or other federal legislation may protect nests of some migratory bird species at all times. The nest of a migratory bird is included in the definition of "residence" for migratory bird species which are endangered, threatened or extirpated under the Species at Risk Act.

It is your responsibility to assess your legal obligations and to avoid harming migratory birds or their nests when they are protected.

Related links

- List of Species at Risk
- Residence descriptions and rationales

Evaluate the risk you might pose to migratory birds

Determine the risk you might pose to migratory birds by reviewing the situations that might apply to you.

Table 1. Examples of lower and higher risk levels for the factor associated with planning of activities harmful to migratory birds in Canada

Factor associated with planning of activities	Example of lower risk level	Example of higher risk level
Knowledge of legal obligations	Awareness of and understanding the relevant provisions of laws and regulations pertaining to the protection of birds, nests and eggs. Notably: the *Migratory Birds Convention Act, 1994*, the *Migratory Birds Regulations, 2022* and, where applicable, the *Species at Risk Act*.	Unaware of legal responsibilities towards the protection of birds, nests and eggs.
Risk assessment and planning	Completed a thorough risk assessment in a timeframe suitable to balance project needs with risk of harm to migratory birds.	Little to no pre-planning or risk assessment around conservation issues related to migratory birds.

Factor associated with planning of activities	Example of lower risk level	Example of higher risk level
Preventive and mitigation measures	Measures are decided upon, implemented and monitored to avoid engaging in potentially destructive or disruptive activities at key locations or during key periods. Records of decision and actions taken. Measures such as policies, procedures, plans, directive or compensatory plan are incorporated into beneficial management practices. Proponent and field operations staff are aware of the identified avoidance measures.	No specific measures planned and implemented to minimize the risk of detrimental effects and to help maintain sustainable populations of migratory birds. No records of decisions and actions taken. No beneficial management practices. Ignorance or lack of training of field operation staff on avoidance measures.

Table 2. Examples of lower and higher risk levels for the factor associated with protection of nests.

Factor associated with protection of nests	Example of lower risk level	Example of higher risk level

Factor associated with protection of nests	**Example of lower risk level**	**Example of higher risk level**
Likelihood of the presence of occupied nests (live bird or viable egg) or nest of species in Schedule 1	When planning your project, you have identified: • available bird habitats • migratory bird species likely to be found in these habitats time periods when migratory bird species are likely to be nesting, with nests containing migratory birds or viable eggsMethods used to prevent disturbance of nests are non-intrusive.	No understanding of local bird presence in space or time. Active nest searches, except when the nests searched are known to be easy to locate without disturbing them.

Factor associated with protection of nests	Example of lower risk level	Example of higher risk level
Habitat	Habitat where your activities will occur is small and simple, such as: • human-made structure (bridge, beacon, tower, and building) • man-made setting or those with few potential nesting spots or few species of migratory birds • urban park made mostly of lawns with few and isolated trees • vacant lot with sparse vegetation	Habitat is large and/or complex with many potential nesting areas, such as woodland and scrubland.

<table>
<tr><th>Factor associated with protection of nests</th><th>Example of lower risk level</th><th>Example of higher risk level</th></tr>
<tr><td>Nest type</td><td>Presence of nests that are:
easy to find and avoid, such as nests of:
Great Blue Heron
Bank Swallow
Chimney Swift
easy-to-find cavity nests in snags, such as nests of:
woodpeckers
goldeneyes
nuthatches
nests of colonial-breeding species, such as terns or gull, that can be located from a distance</td><td>Presence of nest difficult to locate (in other words cryptic or small nests), such as nest of songbirds (this applies to nests of most species)</td></tr>
</table>

Factor associated with protection of nests	Example of lower risk level	Example of higher risk level
Timing	Project occurs when nests do not contain live birds or viable eggs (so generally outside the nesting period) and won't affect nests that are reused in the following year(s) and are protected under Schedule 1 of the MBR 2022.	Operations occur: • during the general nesting period, when they are likely to contain a live bird or viable egg • throughout the year **and** could affect nests that may be reused by migratory birds in the following year(s) and are protected under Schedule 1 of the MBR 2022 (such as nests of Great Blue Heron).

Table 3. Examples of lower and higher risk levels for the factor associated with disturbance of nesting birds.

Factor associated with disturbance of nests and nesting birds	**Example of lower risk level**	**Example of higher risk level**
Intensity of operation	Sources of low intensity disturbance are infrequent **and** quick One or few sources of disturbance. Low or below ambient noise in natural areas.	Sources of disturbance are either: • frequent • lasting • large Several sources of disturbance. Loud noise emissions, especially when: • exceeding 10 decibels (dB) above ambient in natural areas • greater than about 50 decibels (dB)
Landscape context	Birds used to disturbance or already breeding successfully are present in the disturbed areas.	Presence of birds intolerant to disturbance, such as: • birds moving away from their nest • agitated birds • birds performing distraction displays • birds actively defending the nest

Factor associated with disturbance of nests and nesting birds	Example of lower risk level	Example of higher risk level
Preventive and mitigation measures	Disruptive activities around nest are halted. Nest protected with effective/efficient buffer zone and/or setback distances. Avoidance measures are put in place until the young have naturally and permanently left the vicinity of the nest.	No protection measures to reduce the effect of disturbance sources. Ineffective/inefficient buffer or setback distance.

Table 4. Examples of lower and higher risk levels for the factor associated with birds at sea and fishing

Factor associated with birds at sea and fishing	Example of lower risk level	Example of higher risk level
Risk assessment	Awareness of potential risks of fishing methods to seabirds. Knowledge of where and when the birds are concentrated.	No understanding of how fishing practices create risks for birds.

Factor associated with birds at sea and fishing	Example of lower risk level	Example of higher risk level
Preventive and mitigation measures	Avoidance measures are implemented and monitored. Avoidance measures are included into beneficial management practices.	No record or best management practices implemented.

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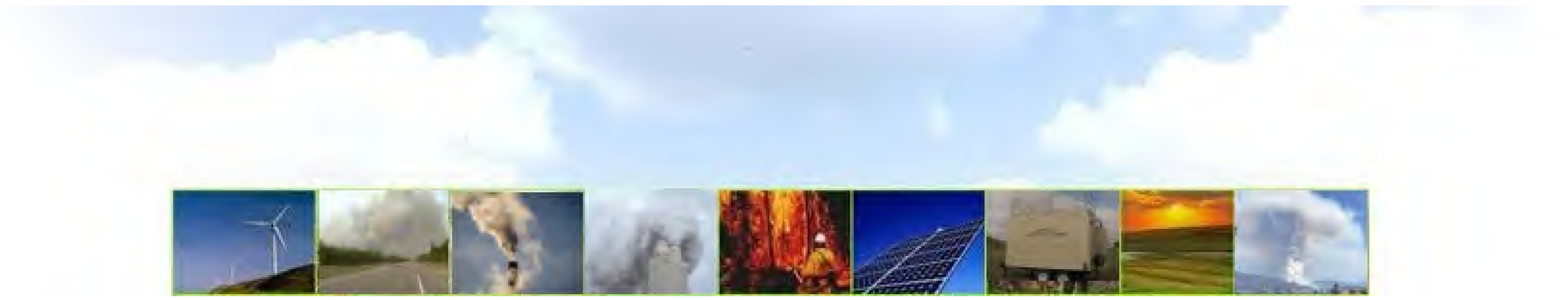

Saskatchewan
Air Dispersion Modelling Guideline

October 2025

saskatchewan.ca/environment

Saskatchewan

PREFACE

The Saskatchewan Air Quality Modelling Guideline is developed to ensure consistency in carrying out air dispersion modelling for regulatory applications in the Province of Saskatchewan. The recommendations in this guideline are used to support the confirmation that Saskatchewan Ambient Air Quality Standards (SAAQS) are met. The guidance document will be reviewed periodically to ensure that up-to-date information and models are available for predicting air quality in Saskatchewan.

To facilitate dispersion modelling in the province, the Ministry of Environment has developed Regional Meteorological Data Sets (Appendix G). The regional meteorological files can be downloaded from the ministry's website. The ministry has also prepared guidelines on calculating air contaminant background/baseline concentrations (Appendix J) that are to be added to the modelled concentrations. In addition, a Modelling Report Checklist is available (Appendix L) to ensure the air quality analysis report is complete.

Some information on models is included in this guideline. However, the user should refer to the user's guides or reference material for the model being used.

All web links provided in this document are only guaranteed to be current at the time of publication of this document. If these sites are no longer available, it is the responsibility of the reader to use the best information available.

Please contact the Inquiry Centre at 1-800-567-2442 if you require clarification on the content of this document or to request additional meteorological files.

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1. INTRODUCTION

This guidance document is intended to ensure consistency in carrying out air dispersion modelling in the province of Saskatchewan. There may be some circumstances where different approaches to modelling from those in this document are more appropriate. In these circumstances, justification for the approach must be provided.

Modelling is an important tool that assists in understanding the impacts of emission sources on the environment near or distant and can be used to predict future scenarios from short-term events to long-term trends. Potential impacts of modelled contaminant concentrations are typically compared to applicable standards or objectives.

The Saskatchewan air quality regulatory requirements are mandated through:
- *The Environmental Management and Protection Act, 2010.*
- Industrial Source (Air Quality) Chapter (Chapter E.1.2) of the Saskatchewan Environmental Code.
- *The Environmental Assessment Act.*
- *The Oil and Gas Conservation Act.*

The purpose of these acts and codes is to ensure that air quality impacts on human health and the environment are minimized and that Saskatchewan's Ambient Air Quality Standards (SAAQS) and Saskatchewan Emission Limit Standards are met. Industries in Saskatchewan are required to show that the surrounding area is not unacceptably adversely affected by contaminants they release and that ambient concentrations meet the results-based objectives. This can be done using approved air dispersion models, which can calculate selected areas ambient concentrations of contaminants given information about the emissions, terrain and meteorology.

Modelling is often required for the development of approvals, environmental impact assessments or environmental protection plans for source construction, operation or expansion. Modelling may be conducted to design sources and air quality monitoring programs. Models can be used to determine air quality under certain weather conditions or emission scenarios. Air dispersion modelling requires knowledge of the physical properties of sources, local meteorology and terrain.

This document provides guidance for short-range (less than 50 km) modelling for regulatory applications. Short-range modelling can be accomplished with validated and recommended steady-state plume models.

This document is not intended to provide technical description or to discuss the theory behind the models to be used, but references to that information are provided and some technical information is provided in the Appendices to help support some of the recommendations provided in this guideline. This guideline does not constitute rulemaking by the Ministry of Environment and may not be relied upon to create a right or benefit, substantive or procedural, enforceable by law or in equity by any person.

The guideline is directed to source owners, modellers, Qualified Persons, permittees, regulators and consultants involved in any aspect of modelling.

The information presented in this document represents the ministry's guidance at the time of publication. The approved dispersion models listed in this document will be updated at times. **It is the responsibility of the user to ensure they are using the most updated model available on the US EPA website**. In the event a newer modelling software version is released during a modelling exercise and prior to it being completed, the modelling results will be considered as valid. The ministry supports innovation and is open to improved modelling methodologies if the alternative method can provide scientifically defensible results.

A report modelling checklist is provided in Appendix L and provides a quick overview of the components of air dispersion modelling.

2. AIR DISPERSION MODELS

AERSCREEN, AERMOD and CALPUFF are the recommended models to be used in Saskatchewan.

The recommended approach to air dispersion modelling should begin with a screening model. The screening model will indicate whether a more detailed, refined model is required to estimate pollutant concentrations more accurately at receptor locations.

These models typically require emission characteristics, structural information, modelling domain, surrounding terrain information, representative meteorology, appropriate receptor density, baseline concentrations and/or information on additional sources in the domain that may contribute to the impact.

Recommended models are approved models typically used to model air emissions in Saskatchewan. Approved models are those that are scientifically defensible for their intended use.

AERSCREEN is the recommended screening model. AERMOD and CALPUFF are the recommended refined models. AERMOD is typically appropriate for most Saskatchewan conditions and CALPUFF is recommended as described in Section 2.1.3.

In most cases, the “regulatory default” option should be selected. There will be some situations in Saskatchewan where selected “non-default” options could be used. Any deviation from the default options should be clearly identified and rationale provided.

A brief description of recommended models and their applicability is provided in the following sections and supplemented in Appendix A.

2.1 Model Types and Application

2.1.1 AERSCREEN

Screening models are known to produce estimates of possible worst-case one-hour concentrations for a single source without the need for on-site or real-time meteorological data. They tend to be used as an initial assessment, with the use of more refined models being required if the model predicts potential concerns. If maximum predicted concentrations are considerably lower than the appropriate standards or objectives, additional modelling may not be required.
AERSCREEN is a single source screening-level air quality model based on AERMOD dispersion algorithms which use a matrix of meteorological conditions that

represents a wide range of possible conditions. If needed, terrain and building information can also be considered in AERSCREEN. The model calculates the maximum concentration by distance for a single source and can find the scenario for the maximum concentration without the need for hourly meteorological data. AERSCREEN also includes conversion factors to estimate "worst-case" three-hour, eight-hour, 24-hour and annual concentrations.

The AERSCREEN program is currently limited to modelling a single stack (either uncapped or capped), horizontal stack, rectangular or circular area, flare, or volume source.

2.1.2 AERMOD

Refined modelling will be used for most air quality assessments in Saskatchewan. It involves the use of the more sophisticated U.S. EPA AERMOD and CALPUFF models and the use of regional meteorological data sets to provide more realistic and detailed results of air quality impacts. These models provide more information on time and space concentration distribution and require more detailed input data such as terrain, surface features, upper air meteorological data and hourly surface meteorological data. Refined models are used when there are multiple sources, when screening models predict readings greater than allowable limits or if the emissions are considered a potentially higher risk to sensitive receptors. They can be used to identify potential contributing sources, worst-case meteorological conditions, and areas of concern as well as help design a monitoring network.

If an air quality assessment shows the appropriate standards or objectives are met using conservative modelling assumptions (i.e. assuming all processes are emitting at maximum emission rate simultaneously and continuously), there is no need for additional modelling. However, refined modelling can include emissions scenario refinements such as operating hours, variable emission rates or modifications to the facility. If there are exceedances of the appropriate standards and/or objectives, then further assessment of the number of exceedances and locations and maximum concentrations may be needed.
AERMOD is a regulatory straight-line, steady-state Gaussian plume dispersion model. For calculating one-hour average concentrations, the plume is assumed to travel in a straight line without significant changes in stability or wind speed. AERMOD consists of three components: AERMET (processes available meteorological data); AERMAP (for terrain base elevations for receptors and sources); and AERMOD, which calculates the concentrations.

AERMET uses surface characteristics (surface roughness, Bowen ratio and albedo) when producing the meteorological files (see Section 8.3). This can be done using the preprocessor AERSURFACE, which reads the U.S. Geological Survey Land Cover datasets and a table of surface characteristics that vary by land type cover and season to produce the meteorological files used by AERMOD.

If there are buildings that could affect the plume behaviour, AERMOD incorporates the Plume Rise Model Enhancements (PRIME) building downwash algorithms. Building Profile Input Program (BPIP) must be used to generate the necessary PRIME downwash parameters which then form part of the input file for AERMOD (refer to Section 6).

AERMOD may be used to model contaminant emissions from many sources including a combination of multiple source types such as point, volume, area, open pit and both buoyant and non–buoyant line source types. AERMOD enables emission rates to be treated as constant or varied by month, season, hour-of-day or other optional periods of variation. These variable emission rate factors may be specified for a single source or a group of sources.

AERMOD modelling is primarily for when the assessment is less than 50 km from the sources. If an assessment is required beyond 50 km, the user should use CALPUFF. In additional situations of low wind speeds, complex terrain and inclusion of deposition or secondary pollutants the user can use CALPUFF.

2.1.3 CALPUFF

CALPUFF model is a multi-layer, multi-contaminant, non-steady state Lagrangian puff dispersion model that simulates the effects of time, space and varying meteorological conditions on contaminants. The CALPUFF system includes three main components: CALMET, CALPUFF and CALPOST. CALMET is a meteorological model that develops a three-dimensional gridded modelling domain for the hourly wind and temperature fields based on terrain and land use information. CALPUFF uses the fields generated by CALMET to simulate contaminant dispersion and transformation. CALPOST is used to process the output files generated by CALPUFF.

The CALPUFF model can be used to predict pollutant concentrations, wet and dry deposition, chemical transformation (secondary particulates), and visibility (extinction coefficient), as well as fogging and icing. The CALPUFF model handles airflows influenced by complex terrain and land-water interfaces and has chemical transformation algorithms. CALPUFF has advantages over AERMOD during calm winds and stagnant conditions. CALPUFF contains algorithms that allow it to emulate AERMOD at short distances which enables CALPUFF to be used for both short distances and long-range transport.

Many model options can be used in CALPUFF and CALMET. The ministry recommends using the options provided in Appendix I. Any parameters in the input file that are not listed in the appendix should be set to the default values unless justification is provided to use other values.

2.1.4 Other Approved Models

Other approved models can be used if they are specialized to specific situations or tasks, or if AERMOD and CALPUFF are not suitable for the situation. Refer to Appendix A and the respective user's guides for more detailed information about each model and specific data input requirements.

The use of a specialized model may be appropriate on a case-by-case basis. The justification should be provided, clearly stating the reasons why the refined models are not appropriate. The justification should demonstrate that the specialized model is more suitable than the recommended refined models while still being representative. All models used for regulatory purposes should be publicly available and USEPA-approved.

Figure 2-1 presents a flow diagram for air dispersion modelling in Saskatchewan illustrating how a facility may start with screening, refined or other models to demonstrate compliance with Saskatchewan Ambient Air Quality Standards (SAAQS) or other guidelines approved by the ministry. In some cases, it may be appropriate to skip the screening model and use a refined or specialized model. Each air dispersion model has different capabilities.

Table 2-1 summarizes the capabilities of the screening and refined models. The table shows that except for small simple sources, the refined model, AERMOD, will likely be the model of choice for most situations.

Table 2-1: Summary of Model Capabilities

	Screening	Refined	
	AERSCREEN	AERMOD	CALPUFF
Terrain (above stack base)	√	√	√
Hourly Meteorological Data		√	√
3-Dimensional Meteorological Data			√
Multiple Sources		√	√
Point, Area, Volume Sources	√	√	√
Line Sources		√	√
Flares	√	√	√
Horizontal and Capped Stacks	√	√	√
Variable Emission Rate		√	√
Chemical Transformation			√
Building Downwash	√	√	√
Gridded Receptors		√	√
Physical Land Characteristics	√	√	√
Plume Visibility and Fog			√
Stagnation Conditions			√
Deposition (Gases / Particles)		√	√
Acid Deposition (Nitrate/Sulphate)			√
Shoreline Effects			√
Regional Air Zone Modelling			√
Long-Range Transport (>50 km)			√
Roadway Emissions		√	

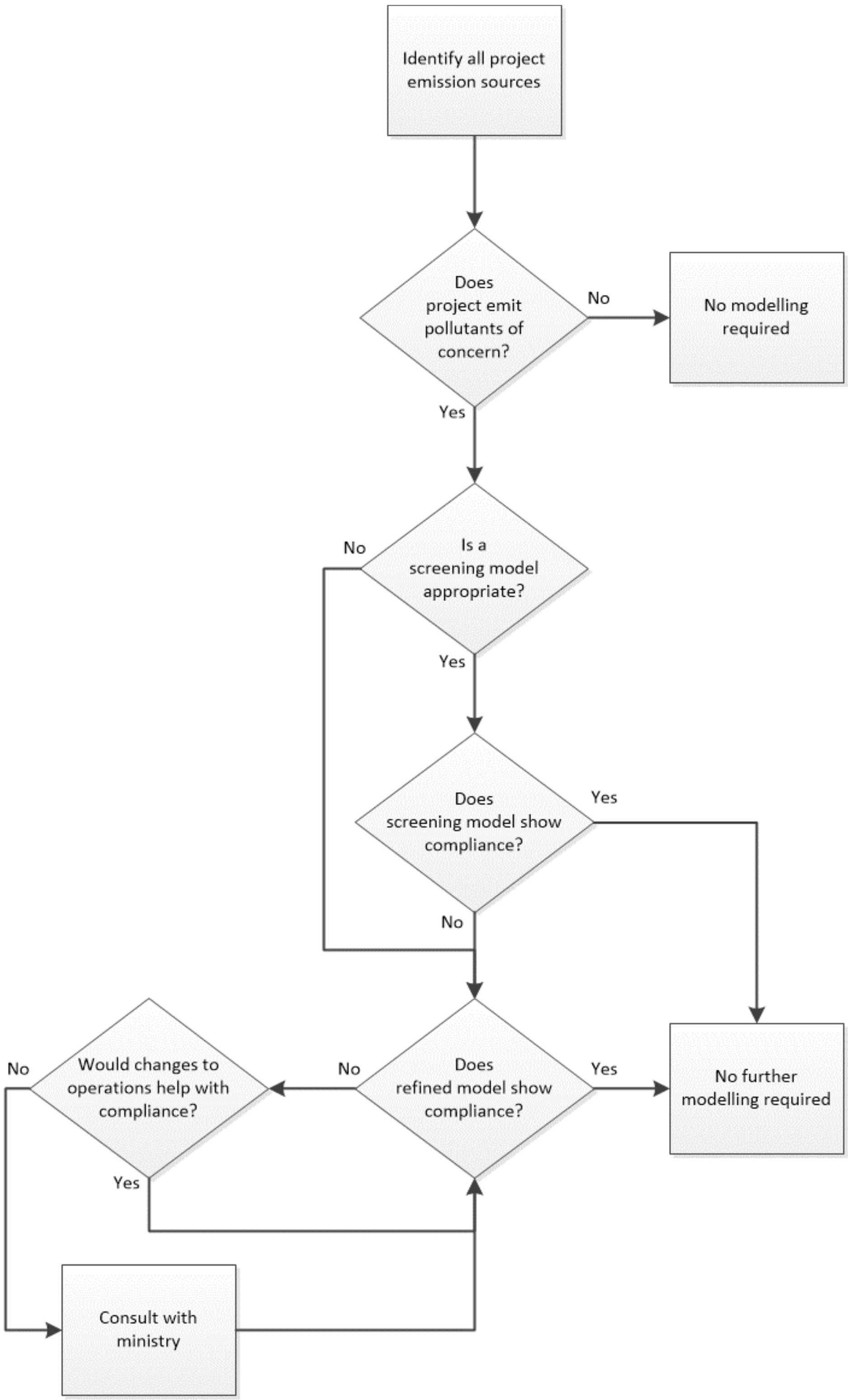


Figure 2-1: Air Dispersion Modelling Flow Diagram

3. MODEL PLAN

No air dispersion model will generate perfect results. The accuracy of the outputs depends highly on the inputs used in the model. The intent is to estimate concentrations as representatively as possible to predicted maximum concentrations under actual conditions.

Decisions that should be addressed in a modelling plan include:

- Model choice and appropriateness;
- The size of the area to be modelled and the type of terrain;
- Sensitive receptors (environment or human);
- The type of pollutants to be considered related to SAAQS and other guidelines;
- The sources of emissions and representative emission rates;
- Regional meteorology;
- The inclusion of other nearby emission sources;
- The inclusion of ambient background concentrations; and
- The determination of compliance criteria or results-based objectives to apply.

SAAQS includes standards only for a limited subset of contaminants including particulate matter, sulphur dioxide, nitrogen dioxides and carbon monoxide. However, all contaminants from the facility, which may have an impact on ambient air quality, should be evaluated for modelling and, if not listed in SAAQS, can be compared against other jurisdictional objectives such as:

- Ontario Ministry of the Environment (Ontario's Ambient Air Quality Criteria)
- Alberta Ministry of Environment and Protected Areas. (Alberta Ambient Air Quality Objectives).
- Texas Commission on Environmental Quality. (Toxicity Factor Database).

Screening-level modelling assessments require the least amount of effort and in most cases should produce more conservative results. Conversely, air dispersion modelling assessments using a refined model are more intensive but provide more representative results.

The modelling input data is comprised of four primary components.

- **Emission data** – Includes the types of sources as well as the physical properties. Additional information is provided in Section 4. Section 5 provides information on the different types of emission scenarios to consider.
- **Building downwash** – Section 6 explains what to consider when a building may affect the flow or transport or pollutants.
- **Terrain and Domain** – Section 7 provides additional information on the terrain and receptor set-up.
- **Meteorological data** – Additional information on using the ministry's meteorological data files or on setting up the meteorological data is provided in Section 9.

In all assessments, tables listing the values used in the modelling input, including source parameters and emission rates for all sources, should be included. Certain electronic copies of output files should also be included, which will help in reviewing the modelling report. This may include the output listing files, error files, the contour plot files and any threshold violation files.

4. EMISSION SOURCES

Air dispersion models can model various source types in a way that is representative of a study area. This section identifies the source types and main emission sources that may be considered, as well as approaches to treat time-varying emissions. For regulatory purposes, the ministry requires the use of the source group "ALL" in AERMOD, which considers all the sources at the same time.

4.1 Emission Types

The main emission sources used in most modelling can be categorized into four types based on the geometric shape (i.e. point, area, volume and line sources). For screening models, only one source type can be used for each model run. As shown in Table 2-1, different models have different capabilities to support various types of sources. The following sections outline the primary source types and their input requirements for both screening and refined models.

The emissions rates for all pollutants from all sources should be reviewed to determine whether they need to be considered in the modelling.

4.1.1 Point Sources

A point source is a stationary discrete source where pollutants are emitted into the atmosphere from a single point of origin. The most common type of point source is air stacks. Information on how to treat horizontal stacks and stacks with rain caps is explained in Section 4.3.5. Flares are also considered point sources but require additional considerations as detailed in Sections 4.1.5 and 11.

The source parameters typically required for point sources include the location (in UTM or grid coordinates), the emission rate of the contaminants modelled (g/s), the stack height (m), inside stack diameter (m) at the release height, stack exit temperature (K) and stack exit velocity (m/s) or actual flow rate (m^3/s).

4.1.2 Area Sources

An area source is a source that releases pollutants into the atmosphere that are distributed over a stationary spatial two-dimensional flat plane. Typically, there is no temperature difference from ambient temperature, vertical velocity, initial mixing or dilution required for area sources. Area sources are typically sources with low-level or ground-level fugitive releases where the emissions occur over an area (e.g. landfills, storage piles, open pit mines, slag dumps, settling ponds and lagoons), but can include an area consisting of multiple point or line sources.

Parameters normally required for area sources include the coordinates of the area perimeter, the emission release height (m) and the mass emission flux rate of the pollutant modelled (i.e. $g/s/m^2$).

4.1.3 Volume Sources

A volume source is a three-dimensional source that releases pollutants into the atmosphere at a stationary release point that has an initial width and depth and assumes evenly mixed emissions of the pollutants being modelled. Volume sources include releases from a variety of industrial sources such as aggregate storage piles, tanks, fugitive leaks from an industrial facility, multiple vents and conveyor belts.

The parameters normally required for volume sources include the coordinates of the volume dimensions, emission release height (centre of volume) (m), initial vertical and lateral dimensions (m) and the mass emission rates. Table 4-1: presents the calculation method for determining values for the initial lateral dimension (σ_{yo}) and initial vertical dimension (σ_{zo}) for volume sources.

Table 4-1: Estimating Initial Lateral and Vertical Dimensions for Volume and Line Sources

Dimension	Type of Source	Procedure for Obtaining Initial Dimension
Initial Lateral Dimension (σ_{yo})	Single Volume Source	σ_{yo} = (side length)/4.3
	Line Source Represented by Adjacent Volume Sources	σ_{yo} = (side length)/2.15
	Line Source Represented by Separated Volume Sources	σ_{yo} = (centre to centre distance)/2.15
Initial Vertical Dimension (σ_{zo})	Surface-Based Source	σ_{zo} = (vertical dimension of source)/2.15
	Elevated Source on or Adjacent to a Building	σ_{zo} = (building height)/2.15
	Elevated Source not on or Adjacent to a Building	σ_{zo} = (vertical dimension of source)/4.3

4.1.4 Line Sources

A line source is a source that emits pollutants into the atmosphere, which are distributed over a linear path. Some examples of line sources are roadways, rail lines and certain conveyor belts. Parameters normally required for line sources include the dimensions of the line and the mass emission rates.

For consideration of traffic-related emissions from roadways, a specialized traffic air dispersion model may need to be used.

4.1.5 Flare Sources

Flare sources are point sources with an ignition source at the top of the stack and are used to burn off excess gases. AERMOD, CALPUFF and AERSCREEN all support flares directly through their flare source type option. The plume rise for flares is based on an effective buoyancy flux parameter. The plume rise is calculated from the top of the flame, assuming that the typical wind flow results in the flame being bent 45 degrees from the vertical.

In CALPUFF, AERMOD and AERSCREEN the input for radiative heat loss (per cent) is required to account for the per cent of heat lost from the flame to the atmosphere. Section 11 provides information on how to calculate the fraction of radiative heat loss based on the composition of the gas being flared.
The calculation methodology for determining the appropriate stack pseudo-parameters and the detailed approach for modelling flares is described in Appendix K.

4.2 Stack Composition

4.2.1 $PM_{2.5}$ Stack Emissions

Particulate emissions from stacks can result through three processes.

1) Direct emission as a solid or liquid.
2) Gases condense to form particles after exiting the stack as the vapours cool to ambient temperature.
3) Gases react downwind with other gases or water vapour to form secondary fine particulates.

During stack testing, only the particulates from direct emission (known as filterable and condensable) are measured and in some stack tests, only the filterable portion of the particulate emissions is measured. In some situations, the condensable portion of the total particulate emission is only a small fraction but for other sources, like veneer dryers, the condensable portion can be >5x the filterable portion of the total particulate emissions. All the condensable particulates can be considered fine particulates ($PM_{2.5}$.).

If using stack testing data, it is important to know whether condensable $PM_{2.5}$ was included. If only filterable $PM_{2.5}$ was sampled, then the emission input data may have to be adjusted to consider the condensable portion. The rationale for this can be supported with similar stack sampling data or emission estimates.

Emissions due to other secondary particulates are not considered in most modelling. However, there are certain cases where they should be assessed such as acid deposition or long-range impacts of fine particulates. Since the formation of secondary particulates involves chemical reactions, CALPUFF should be used.

4.2.2 NO_2: NOx In Stack Ratio

Ambient air quality standards exist only for NO_2 but the emission rates from stacks are reported as nitrogen oxides (NO_x), which is defined as the combination of NO_2 and NO (nitric oxide). Stack sampling data showed that the fraction of NOx emitted as NO_2 can range from less than 0.01 to just over 0.8 (i.e. one – 80 per cent). The fraction is commonly referred to as the In-Stack Ratio (ISR). The higher ISR (i.e. > 0.25) tend to occur from sources with low NOx emissions (i.e. < 400 ppm). Typically, it is assumed that all NOx emissions are emitted in the form of NO_2 when converting from ppm to mg/m^3 or g/s for stack emissions.

For initial NO_2 impact assessments, modelling should be done assuming 100 per cent NO_x conversion to NO_2. Section 10.2 explains how the NOx-modelled concentrations are converted.

4.3 Additional Sources

During some air quality studies, modellers or Qualified Persons may encounter certain source configurations that require additional consideration. The following sections outline modelling techniques on how to account for the additional consideration of such scenarios.

4.3.1 Roadways

Some factors affecting roadway emission rates that should be considered in modelling assessments include paved vs. unpaved, silt loading, vehicle speed and the frequency and type of dust suppressant.

Refer to the refer to the Haul Road Workgroup Final Report Submission to EPA-OAQPS in modelling emissions from hauls roads.

4.3.2 Fugitive Emissions

Fugitive emission sources are typically near the ground and have the greatest impact near the source. Fugitive emissions, such as those from parking lots, or storage piles, can be significant contributors to particulate emissions from a facility. Other sources of fugitive emissions include leaking valves at gas facilities, treatment ponds or major spills of volatile liquids. These types of emissions should be included in modelling assessments if the emissions are significant or if emissions contain metals or other hazardous substances.

Fugitive emission sources are often difficult to characterize since their emissions may vary with wind speed, temperature and time of day or process changes. Compounding this is the control efficiency of mitigation measures applied to reduce emissions, which may only be crudely estimated. If no better emission information is available, e.g., from a site-specific monitoring program, fugitive emissions may be estimated from reputable sources as appropriate.

When modelling fugitive emissions care should be given to the choice of appropriate source type, i.e., whether the choice of an area source or volume source to best represent the nature of the emissions. Consideration should also be given to seasonal variability of the emissions from these sources where appropriate.

4.3.3 Liquid Storage Tanks

Storage tanks are generally either fixed roof tanks or floating roof tanks. In the case of fixed roof tanks, most of the emissions occur through a vent with some additional contribution from hatches and other fittings. In the case of floating roof tanks, most of the emissions occur through the seals between the roof and the wall and between the deck and the wall with some additional emissions from fittings such as ports and hatches.

Approaches for modelling impacts from emissions from these storage tanks are as follows.

Fixed roof tanks

Fixed roof tanks should be modelled as a point source representing the vent, which is usually in the centre of the tank. The tank itself should be treated as a building for downwash conditions.

Floating roof tanks

Floating roof tanks should be modelled as a circle of eight (or more) point sources evenly spaced around the perimeter of the tank. The tank itself should be treated as a building for downwash conditions. Total emissions should be equally distributed among the circle of point sources.

All tanks
Since there is negligible plume rise from tanks, the stack gas exit velocity should be set to near zero. If a tank is being modelled as a building with point sources used to represent the vents or emission points, the diameter should be at or near zero.

AERMOD also allows stack tip downwash to be turned "off" in the Control options, but this turns it off for all stacks, which may not be appropriate. In addition, the stack temperature should be set equal to the ambient temperature. This is done in AERMOD and AERSCREEN by entering a value of 0.0 K for the stack gas temperature. The recommended stack parameters are summarized in Table 4-2.

Table 4-2: Recommended Stack Parameter Values for Modelling Tanks

Velocity	Diameter	Temperature
0.001 m/s	0.001 m	Ambient

If the tank contents are heated, the temperature may be adjusted to a constant value that is based on the temperature of the tank contents. Provide a clear rationale if the recommended values from Table 4-2 are not used.

4.3.4 Pits and Quarries
Emissions from pits and quarries are different from most other ground-level sources. A portion of the emissions is retained in the pit and they are typically emitted from a smaller area of the pit opening. These sources are typically modelled as either area or volume sources. AERMOD is the only recommended model that is set up to directly handle emissions from a pit. The OPENPIT source type in AERMOD simulates the unique way emissions are emitted from pits and quarries.

Some of the key parameters required by the OPENPIT source option include:

- **Source Location**: This is the x and y coordinates (m) of the southwest corner of the pit.
- **Base Elevation**: The elevation (m) of the top of the pit where the emissions are simulated to occur.
- **Length of Sides**: The length and width (m) of the pit opening. These are used to calculate the effective depth of the pit.
- **Pit Volume**: The total volume (m^3) of the pit. This is used to calculate the effective depth of the pit.
- **Release Height (m)**: This is the average release height above the base of the pit (centre of volume). This parameter cannot exceed the effective depth of the pit, which is calculated based on the volume of the pit and specified length and width. For multiple sources within the pit, the specified release height should be based on the average source height within the pit.

4.3.5 Horizontal Sources and Capped Sources
For both horizontal stacks and capped vertical stacks (rain caps), there is very little or no initial vertical velocity and any vertical velocity is mainly dependent on the buoyancy. Depending on the set-up of a stack with a rain cap, the exit velocity may have a downward movement and the plume may originate from a lower point than the actual physical stack height.

With horizontal and capped sources, it is necessary to modify the source input parameters to minimize the effects of momentum while leaving the buoyant plume rise calculations unchanged. Both AERMOD and AERSCREEN can represent this by using the source type options for modelling horizontal (POINTHOR) and capped sources (POINTCAP). With these options, the vertical momentum is suppressed while the buoyancy of the plume is conserved. The user specifies the actual stack parameters of release height, exit temperature, exit velocity and stack diameter and AERMOD performs the necessary adjustments to account for plume rise and stack tip downwash. For horizontal releases, the model assumes that the release is oriented with the wind direction. For plumes with negligible buoyancy, the stack exit temperature can be set to 0 K which automatically sets the exit temperature to the ambient temperature.

In CALPUFF, these sources are handled using the vertical momentum flux factor (FMFAC) for point sources. The value is either 1 (full momentum) for a vertical stack with no restrictions or 0 for horizontal or capped stacks. For situations when time-varying point source emission files (i.e. PTEMARB.DAT) are required, the TIDATA (7) option in the file is equivalent to FMFAC.

For alternate models, the suggested methodology is similar to that in the U.S. EPA Model Clearinghouse Memo 93-II-09 (U.S. EPA, 1993) and Tikvart (1993).

4.4 Non-Continuous Emissions

Sources of emissions at some facilities may emit only during certain periods of operations. Both AERMOD and CALPUFF can model variable emission conditions that represent operational conditions. This is done either by using an external file with hourly emission rates for each source or by applying a factor ranging from 0 to 1, such that 0 is entered for the periods when there are no emissions and 0.5 represents 50 per cent of the maximum emission rate for the selected time periods. This emission factor can be applied to all time periods which are one hour or greater. Varied emissions conditions can be specified by using selected keywords like SEASON, MONTH or HRODY for season, month or hour of the day, respectively. Please refer to the AERMOD User's Guide (U.S. EPA 2022(b)) for information on the various emission rates that can be used and how to use these options.

For periods of variable exit temperature and/or velocity (start-ups and shutdowns), an external hourly emission file should be prepared including mass emission rate, exit velocity and temperature, which can vary on an hour-by-hour basis over the entire modelling period.

4.4.1 Wind Erosion

Emissions from sources such as storage piles are strongly dependent on wind speed and the moisture of the material. This will result in the emission rate being highly variable throughout the year. Therefore, it is recommended to model these emission sources as variable emissions.

There are several equations available to estimate emission rates based on wind speed, the source of material being emitted and the moisture of the material. These calculated values can be input into an hourly emission file for modelling. This allows for more representative emissions from sources that are susceptible to wind erosion. The AERMOD model allows for emission rates to be varied by six wind speed categories and those default values can be adjusted. Once a correlation between emissions and wind speed categories is established, the model will then vary the emissions based on the wind speeds in the meteorological data. This can be important when modelling PM_{10} for exceedances of the SAAQS because maximum concentrations from fugitive sources tend to occur during periods of light winds.

4.5 Combining Individual Sources

There are cases where a facility may have numerous minor sources (e.g. vents or short stacks) in a confined area. To simplify the setup and to reduce the modelling computational time, these multiple sources may be combined into a volume or area source.

When selecting potential sources to combine, the following factors should be considered.

- The source characteristics must be similar (e.g. similar stack heights, exit velocity and temperature for point sources). (e.g. A stack and a stockpile can not be grouped, but several similar stockpiles can be grouped);
- Emission rates from the individual sources must be similar with no one source with significantly higher emission rates;
- Sources must be located in the same general area;
- The source must not be too close to the property line where there are residents in the vicinity; and,
- Operating period of sources must be the same.

When applying this approach, the choices of the size and location of the volume or area sources representing the combined sources should be selected conservatively. In most cases, the volume source height would be the same as the building height or lower. For area sources, the effective radius would be the average radius of all combined sources and not an estimated radius of the area.

4.6 Cumulative Assessment of Nearby Sources

One of the main purposes of air dispersion modelling is to determine whether emissions from a facility are predicted to result in SAAQS exceedances. In many cases, there may be elevated levels of a contaminant already in the ambient air. This existing amount of pollutant can be estimated as a baseline concentration if that information is available. If unavailable, emissions from sources outside of the facility in the general area need to be assessed for the purpose of modelling. Typically, low-emissions sources like comfort heating or vehicle emissions do not need to be considered However, adjacent facilities emitting the same pollutant should be included.

Pre-project – existing sources only
Project only – proposed facility only
Post-project –all existing sources and proposed facility

Emissions from all sources within 5 km of the facility being assessed should be examined to determine whether the impact from these emissions would contribute noticeably to the maximum concentrations, which may result in potential exceedances. It is recommended to use a screening model to identify significant sources. The threshold criterion for including additional sources is if modelling indicates that the maximum concentration contributes an additional 5 percent of the SAAQS of the pollutant of concern. All major sources located within 10 km from the modelled facility, but further than 5 km, should also be considered to determine their impact on the ambient air quality levels.

Modelling existing sources only should be defined as a **"Pre-project case".** The facility-only modelling should be defined as a **"Project only case".** The modelling including all existing sources and the proposed facility should be defined as **"Post-project case".**

5. EMISSION SCENARIOS TO BE CONSIDERED

All emission rates used by a facility for modelling should be conservative.

The accuracy of a dispersion model is strongly dependent on the input data that is provided for the model. Having a good understanding of all emissions sources at a facility as well as the facility's operating conditions is key to building a model representative of operating conditions. Examples of methods used to determine emission rates from processes are provided in Appendix B.

Emission rates from all sources in a facility to be modelled should be assessed to determine if they need to be included in the model. Typically, if emissions from a source are greater than five per cent of the total emissions for that specific pollutant, then it should be included in the modelling assessment. A description of the method used to calculate the emission rates should be provided in all modelling reports as well as example calculations used.

Emission rates from most sources are not constant and will vary depending on facility operating conditions, processes, or schedules. It is important to understand the impact typically expected from a facility as well as the worst-case scenario (i.e. maximum impact).

When conducting an air dispersion modelling assessment, several different emissions scenarios may be considered.

- Maximum emissions scenario;
- Operating emissions scenario;
- Start-up and shutdown scenarios;
- Malfunctions, maintenance and emergency scenarios, and;
- Special case scenario.

5.1 Maximum Emissions Scenario

All emission rates used by a facility for modelling should be conservative. The most conservative approach is to assume that all operations are occurring simultaneously releasing the maximum contaminant emissions from all sources for all hours (all equipment operating concurrently if possible). It is the responsibility of the modeller or Qualified Person to determine the emission rates which will result in the maximum impact.

For modelling one-hour concentrations, the maximum emission rates should be based on the maximum one-hour average emissions expected in a year. If modelling results show non-compliance for the 24-hour concentration, then modelling can be redone using the expected maximum daily emission rate to calculate the maximum 24-hour concentration.

In some situations, the maximum emission rate may result in predicted concentrations exceeding their applicable air quality standard or objective. Remodelling can be done using emission rates to reflect a more typical emissions scenario. Before any remodelling, the frequency and location of potential exceedances, as well as the probability of exceedances occurring, should be examined to determine whether remodelling is a suitable approach or whether it may be more beneficial to consider source mitigation. If remodelling is required, then the results from both the maximum emissions scenario and the more typical emissions scenario should be provided in the air quality assessment report.

5.2 Operating Emissions Scenario

For realistic operation modelling, using emission rates that are typically expected during the operation of the facility can give a comparison of what may be typically compared to the worst-case scenario. For facilities that only operate during part of a day or season or for facilities where emission rates are highly variable, more data and increasingly complex model inputs may be required. A more representative emission scenario can include the consideration of:

- Hours of operation;
- Variable emission rates; and
- Intermittent emission sources.

5.3 Start-ups and Shutdowns

Plant startups and shutdowns can occur periodically due to maintenance or designated vacation periods. These processes impact emissions over the related time periods. As an example, process upsets or problems with the air pollution control system can impact emissions. As result, over short periods of time, upset emissions are often expected to be greater than normal source emissions (U.S. EPA, 2005).

Startups and shutdowns are typically addressed on a case-by-case basis. If there is no increase in emission rates during start-ups and shutdowns or the increase in emissions is minor (i.e. < 10 per cent) and little change in exit temperature or velocity, start-up and shutdown modelling is not required. If a facility has a start-up and shutdown frequently (i.e. every few days or more), start-up and shutdown activities should be considered as part of normal operations.

Assessment of start-ups and shutdowns for all facilities should be included in air quality assessments. If a company determines modelling of start-up or shutdown is not required, rationale must be provided in their report as well as the frequency of occurrence of start-ups and shutdowns and the estimated emission rates expected during start-up and shutdown.

5.4 Malfunctions and Emergency Scenarios

High emissions may be expected from malfunctions and emergency scenarios.

Depending on the location and the size of a facility, an air quality assessment for these scenarios may not be required. However, for facilities located in or near a community or for large industrial sources, the emissions during malfunctions and emergency scenarios may be significant and some assessment of their impact should be completed.

The emission rates used for a malfunction or an emergency situation should be provided in the report with rationale. Depending on the frequency of events the emissions from these processes may be considered as part of "normal" operations.

The following are examples of each type of scenario:
- **Malfunction** – A problem with an air pollution control system can result in high emissions of pollutants over short periods of time until the system is repaired.
- **Emergency** – Flares can burn off excess gas in large amounts for safety purposes.

6. BUILDING DOWNWASH

Buildings or structures located near stacks, especially short stacks, influence plume dispersion and predicted ambient concentrations. Airflows are either forced around or up and over the building or other obstructions. On the lee side of the building, there is more shear resulting in more turbulence with airflow dragged towards to surface further downwind.

If a plume gets caught in this cavity, elevated concentrations can result. If the plume escapes the cavity but remains in the turbulent wake, it may be carried downward and dispersed more rapidly by the turbulence. This can result in either higher or lower concentrations than would occur without the building (see Figure 6-1). Building downwash should be accounted for, when it exists, when modelling for stack sources but should not be used when modelling for area, volume or open pit sources. Appendix C provides guidance on how to set up each model to account for building downwash effects and the different options that may be considered.

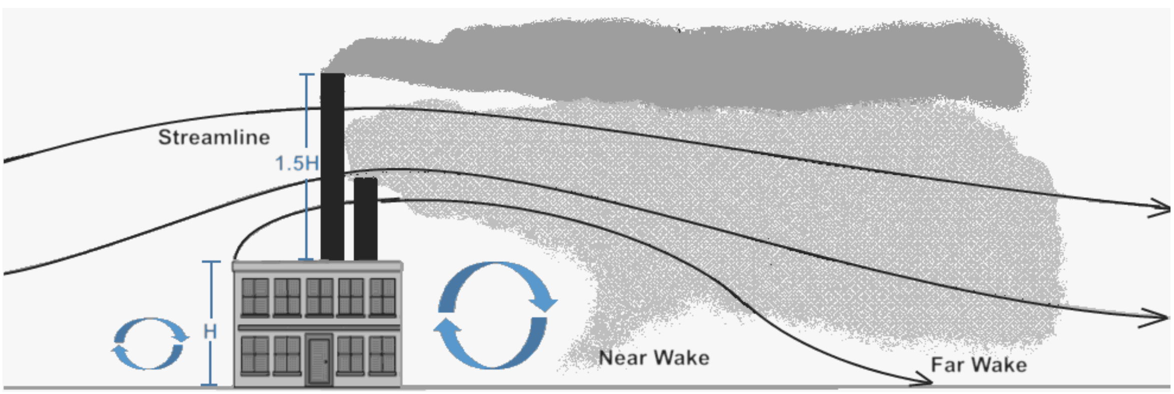


Figure 6-1: Building Downwash

The height to which the turbulent wake has a significant effect on the plume is generally considered to be approximately the building height plus 1.5 times the lesser of the building height or width. This results in a height of 2.5 times the building height for cubic or squat buildings and less for tall, slender buildings. Since it is considered good engineering practice to build stacks taller than adjacent buildings by this amount, this height came to be called Good Engineering Practice (GEP) stack height.

7. MODEL INPUT – DOMAIN AND RECEPTOR LOCATIONS

7.1 Modelling Domain

A modelling domain is a geographic area in which the required air quality analyses are conducted. The modelling domain should include all locations where there is a significant impact (maximum concentration) from the emissions of source(s). The definition of significant impact is any area where the modelled concentrations of pollutants from the project are greater than 10 per cent of their respective ambient air quality objectives/standards when all relevant industrial sources are considered. Typically, the modelling domain should be a 20 km by 20 km grid with the modelled source(s) near the centre of the area. The domain can be smaller for short stacks or larger for all stacks with buoyant emissions and it must

The modelling domain should be large enough to cover all areas where predicted impacts are expected to be a least 10% of the respective ambient air quality standards or objectives.

be within a 50 km distance to be considered applicable for Gaussian dispersion models.

Other factors to consider when determining the size or shape of the modelling domain are:
- Extending the domain to cover areas just outside the domain that are considered sensitive receptors (e.g. hospitals or schools) or communities;
- Extending the domain to cover areas just outside the domain where there is a sudden positive change in elevation;
- Changing the shape of the domain based on terrain (e.g. elongated domain for valleys);
- Extending the domain to cover areas just outside the domain, which has other emission sources that could affect the overall conclusion of the modelling assessment; and,
- For models like CALPUFF, the domain should be big enough to capture the potential recirculation of pollutants.

In many cases, the domain used in CALMET to set up the meteorological database should be larger than the domain chosen for CALPUFF. The CALMET domain should be large enough to include any terrain affecting the flows that determine the dispersion within the CALPUFF domain.

The only area within the modelling domain, which is not assessed, is the facility property. The facility property is determined by the facility fence line and/or the perimeter of the disturbed area that defines where public access is normally restricted. If a facility is located within a larger related facility boundary, the plant property is assumed, for modelling purposes, to be the plant boundary of the encompassing facility. If a public access road passes through the facility, the facility boundary is the perimeter along the road allowance.

7.2 Receptor Locations

Receptor selection is critical to ensure the location(s) where significant impacts (maximum concentrations) are captured. In selecting receptor locations, it is important to identify all sensitive receptors in the modelling domain. Receptors are not required within the facility boundary, which is being assessed except when public roads go through that property.

Various types of receptor grids can be used in dispersion modelling and they are outlined in Appendix D. Further information on each receptor type can be found in the user manual for each model.

For screening models, the receptor locations are placed along a straight line at regular intervals extending from a source to 10 km. Therefore, it can be used as an initial assessment to determine where the area of maximum impact is expected to occur.

7.3 Flagpole Heights

The height of the receptor is known as the flagpole height. The flagpole height should be based on the purpose of the modelling. One example of using a flagpole receptor height is to calculate concentration at an average breathing height (e.g. 1.5 meters). For vegetation impacts involving clusters of trees, the flagpole height could be based on the average height of the treetop canopy. All flagpole heights should be identified in all modelling reports.

8. MODEL INPUT - GEOGRAPHICAL INFORMATION

Terrain elevations relative to the facility can have a significant impact on the flow of a plume and the predicted concentrations. The AERMOD and CALPUFF models make use of complete three-dimensional digital elevation information. It is important to include terrain data extending beyond the modelling domain because the airflow in certain models, like CALMET, may be influenced by elevated terrain several kilometres away.

8.1 Coordinate System

The terrain pre-processors, AERMAP and TERREL, used for AERMOD and CALMET, respectively, require digital terrain in Universal Transverse Mercator (UTM) coordinates. There are three zones covering the province of Saskatchewan (i.e. zones 12 - 14) with most of the region in zone 13 (Figure 8-1). In a rare situation when modelling covers two zones, the zone identified in the model would be the zone where major emission sources are located.

The modeller should ensure that all model objects (sources, buildings, receptors) are defined in the same horizontal datum. The North American datum of 1983 (NAD83) is the preferred datum to use for modelling in Saskatchewan.

Figure 8-1: UTM zones covering Saskatchewan, showing the central meridian for zone 12

8.2 Terrain Processing

The consideration of a terrain type is dependent on the modelled area. For situations where the terrain around the facility is relatively flat and there is a single source, AERSCREEN can be used with a flat terrain option. The ministry recommends that terrain information be incorporated into AERMOD and CALPUFF. AERMAP or TERREL may be used to assign elevations to the receptors and to generate hill heights.

Digital elevation model (DEM) data are available for the province of Saskatchewan from a variety of acceptable sources in several different formats. Examples of sources include:

Canadian Digital Elevation Data (CDED) provided by Natural Resources Canada is terrain data in USGS DEM compatible formats at scales of 1:50,000 and 1:250,000:
ftp.maps.canada.ca/pub/nrcan_rncan/archive/elevation/geobase_cded_dnec/

Geospatial Data Extraction:
maps.canada.ca/czs/index-en.html

The CDED data are based on the NAD83 horizontal reference datum. Additional information on terrain data, as well as a figure showing the terrain file set up for the province of Saskatchewan, is provided in Appendix E.

The use of Shutter Radar Topography Missions (SRTM) terrain data is not recommended as treetop elevation can be interpreted as ground elevation.

The use of the 1:50,000 terrain data is recommended for improved accuracy. In some cases, site-specific information may be best represented by facility-generated data when active terrain changes are being done on-site, such as in open pits. Regardless of what terrain data is used, it is recommended to check the accuracy of the terrain files before running AERMOD.

8.3 Land Use Characterization

Characterization of representative land use data in the vicinity of a site is necessary to determine the appropriate surface characteristics, which govern how plumes are dispersed. Surface characteristics such as roughness, albedo and Bowen Ratio are used by AERMET in the development of the surface meteorological data (.sfc files). Each surface characteristic has numerical values applied to them which are used in the model to determine the airflow over a terrain that would be representative of each land use category.

Land characteristics should be as representative of Saskatchewan conditions as possible.

Appendix F provides information on how surface characteristics were determined as well as how to apply these values in the model. Additional information on determining surface characteristics can be found in the AERMOD Implementation Guide (U.S. EPA, 2022(c)) or the U.S. EPA AERSURFACE guide (U.S. EPA 2020). The AERSURFACE program assists in the selection of appropriate surface characteristics in the vicinity of the modelled facility.

For CALMET, a file of land data in the form of gridded land use types is required by the CTGPROG preprocessor, which produces a file with the fractional land use for each computational grid cell in the modelling domain. This file is used by MAKEGEO to create a gridded land use type and surface parameters that make up the GEO.DAT file.

The Saskatchewan Regional Meteorological Data Sets have been prepared using vegetation type and land use data from the MODIS-20 database provided with the Weather Research Forecast (WRF) data. The surface characteristics required by AERMOD were calculated from the WRF data using the Mesoscale Model Interface (MMIF) program to produce monthly values for the five years. If the closest meteorological file available is not representative of the land where the modelled facility is to be located, then the nearest meteorological file with similar land characteristics and airflow should be used.

There may be a situation when wind sector-dependent surface characteristics may have to be determined on a site-specific basis, or the surface characteristics near the site do not match any of the fully processed Regional Meteorological Data Sets. In those situations, an explanation of any changes should be provided in the assessment and the values used should be based on the ministry's recommended default values provided in this document.

8.3.1 Urban/Rural

The land use procedure is the recommended procedure in Saskatchewan to determine whether a site is urban or rural. This procedure examines the land use within a 3 km radius around the facility to be modelled. If more than 50 per cent of the area is accounted for by land use categories ranging from multi-family dwellings to commercial and industrial use, it is classified as urban. Otherwise, the site is classified as rural.

For AERMOD, the urban option (URBANOPT) is used to account for the urban heat island effect, which can increase convective turbulence during nighttime stable conditions above a level calculated in the AERMET preprocessor and for the decomposition of SO_2. Site-specific turbulence measurements should not be used when applying AERMOD's urban option to avoid double counting the effects of enhanced turbulence due to the urban heat island effect (U.S. EPA 2022(c)). Factors that affect the selection of the urban option in AERMOD include the population density and the location of a facility relative to the urban core. If a facility is located close to the edge of an urban area, the urban heat island option should be selected, especially if it is downwind from the urban area, since the urban heat island is not a localized effect but more of a regional effect (U.S. EPA 2022(c)).

8.3.2 Surface Roughness Length

Surface roughness values in AERMOD are more important in stable atmospheric conditions than in neutral/unstable conditions. The surface roughness length/height (Z_o) is a measure of the height of obstacles to the wind flow. Typically, the surface roughness length is estimated to be about one-tenth the height of the obstacle but less than 1.4 m.

MMIF can calculate hourly surface roughness lengths from WRF. These hourly values are averaged to determine a monthly average value to be used in AERMET. Information on how to calculate the surface roughness for AERMET and CALMET is provided in Appendix F.

8.3.3 Albedo

Albedo is the fraction of incoming solar radiation that is reflected from the surface back into the atmosphere. The amount of incoming radiation is used to estimate the strength of convective turbulence during unstable conditions. A high albedo surface would cause morning inversion to break up later than in the morning, resulting in any pollution trapped under that inversion layer remaining over that location for a longer time. In valleys during the winter with a strong inversion, an area with a low albedo may result in the pollution remaining over that location for several days.

Since the albedo of a surface can change hourly depending on the solar angle (highest at low sun angles and the lowest near solar noon) as well as the wavelength, the albedo values used in dispersion modelling represents the albedo value, in the visible spectrum range, at noon when the sun it at its maximum angle. A region with coniferous forest can have a high albedo of 0.9 or greater after a large snowfall but the albedo can drop to <0.2 within a few days once the snow has dropped from the branches. Also, the albedo of fresh snow can decrease at a rate of about 0.006/day as this fresh snow ages and as much as 0.07/day as it melts when temperatures are above zero (Gray et al., 1987).

The MMIF program reads the noontime albedo and calculates the hourly albedo for all daylight hours. For nighttime, a default value of 1 is used for the albedo. The ministry has five years (2012-2016) of monthly average noontime albedo values available for the whole province at 0.25-degree intervals to help compare albedo at a facility to that provided for the meteorological site. This data was compiled from the NASA Earth Observations website at neo.gsfc.nasa.gov/ and is available at geohub.saskatchewan.ca/.

In situations where the albedo values need to be determined for a specific location, information on how to calculate the albedo for AERMET and CALMET is provided in Appendix F.

8.3.4 Bowen Ratio

Bowen ratio is the ratio of the sensible heat flux to the latent heat flux and is used to calculate the heat loss/gained from the surface by determining the amount of moisture that exists at the surface. The latent heat flux predominates over bodies of water or regions covered by vegetation, whereas the sensible heat flux predominates in desert regions and over cities (Wallace and Hobbs, 1977).

Information on how to calculate the Bowen ratio for AERMET and CALMET is provided in Appendix F.

8.3.5 Anthropogenic Heat Flux

Anthropogenic (man-made) heat flux can be a substantial input into the urban energy balance, especially in Saskatchewan during the autumn, winter and early spring as well as at night. Only urban and residential areas would have anthropogenic heat flux values assigned to them. All other land use categories would have zero for the anthropogenic heat flux.

The anthropogenic heat flux is used to set up CALPUFF, but it is not used in AERMOD. AERMOD handles the urban heat flux through the URBANOPT switch.

8.3.6 Soil Heat Flux

Soil heat flux, also known as heat flux density, is the amount of thermal energy that moves through an area of soil in a unit of time. The soil heat flux is positive when the soil receives energy and negative when the soil loses energy (cools). AERMOD does not use the Soil Heat Flux in its calculations, but CALMET does when setting up the meteorological file for CALPUFF. Table F.6 shows the ministry's recommended default values for the soil heat flux based on land use and season.

Information on how to calculate the soil heat flux for CALMET is provided in Appendix F.

8.3.7 Leaf Area Index

The leaf area index (LAI) is a dimensionless quantity that characterizes plant canopies. AERMOD does not consider LAI in its calculations, whereas CALPUFF uses LAI when modelling dry deposition. The LAI values shown in Table F.7 were derived from (Zhang, Brook & Vet, 2003) and (Zhang, et. al., 2002)

Information on how to calculate the LAI for CALMET is provided in Appendix F.

9. MODEL INPUT — METEOROLOGICAL INFORMATION

9.1 Comparison of Screening and Refined Model Requirements

Meteorological data are essential for air dispersion modelling and require appropriate data as input.

AERSCREEN uses a MAKEMET processor to generate a set of screening meteorological data that is dependent on the surface characteristics around the modelled site and provides three options for generating the screening meteorology based on surface characteristics (Appendix A).

AERMOD uses hour-by-hour meteorological data that must be processed through AERMET into a form that AERMOD can use as input. AERMET can process three types of meteorological data.

1) Hourly surface observations at a meteorological station.
2) One upper air station (twice daily data).
3) Hourly data from an optional on-site or nearby meteorological site. AERMET can also rely on the numerical weather predictions (NWP) model to produce meteorological data.

The AERMET processor will create two files to represent the meteorology over the modelling domain. A surface file (.sfc) of calculated hourly boundary layer parameters and measured meteorology and a profile file (.pfl) of one or more level observations of wind speed direction, temperature and standard deviation of the fluctuating wind components.

For CALPUFF, CALMET merges all available meteorological files, including a surface data file (SURF.DAT), upper air file (UP.DAT), precipitation file (PRECIP.DAT) and the NWP file (PROG.DAT) into one binary file. All required upper air data is combined into one UP.DAT file and all required surface meteorological data is combined into one SURF.DAT file.

Unlike AERMET, which generates one set of meteorology representing the whole modelling domain, CALMET generates meteorology at evenly distributed grids identified by the user based on terrain and land type. Terrain and surface characteristics of albedo, surface roughness Bowen ratio, anthropogenic heat flux, soil heat flux and leaf area index can be input for each computational grid cell before running CALMET.

Further information on setting up the meteorological files to be used by CALMET can be found in Appendix H-2.

9.2 Meteorological Data for the Province of Saskatchewan

9.2.1 Saskatchewan Regional Meteorological Data Sets

The ministry has developed a series of fully processed AERMOD-ready screening meteorological data sets that will be referred to as “Regional Meteorological Data Sets”. The Regional Meteorological Data Sets contain five years of hourly meteorological data (~43,800 hours) representing the years 2012 to 2016.

Regional Meteorological Data Sets were generated from Weather Research and Forecasting (WRF) model using a Mesoscale Model Interface (MMIF) program and AERMET, and they are spaced approximately every 100 km throughout the province (Figure 9-1). The output .sfc files for AERMOD record one line for every hour, starting with hour one and ending with hour 24, such that hour three would contain the period from 2:01 a.m. to 3:00 a.m. local standard time. Details on how the Regional Meteorological Data Sets were prepared are available in Appendix G.

The relevant files for each Regional Meteorological Data Set are available at: geohub.saskatchewan.ca/datasets/aermod-input-file-download-by-location-.

Each zipped file is based on the latitude and longitude for which that file represents (i.e. 492N1016W represents 49.2 latitude and 101.6 longitude). All AERMOD modelling in Saskatchewan should be conducted using one of these processed meteorological data sets. Meteorological observations from a site-specific collection program, either on-site or nearby, can be used as an addition to provide localized conditions over that site.

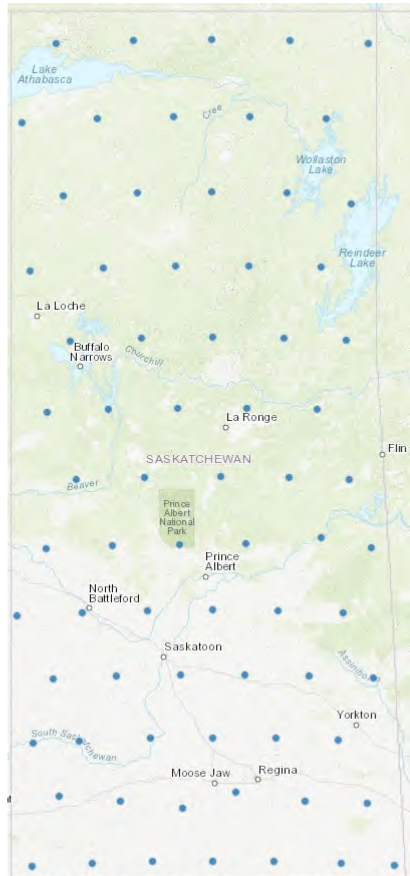


Figure 9-1: Saskatchewan Air Dispersion Meteorological sites

9.2.2 Modified Meteorological Data Sets

The Regional Meteorological Data Sets were prepared assuming that the surface characteristics around the facility are relatively uniform. If the facility to be modelled has surface characteristics that do not match any of the available fully processed AERMOD-ready meteorological data files, the fully processed Regional Meteorological Data sets may not be appropriate. In these cases, it is recommended to use AERMET to recompile the MMIF-generated meteorological files using more representative land use data.

If other meteorological data, such as on-site data or other computational-derived data, is used justification should be provided explaining why that option was selected.

9.2.3 Other Surface Meteorological Data

If the modelling study is being undertaken to assess the impact at specific receptors or to match modelled and monitored data which does not cover the period in the Regional Meteorological Data Set, the choice of nearby surface meteorological data becomes more important. Justification for the use of any alternate source of meteorological data should be provided to the ministry as well as all quality assurance checks done on the data (U.S. EPA, 1995(a)) and the methodology to be used for its processing/handling. For assessing the impact at specific receptors, a

minimum of one year of meteorological data is required. If there is more than one year of on-site meteorological data available, then either all or at least five years of available valid data should be used. Additional information on selecting and setting up a representative surface meteorological dataset is provided in Appendix H.
NWP models can be used to generate site-specific upper air data that can be manipulated into a form that may be used with surface data. A detailed description of the sources and methods used to generate this numerically generated meteorological dataset is required when this option is chosen.

9.3 Calm Wind Conditions

Calm winds can result in emissions accumulating in an area. Stagnation occurs when calm wind conditions persist for many hours or days. With stagnation, dispersion is minimal due to limited turbulence and transport of the emissions from the area as well as the recirculation of contaminants.

The wind speed limit that defines calms will vary depending on the jurisdiction but is typically defined as wind speeds below 0.5 m/s or less than the anemometer starting threshold. In AERMOD, a calm wind is normally defined as any wind speed less than 0.5 m/s. AERMOD will skip the hours when the wind speed is defined as calm and will not calculate concentrations for those hours. AERMOD will not calculate daily concentrations if there are more than eight hours in that day that are skipped due to calm conditions and/or missing data. This may be significant when modelling in areas with a high frequency of calm winds.

If an alternate meteorological station is to be used, then all hours with wind speeds less than 0.5 m/s should have the wind speeds adjusted to be 0.5 m/s and the wind direction should be recorded as is. In situations when the wind direction is missing or steady from one specific direction due to the wind speeds being too light to cause the wind vane to shift, then a 30-degree random wind fluctuation should be applied to the wind direction for those hours based on the last hour when the winds speed was strong enough to show a valid wind direction.

If an alternate meteorological station to be used in modelling is subject to frequent and prolonged stagnations, the Regional Meteorological Data Sets should be used.

9.4 Missing Data

All Regional Meteorological Data Sets prepared by the ministry have no missing hours of data. Missing data may occur when alternate meteorological data is used in the modelling.

When using alternate meteorological data, it is recommended to have at least 90 per cent data completeness for all parameters required by the model for each year with no more than two consecutive weeks of missing data.

To increase the data completeness, use the data filling procedures based on the Meteorological Monitoring Guidance for Regulatory Modeling Applications (U.S. EPA, 2000) to fill missing data gaps.

- If there are multiple measurements at different levels on a tower, then missing data for one level can be replaced by data from an alternative level. Corrections can be made based on established vertical profiles or historical correlations. This method is the preferred approach to fill longer missing data periods.

- If the missing period is four hours or less, use linear interpolation from the last valid hour. For transition periods (e.g. sunrise/sunset).
- For periods greater than four hours, determine if data from a nearby representative site are available to substitute missing hours. An assessment to determine whether this data is representative should involve an examination of the surrounding terrain, surface characteristics and height.
- For datasets with large data gaps in the day or night (i.e. anything greater than eight hours), replace the entire day or night period with the previous valid data from that site.

Any missing data which are filled should be flagged to assist in the interpretation of model output and the uncertainty associated with the concentrations predicted during periods of substituted data.

10. Air Quality Assessment

10.1 Existing Concentration

To properly compare modelling results to air quality standards or objectives, the existing air quality needs to be added to the modelled concentration to get the total concentration expected in the modelling domain. The existing air quality includes surrounding sources as well as sources from long-range transport.

Before comparing to any ambient air quality Standards or Objectives, background or baseline concentrations need to be considered.

Quite often the term baseline and background are used interchangeably, but there is a difference.

Background concentrations are those that result from long-range transport of pollutants that can not be locally controlled and they tend to be consistent over a wide region. Those include natural sources like forest fires, volcanic eruptions, wind-blown dust or anthropogenic sources like primary and secondary pollutants from long-range transport.

Baseline concentrations include background levels as well as the impact of local activities and tend to be localized covering an area less than 10 km in radius. Baseline concentrations are the contribution of all sources except the source(s) being modelled. Typically, background concentrations are applied to modelling results from sources in rural areas whereas baseline concentrations are applied to modelling results in urban or industrial areas.

Ambient background and/or baseline concentrations of the air contaminants being modelled should be added to the modelled concentrations to assess air quality against referenced standards and objectives.

10.1.1 Regional Background Concentrations

Regional background concentrations are required for sites located in rural or remote locations where the impact on air quality from local sources is minimal. Air quality monitors that are in areas not affected by local sources may be designated as "background monitors" and used to provide regional background data for modelling of sources in the region. The ministry has processed measured concentrations from a series of monitoring locations to provide an estimate of background concentrations (refer to Appendix J).

As a conservative screening approach, a single value is chosen for the background for each contaminant and applied to every hour of each year and for every location within the modelling domain. However, background concentrations for most contaminants will vary throughout the year (e.g. O_3 and PM_{10}) and should be used if available. Appendix J provides guidance on calculating background concentrations. It also provides typical regional concentrations if no other data is available. Supporting rationale and data should be provided by the modeller or Qualified Person on what approach and results were used for background concentrations.

10.1.2 Regional Baseline Concentrations

In most cases, the use of the conservative regional background concentrations will be sufficient to describe current ambient conditions. However, in areas where there are many minor sources (e.g. urban areas) or other significant sources emitting the same contaminants that are being modelled, these sources should be considered. Air quality data collected in the vicinity of the proposed source or at a representative site may be used as baseline values.

A description of the methods used to determine a baseline concentration(s) should be included in all air quality assessments. Include a table showing the modelling results, the baseline/background concentration for the contaminants modelled and a sum of the modelled and baseline/background concentrations.

Both AERMOD and CALPUFF can accept an external hour-by-hour time-varying baseline/background concentration file. The use of this option with representative data and matching years of meteorological data would result in modelling results that represent ambient air quality conditions as realistically as possible. This approach would not be suitable for ozone as the chemical transformation process cannot be appropriately handled in AERMOD and CALPUFF.

10.2 Nitrogen Conversion

Once NOx exits the stack, it undergoes a series of complex atmospheric reactions that may result in production or reduction in NO_2 concentrations. Therefore, the fraction of NO_2 emitted from the stack, based on the ISR, will vary as the plume travels away from the stack. NO can quickly react with ozone (O_3) and certain VOC compounds to produce NO_2. In rural areas, it is typically O_3 that dominates the conversion rate of NO to NO_2. The conversion for NO to NO_2 should be accounted for.

The following recommended methods for estimating the concentration of NO_2 are presented in the order of preference. For all methods, the background/baseline concentration should be added to the modelled concentration after the NO_2 conversion is applied.

10.2.1 Total Conversion Method

The most conservative screening approach is to assume 100 per cent of the nitrogen oxides emitted are instantly converted to NO_2. If this assumption shows that the maximum modelled concentration is exceeding the applicable air quality standards, then the alternate methods below can be used. Results from the Total Conversion Method should be presented as part of any assessment for all scenarios.

10.2.2 Ambient Ratio Method (ARM)

ARM is no longer available in AERMOD versions 18081 and newer.

10.2.3 Ambient Ratio Method 2 (ARM2)

The Ambient Ratio Method 2 (ARM2) is an extension of the ARM method based upon the premise that the NO_2/NO_x in a plume change as it is transported but reaches an equilibrium value some distance away from the source. Data has been compiled from over 580 stations in North America covering the period from 2001 to 2010 to determine a conversion factor that can be used to calculate the portion of NO_x in a plume that is converted to NO_2 (RTP Environmental, 2013). An equation was developed based on the 98th percentile NO_2/NO_x ratios for each bin of NO_x concentrations.

The polynomial defining the ARM2 ratio for AERMOD (v19191) is $(-1.1723e^{-17})x(NO_x)^6 + (4.2795e^{-14})x(NO_x)^5 + (-5.8345e^{-11})x(NO_x)^4 + (3.4555e^{-8})x(NO_x)^3 + (-5.6062e^{-6})x(NO_x)^2 + (-2.7383e^{-3})x(NO_x) + 1.2441$ where NO_x is the predicted ground level concentration in µg/m3. Note that the upper and lower bounds of this conversion are defined by the minimum and maximum NO_2/NO_x ratio as defined within the assessment.

Current guidance from the U.S. EPA and the ministry recommends a minimum ARM2 ratio of 0.50 to maintain an appropriate level of conservatism in the results.

10.2.4 Plume Volume Molar Ratio Method (PVMRM)

For relatively isolated and elevated point sources, it is recommended to use the PVMRM. The PVMRM determines the conversion rate for NO_x to NO_2 based on a calculation of NO_x moles emitted into the plume and on the number of moles of ozone contained within the volume of the plume between the source and the receptor. The initial in-stack NO_2/NO_x ratio of the emitted plume is also considered. This method accounts for plume merging and calculates a resultant plume volume from multiple sources to calculate the ambient NO_2/NO_x ratios. The PVMRM (MACTEC, 2004; Hanrahan, 1999) option is incorporated into AERMOD.

PVMRM is considered as an alternate method and justification of its use should be provided. If the PVMRM is to be used, the following defaults are recommended:

- For baseline O_3, use monthly background values in accordance with calculations detailed in Appendix J or pre-calculated ministry concentrations.
- A NO_2/NOx equilibrium ratio = 0.90 unless information is available to justify using a different value.
- The determination of the short-range NO_2/NO_x equilibrium is dependent on the in-stack ratio for all sources.

PVMRM is not recommended for large groups of sources, area or line sources and near-surface releases, including roadways.

10.2.5 Ozone Limiting Method (OLM)

The ozone limiting method (OLM) involves an initial comparison of the estimated maximum NO_x concentration and the ambient ozone concentration to determine which is the limiting factor to NO_2 formation (Cole and Summerhays, 1979). If the concentration of NO_x is greater than the ozone concentration, then the formation of NO_2 is limited by the ambient ozone concentrations.

The following equations are used in the OLM to calculate NO_2 levels based on modelled NO_x concentrations.

If $[O_3] > 1.59*(1\text{-}ISR)*[NO_x]$ then $[NO_2] = ISR*[NO_x] + 1.53*(1\text{-}ISR)*[NO_x]$
otherwise $[NO_2] = 0.96*[O_3] + ISR*[NO_x]$.

Note units for concentrations are in $\mu g/m^3$.

According to the above equations, if the ozone concentration is greater than (1 – ISR) of the predicted NO_x concentrations, all the NO_x is assumed to be converted to NO_2. The OLM assumes that a portion of the NO_x emissions are generated as NO_2. The remaining NO_x emissions are assumed to be in the form of NO, which reacts with ambient levels of ozone to form additional NO_2. This method assumes there are no other chemical reactions (i.e. no reaction of NO with organic radicals to produce NO_2) and assumes that there is no photodissociation of NO_2 in the plume.

The use of the OLM is not recommended for highly populated communities or in areas with a lot of industrial activity.

For CALPUFF, each source must be treated separately and then summed to determine the total NO_2. When using this method all NOx emissions must be entered as NOx and NO_2 should not be included as an input emission.

10.2.6 RIVAD/ARM3 and RIVAD/ISORROPIA

The ministry does not recommend the use of RIVAD/ARMs or RIVAD/ISORROPIA for the conversion of NO_x to NO_2. Therefore, when modelling with CALPUFF, the chemistry option should be disabled. All NOx emissions should be entered as NOx and NO_2 should not be included as an input emission.

10.3 Post-Modelling Processing

The type of output submitted to the ministry is integral in demonstrating the impact that a facility may have on the surrounding environment. This information should be sufficient to demonstrate the modelling is scientifically defensible and the objectives of the assessment have been met. The information submitted should include but not be limited to:

- Tables of maximum predicted concentrations, distances from source(s) and frequency of exceedances (if any are predicted).
- Figures showing isopleths of maximum concentrations by averaging times (e.g. one-hour, 24-hour, annual);
- Input/output model control files; and,

- Any other information that may be necessary to demonstrate modelling and compliance with SAAQS.

The assessment report must include enough information so that the reviewer can understand the methodology and assumptions that were made and can support the elections/decisions made in the assessment.

10.3.1 Averaging Times

AERSCREEN only provides results on an hourly average basis. AERMOD and other advanced models can calculate concentrations at various averaging times which are factors of 24 (i.e. 1, 2, 3, 4, 6, 8, 12, 24). These averages are discrete averages recorded every n^{th} hour (e.g. there are three eight-hour averages per day (1-8, 9-16, 17-24)). This may result in elevated levels getting missed if pollution episodes occurred at the end of one time period and the start of the following period. In addition, multiple averaging times can be specified in a single run.

The following conversion factors are only intended for use in air dispersion modelling.

10.3.2 Conversion Factors for Screening Models

If using AERSCREEN when comparing to 24-hour or annual criteria, the maximum one-hour concentrations produced by the model should be converted to a maximum 24-hour or annual average concentration. This is done using conversion factors as described below (U.S. EPA 2021). These conversions are automatically applied when using AERSCREEN.

When using the AERSCREEN model, the following ratios should be used to convert one-hour maximum concentration to longer-term averages:

$$C\_avgt=C\_hour\ (ratio).$$

Table 10-1: Recommended Conversions Factors used in AERSCREEN.

Averaging Time	Multiplying Factor (Ratio)
3 hours	1.0
8 hours	0.9
24-hours	0.6
Annual	0.1

10.3.2.1 Conversion Factors for Sub-Hourly Values

AERMOD has the capability of modelling using one-minute meteorological data. Conversion factors can be used to convert the peak one-hour average concentrations from refined models (e.g. AERMOD) to compare with standards for shorter averaging times such as a half-hour standard or a 10-minute odour-based standard. The ministry recommends the following power law equation to convert concentrations from one hour to the desired minutes:

$$C_p = C_m \left(\frac{T_m}{T_p}\right)^{0.28}$$

Where:
C_p = Mean concentration for the new averaging time [µg/m^3].
C_m = Mean concentration for one-hour averaging time [µg/m^3].
T_m = Averaging time for 1 hour [60 minutes].
T_p = New averaging time [minutes].

10.3.3 Unit Conversion for Concentrations

Most air quality standards for gases are provided as ppb (parts per billion) or ppm (parts per million) whereas the modelled output is provided as µg/m^3 (micrograms per cubic metre). The concentration of a gas can be converted from µg/m^3 to ppb using the ideal gas law equation, which is dependent on the ambient temperature, atmospheric pressure and molecular weight of the pollutant. For simplicity and consistency, the conversion for air quality standards in most jurisdictions is based on standard conditions (T_{std} = 25°C, P_{std} = 101.325 kPa). The following equation can be used based on the standard conditions.

[µg/m^3] = [ppm] x 40.874 x (molecular weight of pollutant [g/gmol]).

10.3.4 Modelling Output

Modelling should be done for the five complete years of representative meteorological data. At times, the maximum modelled concentrations can be due to rare and unusual meteorological conditions that are considered outliers. Therefore, hourly averages above the 99.9th percentile for each receptor in each year can be disregarded (i.e. the ninth-highest hourly average would be reported). For averaging periods between two – 12 hours, all the hourly averages must be included in the calculation, then the first highest value can be disregarded. For all averaging periods 24 hours or greater, all the hourly averages must be included in the calculation and no values can be disregarded.

Alternatively, the five-year data set could be run as one singular model. In this scenario, the eighth-highest hourly and first-highest two – 12-hour average blocks can be disregarded. No values can be disregarded for the 24-hour or greater averaging period. For the hourly averages, this represents a 99.98th percentile and a very conservative approach. If this approach complies with applicable limits, individual years do not need to be modelled. Annual averages for each of the five years still need to be calculated and reported.

The maximum modelled concentration for all receptors should be included in the assessment report.

The maximum concentration in those five years should be recorded for each receptor point. A table showing the modelled maximum concentration for each pollutant, as well as the modelled maximum plus background or baseline concentration, should be provided with all assessments. Maps showing the isopleths of these maximum concentrations are the best method to report the maximum concentration for each receptor and should be provided as well. If there are exceedances of the SAAQS or any other objective for the pollutants modelled, then one of the isopleths should represent that objective level. The selection of intervals and the number of isopleths plotted on each graph should be enough to easily interpret the map. Isopleths need to provide a good visual representation of the concentrations. Typically, the lowest isopleth should be the lowest of 10 $\mu g/m^3$ or 10 per cent of the ambient standard or objective of the pollutant being modelled. The modeller can adjust the scales as necessary as long as details of the isopleth are not being washed out. For example, the SAAQS for NO2 is 300 ug/m3. If the max modelled concentration is 30 ug/m3, it would be inappropriate to scale to 300. The lowest isopleth should be appropriate to the levels measured.

Note: For the purposes of modelling, all metrics should be removed (e.g. 3 year average of the annual 98th percentile). The value listed in the SAAQS is considered to be the limit.

All averages in AERMOD greater than one-hour are block averages (e.g. the eight-hour average applies to either midnight to 8:00 a.m., 9:00 a.m. to 4:00 p.m. or 5:00 p.m. to midnight, inclusively). Therefore, the recommendation for averages greater than one hour, excluding annual averages, is to initially calculate the averages as block averages (AERMOD default). If, after adding background and the impact of other sources, the maximum concentration is greater than 70 per cent of the SAAQS, then running averages should be calculated.

Isopleths showing exceedance frequency for the full monitoring period above a certain threshold concentration should be provided, if applicable. Typically, the threshold concentration is based on the ambient standard or objective of the pollutant being assessed and the time period being modelled. For cases when there are exceedances, the isopleth intervals should be selected to easily interpret the impacts visually and should include an isopleth showing at least one exceedance. The maximum number of exceedances as well as the location should be identified on the map.

For determining the annual average, the model should be run five times (once for each year of meteorological data) and the highest annual average for each receptor should be recorded and plotted on a map showing isopleths of the concentrations. Any exceedances of the annual standard of the pollutant modelled should be identified on the map as well as the location with the highest concentration.
The annual air quality standard for TSP is based on a geometric mean whereas models only predict annual averages. If the annual average is below the air quality standard for TSP, then use the average value as the geometric mean. If the average value shows exceedances of the air quality standards for TSP, the geometric mean for each year will have to be calculated for any receptors with exceedances based on all the modelled daily values for that year. The isopleths can be the average or combined. Exceedances should be displayed in a table accordingly. All modelled daily values equal to zero should be converted to 0.1 $\mu g/m^3$.

All figures showing isopleths should be overlaid on a map where at least 90 per cent of the map includes the full modelling domain. All maps should display the topography as well as identify the source(s) modelled and any communities or sensitive receptors. To adequately interpret and understand modelling results, additional isopleths can be included showing a smaller domain focussing on impacted areas.

It is the modeller or Qualified Person's responsibility to ensure modelling results are comparable to applicable limits or objectives in determining compliance.

11. Flaring

Flaring may be necessary for burning excess gases rather than releasing these gases directly into the atmosphere.

The treatment of a flare in dispersion modelling is more complicated than a stack source since the duration may be less than one hour and the gas composition and flow rates will vary during the duration of the flare.

There are four main types of flaring.

- **Continuous**: Typically used at chemical plants, refineries, and oil batteries to dispose of excess waste gas rather than venting them directly into the atmosphere. These should be modelled as continuous sources.
- **Routine**: Intermittent but controlled or occurs at a scheduled interval. They may include a pipeline blow-down to depressurize a pipeline or scheduled maintenance. They tend to be several minutes to several hours.
- **Non-routine**: Intermittent and will occur under unplanned or abnormal conditions. Some examples include by-pass flaring for plant safety or emergency shut-down conditions. The durations tend to be several minutes to several days.
- **Well Test**: This results in excessive amounts of gas being released from a well to determine the amount of gas that exists in a reservoir below the surface. These flares can last for several hours to several days and SO_2 impacts can at times exceed 1,000 µg/m^3, depending on the composition of the gas and the surrounding terrain.

The flare should be modelled for the purpose for which they will be used. Some flares are designed to handle both routine and non-routine flare events. Flows during non-routine flare events are much larger than those during routine flare events. This would lead to modelled plume rise being much higher for non-routine flare events which may result in areas of maximum impacts being at different locations. Therefore, it is important to monitor appropriate scenarios expected for a particular flare/incinerator.

11.1 Source Parameters

As per Section 4.1.5, AERMOD, CALPUFF and AERSCREEN contain a FLARE source option, which calculates stack pseudo-parameters (i.e., stack height and diameter and exit velocity) to appropriately characterize the flare to ensure that the resulting plume rise and spread are reasonably representative. AERMOD and AERSCREEN allow the user to enter a value for the radiative heat loss fraction rather than the default value of 0.55. AERMOD also provides the options for stack temperature and exist velocity, rather than using the default values of 1273 K and 20 m/s, respectively. In CALPUFF, the stack pseudo-parameters can vary depending on wind speeds, which determines the angle of the flame (Exponent, 2019). For radiative heat loss, the ministry's recommended method is similar to the Ontario Ministry of Environment (Ontario Ministry of Environment and Climate Change, 2017(b)) which considers the molecular weight of the gas stream.

R = (MW)/3 + 21.

Where:
R = radiative heat loss (per cent).
MW = molecular weight of the gas stream.

Additional information on how this is used to determine pseudo-stack parameters is outlined in Appendix K.

The flare design and performance should meet the requirements of the Saskatchewan Ministry of Energy and Resources when needed using the Saskatchewan Upstream Flaring and Incineration Requirements, S-20.

11.2 Intermittent Emissions from Routine and Non-Routine Flaring

In many cases, flaring can occur intermittently for short durations. Modelling the worst-case scenarios is recommended to show due diligence to protect people and the environment. When modelling these events, it is important to include the probability of the flaring events occurring.

For flaring events which last several hours and have a very gradual decrease in emissions during the period, each hourly emissions scenario should be assessed using AERSCREEN. If any of those hours show levels near or exceeding the one-hour SAAQS then refined modelling is required for each of those periods, assuming a continuous source, to assess the hourly impacts. The probability of the event occurring needs to be included in any assessment. The average of the one-hour maximum concentration of each hour scenario modelled (up to the first 24 hours) using AERSCREEN should be calculated to determine if there are any exceedances of the 24-hour SAAQS. Consideration needs to be made to account for the number of hours during flaring compared to the number of hours of no flaring in those 24 hours and a baseline concentration should be included.

11.3 Well Test Flaring

In areas of oil and gas exploration, a process known as well test flaring is quite common, especially for areas with a high content of H_2S in the gas (known as sour gas). The flaring of the H_2S results in high emission of SO_2 gases from these flares.

Since well-test flaring is planned and tends to be short-term, dispersion modelling for the full five years is not required. Only the month when the flaring is planned as well as the adjacent months (i.e. three months per year equals 15 months in total) are required for the assessment.

For vegetation impact, the flagpole height should be set to the average height of the vegetation canopy in the region of the flare. The output files and maps provided in the assessment should be similar to those for normal modelling assessment with the addition of vegetation locations showing potential impacts and seasonal consideration. A wind rose for the meteorological period used for modelling should also be provided.

Table 11-1 SO_2 Concentrations Criteria for the Onset of Acute Visible Foliar Injury (SENES, 2007)

Number of consecutive hours with conc. above given level	Daytime April - June (µg/m^3)	Daytime July - Sep (µg/m^3)	Nighttime April-Sep (µg/m^3)	Anytime Oct-March (µg/m^3)
1	1306	1741	4724	7086
2	832	1110	3025	4538
3	639	852	2331	3496
4	530	707	1937	2906
5	459	612	1678	2517
6	408	543	1493	2239
7	369	491	1352	2028
8	338	451	1241	1861
9	313	417	1150	1725
10	292	390	1075	1612
11	275	366	1011	1516
12	260	346	956	1434

11.4 Other Flaring Models from Relevant Jurisdictions

Due to the complicated nature of the treatment of a flare in dispersion modelling, the Ministry of Environment recognizes that there are other appropriate tools developed in other jurisdictions that may be more suitable for evaluating flare-type emission calculations for specific situations.

12. Special Topics

12.1 Lake Effects

Since AERMOD does not treat the effect of shoreline fumigation, CALPUFF in Hybrid mode is recommended. The NWP model output blended with observations in CALMET is an effective way to include the 3-D sea and land breeze effects in the meteorological fields. To properly treat the lake effects, overwater meteorological data are required. In addition, if the effects of the TIBL on the plumes are occurring at scales smaller than the CALMET grid spacing, then a sub-grid scale treatment can be invoked. This treatment requires the X, Y coordinates of one or more shorelines in a COASTLN.DAT file. The purpose of this file is to better resolve the relationship between the shoreline and source locations during periods conducive to onshore fumigation events. Further instructions on the treatment of coastline effects and the required data are found in the CALPUFF user manual (Exponent (2011)).

Shoreline fumigation only needs to be considered for stacks within 1 km of the shoreline of a large body of water. Shoreline fumigation does not occur for emissions from ground-level sources like area or volume sources.

12.2 Odour Modelling

Odour emissions may be modelled using any of the approved air dispersion models. For some odorous contaminants like total reduced sulphur (TRS), the mass emission rates are entered as g/s and the resultant concentrations output by the model are in $\mu g/m^3$. For other odorous contaminants, the concentrations are typically expressed in odour units per cubic metre (OU/m^3). For modelling purposes, multiply the OU/m^3 in the exhaust by the volumetric flow in cubic metres per second (m^3/s) to obtain emission rates in OU/s.

For screening models, multiply the calculated emission rate in OU/s by 1,000,000, so that the results are in OU/m^3 for comparison to criteria. AERMOD has the option to change the emission output factor to one so that emissions do not need to be multiplied by 1,000,000.

As odours are detected by humans and are defined as a nuisance, odour modelling should be assessed at sensitive receptors where human activities regularly occur. Examples of these sensitive receptors are listed in Appendix D.5.

The ministry has developed a set of recommended ambient odour criteria (subject to change) to be used for dispersion modelling assessment in Saskatchewan (Guo and Yu, 2011). These are presented in Table 12-1 and are based on a one-hour average time and vary depending on the land use surrounding the facility. In addition, compliance is based on achieving the criteria at a minimum of 99.5 per cent of the time.

Table 12-1: Recommended Ambient One-Hour Odour Criteria for Odour Dispersion Modeling in Saskatchewan (99.5th percentile)

Odour criteria	**Land Use**
1 OU/m^3	Urban residential zones
2 OU/m^3	Urban commercial zones or mixed residential and commercial zones
4 OU/m^3	Industrial or restricted business zones and rural zones with mixed utilisation
6 OU/m^3	Industrial or agricultural zones with predominantly agricultural utilisation

12.3 Fogging, Icing and Plume Visibility

The possibility of fog or icing occurring due to emissions can be an issue (primarily in cold seasons) for facilities that emit large amounts of water vapour. Even though there are no air quality objectives for fog, icing or plume visibility, severe icing or fog can cause a safety hazard and may have to be considered for areas located near residents, airports or high-traffic roads.

For this type of assessment, CALPUFF with the FOG algorithm is recommended. The FOG module in CALPUFF has two modes. The Plume mode (MFOG=1) is used to determine the length and height of the visible plume due to condensation, and the Receptor mode (MFOG=2) is used to indicate whether ground-based fog or ice is occurring. To determine the length and height of visible plumes, CALPUFF is used with a single hourly meteorological data file in ISC meteorological format which includes hourly wind speed, direction, temperature, stability class and mixing height.

CALPUFF has two source preprocessors for water emissions. One for mechanically forced cooling tower plumes (CTEMISS) and one for combustion turbines (FGEMISS – Flue Gas Emission Pre-processor). Hourly emissions of water vapour and excess temperature from each cooling tower are computed by CTEMISS for the current cell configuration and ambient conditions. The FGEMISS preprocessor produces an external variable emission input file containing water emissions and temperature-dependent parameters. CALPUFF models the dispersion of these emissions and provided cloud information in a specialized format for further analysis. These preprocessors create CALPUFF-ready PTEMARB.DAT variable water vapour emission files as input to the CALPUFF-ISC fog model. Note, these preprocessors can work only with the Schulman-Scire building downwash algorithm.

12.4 Particle Deposition Size Fraction

Particulate matter can be emitted from a variety of sources including stacks emissions, open burning, coal piles, road dust and vehicle emissions. On some occasions, stack sampling reports or manufacturer's specifications have provided a particle size distribution, which can be used in modelling. If the particulate matter is just reported as total suspended particulates (TSP), there are options to identify size fractions. Typically, the TSP contains a high portion of $PM_{2.5}$ from the combustion source and a very low portion of $PM_{2.5}$ from crustal emissions like road dust or coal piles. The U.S. EPA AP42 has information on emission factors to use for various sources to help determine the particulate size distribution. These size distributions are typically in three categories: fine particulate matter ($\leq PM_{2.5}$), coarser matter smaller than 10 µm ($> PM_{2.5}$ and $\leq PM_{10}$) or coarser matter ($> PM_{10}$).

To properly assess the impact of particulate ($PM_{2.5}$, PM_{10}, and TSP), it is necessary to first determine the particle size distribution and then the aerodynamic properties of particle size. Both AERMOD and CALPUFF can model particulate deposition for a range of user-specified particulate sizes, mass fractions and densities. With this option, a range of particle size categories is required along with information such as corresponding mass fractions and particle densities.

To determine the aerodynamic profiling by mass, use the following (Lawrence, 2012).

For AERMOD, it is necessary to first define the mass fraction. For this problem, a table of input values for particulate modelling is as follows:

Table 12-2: PM Granulometry distribution for seven PM species (particle density 1g/cm³)

PM Species	Size Range (µm)	Mean Particle Diameter (µm)	Mass Fraction	Mass Emission Rate (g/s)
P1 ($PM_{2.5}$)	0.50 - 0.75	0.625	0.1400	1.400
P2 ($PM_{2.5}$)	0.75 – 1.00	0.875	0.1400	1.400
P3 ($PM_{2.5}$)	1.00 – 1.25	1.125	0.1400	1.400
P4 ($PM_{2.5}$)	1.25 – 2.50	1.875	0.1400	1.400
P5 (PM_{10})	2.50 – 6.00	4.250	0.0885	0.885
P6 (PM_{10})	6.00 – 10.00	8.000	0.0885	0.885
P7 (PM>10)	> 10.00	20.000	0.2630	2.630

Where:
$PM_{2.5}$ (mass) = (P1 + P2 + P3 +P4).
PM_{10} (mass) = $PM_{2.5}$ (mass) + (P5 + P6), and
TSP (mass) = PM_{10} (mass) + P7.

The mass fraction for the different diameter bins associated with a particular PM species is assumed to be distributed uniformly.

For the CALPUFF model, it is recommended to use the information in Table 12.3 for deposition calculations.

To set the mass fraction in each diameter bin associated with a particular PM species to be distributed uniformly, the geometric sigma in CALPUFF is set to zero. CALPUFF uses the number of species size categories as input and ignores the number of categories as specified in the number particle size intervals (NINT) option. Concentrations for $PM_{2.5}$, PM_{10} and TPM can be calculated at the post-processing stage using CALSUM or POSTUTIL by adding the relevant PM size categories.

Both AERMOD and CALPUFF by default assume a particle density of 1 g/cm³. This should not be changed unless the proponent is modelling a source where the particle density is known to be considerably denser than the default value (e.g. a hard rock mining operation where particles can have a density as high as 5 g/cm³; Uranium operations may have densities as high as 10 g/cm³ or more). To overcome this issue, pseudo particle parameterizations should be established. This can be done by retaining the geometric standard deviation at 1.242 µm and the NINT set to 5, but adjusting the geometric mean diameter to simulate how a particle would react if it had a density of 1 g/m³ but maintaining the mass for a heavier particle (Lawrence 2012). Table 12.3 provides illustrative modifications to the input that would be required to model particles which have a significantly high density.

Table 12-3: Adjusted particulate diameter based on density

Particle density (g/cm^3)	Geometric mean diameter (µm)		
	$\leq PM_{2.5}$	$>PM_{2.5}$ and $\leq PM_{10}$	$>PM_{10}$
0.5	0.87	3.52	14.13
1	1.25	5.00	20.00
2	1.79	7.09	28.31
3	2.20	8.70	34.68
4	2.55	10.05	40.05
5	2.86	11.25	44.79

Where < $PM_{2.5}$ represents fine particles (P1 to P4 in Table 12.2) and > PM_{10} represents the very coarse particles (P7 in Table 12.2), the use of a non-default particle density should be noted in the assessment and the justification as to why the non-default values were used.

REFERENCES

Alberta Environment, 2003. Emergency / Process Upset Flaring Management: modelling Guidance, Alberta Environment, Edmonton, AB.

Alberta Environment, 2008. Alberta Acid Deposition Management Framework, Air Policy Section, Alberta Environment, Edmonton, AB.

Alberta Environment and Parks, 2021 Air Quality Model Guideline, Air Policy Branch, Edmonton, Alberta, November. ISBN 978-1-4601-4776-4

Alberta Government, 2019, Alberta Ambient Air Quality Objectives and Guidelines Summary, EP, Air Policy, 2016, No. 2, January 2019, https://open.alberta.ca/publications/9781460134856

Angevine, Wayne M., Eddington, L., Durkee, K., Fairall, C., Bianco, L. and Brioude, J., 2012, Meteorological Model Evaluation for CalNex 2010., 140, 3885-3906.

Barclay, J. and Scire, 2011. Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'. Prepared for: NSW Office of Environment and Heritage, Sydney, Australia. TRC Environmental Corporation, Lowell, MA, USA, March 2011.

J. Barnhart, Donald H. and Diehl, Erle K., 1960. Control of Nitrogen Oxides in Boiler Flue Gases by Two-Stage Combustion. Journal of the Air Pollution Control Association. Vol. 10, No. 5, Oct 1906, p 397-406

Bonan, Gordon, 2016, Ecological Climatology: Concepts and Applications, Cambridge University Press, New York.

Brashers, Bart: e-mail conversation March 28, 2019.

Briggs, G.A., 1969, Plume Rise. USAEC Critical Review Series, TID-25075, National Technical Information Service, Springfield, Virginia 22151.

British Columbia Ministry of the Environment, 2015. British Columbia Air Quality Dispersion Modelling Guideline. Environmental Protection Division. Environmental Standards Branch, Clean Air Section, Victoria B.C. November.

Brook J.R., T.F Dann and R.T. Burnett, 1997. The Relationship Among TSP, PM_{10}, $PM_{2.5}$ and Inorganic Constituents of Atmospheric Participate Matter at Multiple Canadian Locations, Journal of the Air & Waste Management Association, 47: 2-19.

Canadian Council of Ministers of the Environment (CCME), 2020(a). Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Nitrogen Dioxide, ISBN 978-1-77202-063-2, ccme.ca/en/res/gdadforcaaqsfornitrogendioxide_en1.0.pdf

Canadian Council of Ministers of the Environment (CCME), 2020(b). Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Sulphur Dioxide, ISBN 978-1-77202-061-8, ccme.ca/en/res/gdadforcaaqsforsulphurdioxide_en1.0.pdf

Cimorelli, Perry, A.J., S.G., A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee and W.D. Peters, 2005. AERMOD: A dispersion model for industrial source applications Part I: General formulation and boundary layer characterization. J. Appl. Meteor. Vol. 44, No. 5, pp. 682–692.

Cimorelli, A.J., S.G. Perry, A. Venkatram, J.C. Weil, R.J. Paine, R.B. Wilson, R.F. Lee, W.D. Peters, R.W. Brode, J.O. Paumier, 2004: AERMOD: Description of Model Formulation. U.S. Environmental Protection Agency, EPA-454/R-03-004, Sept. 2004. nrc.gov/docs/ML1118/ML11182C060.pdf

Coles, Henry S. and Summerhays, John E, 1979. A Review of Techniques Available for Estimating Short-Term NO_2 Concentrations, Journal of the Air Pollution Control Association, Vol. 29, No. 8, p. 8122-817, 1979

Davison, D.S., Hanson, M., Rudolph, R.C., Davies, M.J.E., 1981, Airshed Management System for the Alberta Oil Sands, Vol. II: Meteorological Data, prep. For the Research Management Division by Intera Environmental Consultants Ltd, and Western Research Development, AOSERP Report 120.

Exponent. 2011. CALPUFF Modeling System Version 6 User Instructions. Src.com/calpuff/download/CALPUFF_Version6_UserInstructions.pdf

Exponent, 2019. CALPUFF Version 7, Users Guide Addendum, Exponent Inc., Maynard, MA, October 2019, src.com/calpuff/download/CALPUFF_v7_UserGuide_Addendum.pdf

Government of Canada. 2007. Canadian Digital Elevation Data, Level 1 Product Specifications. Edition 3.0. Natural Resources Canada, Geogratis Client Service, Feb 2012

Government of Saskatchewan, 2014, Saskatchewan Environmental Code – Moving Forward in Partnership, Nov. 2014

Granger, Raoul and Bussieres, Norman, 2005, Evaporation/Evapotranspiration Estimates with Remote Sensing, Remote Sensing in Northern Hydrology, Measuring Environmental Change, American Geophysical Union, Washington, 2005 p. 143-154

Gray, D.M. and Landine, P.G., 1987, Albedo model for shallow prairie snow cover, Canadian Journal of Earth Science, 24, 1760-1768

Grosch, Thomas G, and Lee, R.F., 1999, Sensitivity of the AERMOD air quality model to the selection of land use parameters, Paper presented at the Seventh International Conference on Air Pollution: AIR POLLUTION 99, Palo Alto, CA.

Guigard, S.E., Kindzierski, W.B., and Harper, N. 2002. Heat Radiation from Flares. Alberta Environment, Science and Technology Branch, Edmonton, Alberta.

Guo, Huiqing and Yu, Zimu, 2011. Supporting Information for the Development of an Odour Guideline for Saskatchewan. Prepared for the Technical Resources Branch, Saskatchewan Ministry of Environment. Chemical and Biological Engineering Department, University of Saskatchewan.

Hanrahan, P.L. 1999. The Plume Volume Molar Ratio Method for Determining NO_2/NOX Ratios in Modeling—Part I: Methodology. Journal of the Air & Waste Management Association, 49(11), pp.1324-1331.

Igri, Pascal Moudi; Vondou, D. A., Kamga, F. M., 2011, Case Study of Pollutants Concentration Sensitivity to Meteorological Fields and Land Use Parameters over Douala (Cameroon) Using AERMOD Dispersion Model, Atmosphere 2(4): p. 715-741

Lawrence, B. 2012. Guidance Document: Guideline for Plume Dispersion Modelling. Government of Newfoundland and Labrador, Department of Environment and Conservation, GD=PPD-019.2, gov.nl.ca/ecc/files/env-protection-science-gd-ppd-019-2.pdf

Leahey, D. M. and Davies, M.J., 1984. Observations of Plume Rise from Sour Gas Flares, Atmospheric Environment, Vol. 18, No. 5, pp 917-922

Lee, R. F., July 1, 1993. Stack-Structure Relationships – Further clarification of our memoranda dated May 11, 1988, and June 28, 1989, Memorandum to Richard L. Daye, U.S. EPA.

Lee, Temple R. and Pal, S., 2017, On the Potential of 25 Years (1991–2015) of Rawinsonde Measurements for Elucidating Climatological and Spatiotemporal Patterns of Afternoon Boundary Layer Depths over the Contiguous US, Advance in Meteorology, Hindawi, 2017

Lin, K.M., Juang, J.Y., Shiu, Y.W., Chang, L.F.W., 2016, Estimating the Bowen Ratio for Application in Air Quality Models by Integrating a Simplified Analytical Expression with Measurement Data, Journal of Applied Meteorology and Climatology, 55, 1041-1047

MACTEC, Inc., 2004. Sensitivity Analysis of PVMRM and OLM in AERMOD- Final Report. Alaska DEC Contract #18-8018-04. Alaska Department of Environment Conservation. Alaska, Sept 2004. gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/pvmrm_sens.pdf

McGrath-Spangler, Erica and Denning, Scott, 2012, Estimates of North American summertime planetary boundary layer depths derived from space-borne lidar, Journal of Geophysical Research, 117

Ontario Ministry of Environment and Climate Change, 2017(a), Air Dispersion Modelling Guideline for Ontario [Guideline A-11], Air Monitoring and Transboundary Science Section, Environmental Monitoring and Reporting Branch, Toronto, Ontario, Feb 2017, PIBs #5165e03

Ontario Ministry of Environment and Climate Change, 2017(b), Modelling Open Flares under O. Reg. 419/05. Technical Bulletin, Environmental Monitoring and Reporting Branch, February 2017.

Ontario Ministry of Environment and Climate Change, 2018, Procedures for Preparing an Emission Summary and Dispersion Modelling Report [Guideline A-10], Standards Development Branch, Toronto, Ontario, March 2018, PIBs #3614e04.1

Ontario Ministry of Environment, Conservation and Parks, 2020. Ambient Air Quality Criteria. Human Toxicology and Air Standards Section, Technical Assessment and Standards Development Branch, ISBN: 978-1-4868-4498-2, files.ontario.ca/mecp-ambient-air-quality-criteria-list-en-2020-05-01.pdf

Owen, R.C and R. Brode, September 30, 2014. Memorandum – Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard, Air Quality Modeling Group, C439-0I, U.S. EPA, North Carolina

Paine, R.J, R.W. Brode, R.B. Wilson, A.J Cimorelli, S.G Perry, J.C Weil, A. Venkatram, W.D. Peters and R.F Lee, 2003: AERMOD: Latest Features and Evaluation Results. Paper number 69878 presented at A&WMA 96th Annual Conference and Exhibition, June 22-26, 2003.

Petersen, R.L., A. Beyer-Lout. 2012. AERMOD building downwashes theoretical limitations and possible solutions. Technical Paper 387. Presented at the 105th Annual A&WMA Conference & Exhibition, San Antonio, TX, June 19–22, 2012.

Petersen, R.L., S.A. Guerra and A.S. Bova. 2017. Critical review of the building downwash algorithms in AERMOD, Journal of Air and Waste Management Association, Vol. 67, No. 8, 826-835, 2017.

Raddatz, R.L., 1998, Anthropogenic vegetation transformation and the potential for deep convection on the Canadian Prairies, Canadian Journal of Soil Science, 78, 657-666

Ramboll Environ US Corp, 2018. 5-Year Meteorological Modeling of the Province of Saskatchewan-Meteorological Model Performance Evaluation, Prepared for the Saskatchewan Ministry of Environment. Regina, SK. March 2018, Project # 324000213

RTP Environmental Associates, 2013. Ambient Ratio Method Version 2 (ARM2) for use with AERMOD for 1-hr NO_2 Modeling – Development and Evaluation Report. Prepared for American Petroleum Institute., Washington, DC. Sept 2013.

Saskatchewan Ministry of Energy and Resources, Saskatchewan Upstream Flaring and Incineration Requirements, Directive S-20, Revision 1.1, December 2019.

Saskatchewan Ministry of Energy and Resources, Venting and Flaring Requirements, Directive PNG036, Revision 3.0, June 2022.

Sauer, T. J., and Horton, R., 2005 Soil Heat Flux. Agronomy Publications, Iowa State University, P. 131-155. Core.ac.uk/download/pdf/141671921.pdf

Schulman, L.L, and J.S. Scire. 2012. Building downwash modelling with AERMOD. Public comments. Presented at the 10th Conference on Air Quality Modeling, EPA Research Triangle Park, NC, March 3–5, 2012.

Schulman, L.L., D.G. Strimaitis and J.S. Scire, 1997. Addendum to ISC3 User's Guide – The Prime Plume Rise and Building Downwash Model. Electric Power Research Institute. Concord, MA

Schulman, L.L., D.G. Strimaitis and J.S. Scire, 2000. Development and evaluation of the PRIME plume rise and building downwash model. Journal of the Air & Waste Management Association, 50:378-390.

Scire, J.S., Robe, F.R., Fernau, M.E., Yamartino, R.J., 2000. A User's Guide for the CALMET Meteorological Model (Version 5), Earth Tech Inc. Concord, MA, January 2000.

SENES Consultants Limited, 2007. Sour Gas Well-Test Flaring Review. Prepared for British Columbia Oil and Gas Commission and B.C. Ministry of Environment. Vancouver, B.C. May 2007. bcogris.ca/documents/scek/Final_Reports/RA 2006-08 Sour Gas Final Report-May 17_ 2007.pdf

Shrestha, Bharat M., Raddatz, R. L., Desjardins, R. and Worth, D., 2012, Continuous Cropping and Moist Deep Convection on the Canadian Prairies, Atmosphere 3(4), 573-590

Tan, Son H., 1967. Flare System Design Simplified. Hydrocarbon Processing, C.F. Braun & Co., Calif., Vol. 46, No. 1. P. 172-176

Texas Commission on Environmental Quality, 2004. Technical Basis for Flare Parameters – Interoffice Memorandum

Tikvart, J. A., 1988. Stack-Structure Relationships, Memorandum to Richard L. Daye, U.S. EPA. May 11, 1988

Tikvart, J. A., 1989. Clarification of Stack-Structure Relationships, Memorandum to Regional Modelling Contacts, Regions I-X, U.S. EPA. June 28, 1989

TRC Environmental Corporation. (2010). CALPUFF Chemistry Updates: User's Instructions for API Chemistry Options. Prepared for WEST Assoc. src.com/calpuff/download/Mod64_Files/UsersInstructions_UpdatedChemistry.pdf

United States Environmental Protection Agency (U.S. EPA), 1985. Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) – Revised EPA-450/4-80-023R, U.S. Environmental Protection Agency, Research Triangle Park, NC.

United States Environmental Protection Agency (U.S. EPA) 1992. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised. EPA-454/R-92-019. Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711. October.

United States Environmental Protection Agency (U.S. EPA) 1995(a). Quality Assurance Handbook for Air Pollution Measurement Systems. Vol. IV, Meteorological Measurements. EPA/600/R-94/038d, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Also available from the following website as of February 2003, epa.gov/scram001.

United States Environmental Protection Agency (U.S. EPA) 1995(b). User's Guide to the Building Profile Input Program- Revised EPA-454/R-93-038. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. gaftp.epa.gov/Air/aqmg/SCRAM/models/related/bpip/bpipd.pdf

United States Environmental Protection Agency (U.S. EPA) 1997. Addendum to ISC3 User's Guide – The Prime Plume Rise and Building Downwash Model. Submitted by Electric Power Research Institute. Prepared by Earth Tech, Inc., Concord, MA. U.S. EPA, 1992.

United States Environmental Protection Agency (U.S. EPA) 2000 Meteorological Monitoring Guidance for Regulatory Modeling Applications. EPA-454/R-99-005, Office of Air Quality Planning and Standards, Research Triangle Park, NC, epa.gov/sites/default/files/2020-10/documents/mmgrma_0.pdf

United States Environmental Protection Agency (U.S. EPA), 2012. Memorandum on the Haul Road Workgroup Final Report Submission. Office of Air Quality and Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC.

United States Environmental Protection Agency (U.S. EPA) 2017. Appendix W to Part 51 Revisions to the Guideline on Air Quality Models, 40 CFR Part 51. U. S. Environmental Protection Agency, Research Triangle Park, NC. Federal Register, Vol 82, No. 10

United States Environmental Protection Agency (U.S. EPA) 2018: User's Guide for the AERMOD Terrain Preprocessor (AERMAP). Publication No. EPA–454/B–18–004. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711; April 2018. Gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aermap/aermap_userguide_v18081.pdf

United States Environmental Protection Agency (U.S. EPA) 2020. User's Guide to AERSURFACE Tool. Publication No. EPA-454/B-20-008. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. Feb 2020, gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aersurface/aersurface_ug_v20060.pdf

United States Environmental Protection Agency (U.S. EPA) 2021. AERSCREEN User's Guide, April 2021. EPA-454/B-21-005, U.S. Environmental Protection Agency, Research Triangle Park, NC, April 2021 gaftp.epa.gov/Air/aqmg/SCRAM/models/screening/aerscreen/aerscreen_userguide.pdf

United States Environmental Protection Agency (U.S. EPA) 2022(a): User's Guide for the AERMOD Meteorological Preprocessor (AERMET). Publication No. EPA–454/B–22–006. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711; June 2022. gaftp.epa.gov/Air/aqmg/SCRAM/models/met/aermet/aermet_userguide.pdf

United States Environmental Protection Agency (U.S. EPA) 2022(b). User's Guide for the AMS/EPA Regulatory Model (AERMOD). Publication No. EPA-454/B–22–007. U.S. Environmental Protection Agency, Research Triangle Park, NC, June 2022. Gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_userguide.pdf

United States Environmental Protection Agency (U.S. EPA) 2022I. AERMOD Implementation Guide. Publication No. EPA-454/B-22-008, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. June 2022. gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf

United States Environmental Protection Agency (U.S. EPA) 2022(d). AERMOD Model Formulation. EPA-454/B-22-009, Air Quality Assessment Div., Research Triangle Park, NC June 2022, epa.gov/scram001/7thconf/aermod/aermod_mfd_addm_rev.pdf

United States Environmental Protection Agency (U.S. EPA) and Office of Solid Waste and Emergency Response, Sept. 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA530-R-05-006. U.S. EPA, Office of Solid Waste, U.S. Environmental Protection Agency, Research Triangle Park, NC.

Wallace, John M., Hobbs, Peter V., 1977, Atmospheric Science – An Introductory Survey, Academic Press, New York

Wang, X.Y. and Wang, K.C., 2014, Estimation of atmospheric mixing layer height from radiosonde data, Atmos. Meas. Tech., 7, 1701–1709

Zhang, L., Brook, J. R., & Vet, R. (2003). A revised parameterization for gaseous dry deposition in air-quality models. Atmospheric Chemistry and Physics, 33, 2067-2082.

Zhang, L., Moran, M. D., Makar, P. A., Brook, J. R., & Gong, S. (2002). Modelling gaseous dry deposition in AURAMS: a unified regional air-quality modelling system. Atmospheric Environment, 36, 537-560.

GLOSSARY OF TERMS

AERMAP: The terrain preprocessor for AERMOD. AERMAP allows the use of digital terrain data in AERMOD.

AERMET: The meteorological preprocessor for AERMOD.

AERMIC: The joint work committee between the American Meteorological Society (**A**MS) and the U.S. **E**nvironmental Protection Agency (U.S. EPA), **R**egulatory **M**odel **I**mprovement **C**ommittee

AERMOD: Short-range air dispersion model developed by AERMIC that incorporates planetary boundary layer theory and advanced methods for handling complex terrain. It is the Saskatchewan Ministry of Environment's recommended air dispersion model.

AERSCREEN: A Screening model based on AERMOD that produces estimates of concentrations without the need for a representative set of meteorological data.

Air Emissions: Contaminants released from a source into the air.

Albedo: A portion of the incoming solar radiation reflected and scattered back to the atmosphere, which is an input data to AERMET.

Ambient Air: The portion of the atmosphere surrounding a pollution plume in the study which is not enclosed in a building or structure.

AMS: American Meteorological Society.

Approved Model: The air dispersion model identified in this report as a preferred model to be used in Saskatchewan.

Block Average: The average of a set of data calculated every Nth hour where N is the averaging period. The number of averaging periods in a day is 24/N.

Bowen Ratio: The ratio of sensible heat to latent heat transport from the ground to the atmosphere.

CAAQS: **C**anadian **A**mbient **A**ir **Q**uality **S**tandards

CALPUFF: An advanced, non-steady-state puff dispersion model for assessing long-range transport of contaminants.

Calm: In the Province of Saskatchewan (the province), CALM is defined as the weather condition where the wind speed is below 0.5 m/s.

CCME: The **C**anadian **C**ouncil of **M**inisters of the **E**nvironment is an inter-governmental organization in Canada with members from the federal government, ten provincial governments and three territorial governments.

CDED: **C**anadian **D**igital **E**levation **D**ata. Digital terrain files containing elevations covering Canada, typically at a consistent interval.

Complex Terrain: Terrain exceeding the height of the stack being modelled.

DEM: **D**igital **E**levation **M**odel. Digital terrain files containing elevations across a standard region typically at a consistent interval.

Dispersion Model: A group of related mathematical algorithms used to estimate (model) the dispersion of contaminants in the atmosphere due to advection by the mean (average) wind and mixing by atmospheric turbulence (including both mechanical and thermal).

Emission Factor: Calculation of the rate of release of contaminants to the atmosphere, typically based on a product production rate or a raw material consumption rate.

Flagpole Receptor: Any point modelled that is located above ground level.

Inversion: Any layer of the atmosphere where there is a vertical restriction of a parcel of air. In most cases, it is due to an increase in ambient air temperature with height.

ISCST: **I**ndustrial **S**ource **C**omplex – **Short-Term** dispersion model. The old air dispersion model, which preceded AERMOD.

Lee side: Side of a building or mountain, which is sheltered from the wind.

Mixing Height: The height of the layer above the ground to which the lower atmosphere will undergo mechanical or turbulence mixing, producing a nearly homogeneous air mass.

Monin-Obukhov Length: The height at which turbulence is generated more by buoyancy than by wind shear. The Monin-Obukhov Length has a negative sign under unstable conditions (upward heat flux) and is positive for stable conditions and approaches infinity as the actual lapse rate reaches the dry adiabatic lapse rate.

NWS **National Weather Service:** A US government organization associated with the National Oceanic and Atmospheric Administration

$PM_{2.5}$ Particulate matter less than 2.5 micrometres per cubic metre. Also known as fine particulate matter.

PM_{10} Particulate matter less than 10 micrometres per cubic metre. Also known as fine particulate matter.

Primary Contaminant: Substance emitted from the source which does not break down or form other compounds.

Receptors: User-defined spatial points used in the modelling exercise to determine concentrations of contaminants emitted from a source.

Running Average: The average of a set of data over a period calculated for each hour in the database. The number of averaging periods in a day is 24. Also known as the rolling average or moving average.

SAAQS: **S**askatchewan **A**mbient **A**ir **Q**uality **S**tandards. envrbrportal.crm.saskatchewan.ca/Pages/SEQS/Table20-SEQS-SAAQS.pdf.

Secondary Contaminants: Pollutants which are formed after contaminant release from a source (e.g. reacting with other contaminants or with sunlight).

Screening Models: A relatively simple analysis technique to determine if a given source is likely to pose a threat to air quality. Concentration estimates from the screening model are typically conservative.

Sensitive Receptors: Points in a modelling domain which may require special attention or analysis. These may include, but are not limited to, residential areas, individual residences, schools, hospitals, commercial daycares and senior centres, parks, recreational areas, monitoring sites, endangered species and sensitive ecosystems.

Simple Terrain: An area where terrain features are higher in elevation than the based on the stack but lower in elevation than the top of the stack of the source.

Surface Roughness Length: The height above ground at which the wind speed theoretically becomes zero.

TSP Total suspended particulate matter. Small particles that remain suspended in the air for an extended period.

Upper Air Data (soundings): Meteorological data obtained from balloon-borne instrumentation or computer-generated prognostic model that provides information on pressure, temperature, humidity and wind at certain elevations above the surface of the earth.

U.S. EPA: United States Environmental Protection Agency.

APPENDIX A
A. Brief Description of Approved Models

A.1 AERSCREEN
AERSCREEN is a single-source screening-level air quality model developed jointly by U.S. EPA and state modellers along with contractor support (U.S. EPA, 2021). AERSCREEN is an interactive command-prompt application that interfaces with MAKEMET for generating a matrix of meteorological conditions that represents a wide range of possible conditions and interfaces with the AERMOD model utilizing the SCREEN option to perform the modelling runs. If needed, it can interface with the program called AERMAP to automate the processing of terrain and the program called BPIPPRM to automate the processing of the building information.

The benefits of AERSCREEN as a screening model:
- AERSCREEN utilizes all the advantages of BPIPPRM used for building wake effects.
- AERSCREEN provides three options for generating the screening meteorology allowing for site-specific and seasonally varying surface characteristics for land classifications; and terrain details for the whole modelling domain are used in one run rather than each specific direction.
- AERSCREEN includes conversion factors to estimate "worst-case" three-hour, eight-hour, 24-hour and annual concentrations (1.0, 0.9, 0.6, 0.1, respectively) (U.S. EPA, 2021). For area sources, the 3, 8, and 24-hour average concentrations are equal to the 1-hour average, and no annual average concentration is calculated.
- AERSCREEN performs error checks on AERSCREEN inputs, AERMOD output and/or AERMAP output.
- AERSCREEN has several options to model NOx to NO_2 conversion, the option to adjust surface friction velocity based on AERMET algorithms, as well as inversion break-up and shoreline fumigation.

Inputs or options to AERSCREEN are:
- Physical properties for point, rectangular area, circular area, volume, capped stack, horizontal stack or flare sources;
- Building downwash information for point, capped stack, horizontal stack, and flare sources;
- Source elevation or terrain heights for sources and receptors via AERMAP;
- Minimum and maximum temperatures for MAKEMET;
- Minimum wind speed and anemometer height for MAKEMET;
- Surface characteristics for input to MAKEMET by the following methods:
    - user-specified surface characteristics – albedo, Bowen ratio, and surface roughness (no temporal or spatial variation),
    - seasonally varying surface characteristics for generic land use classifications based on Tables 4-1, 4-2, and 4-3 of the AERMET User's Guide (U.S. EPA 2022(a)) or,
    - Values listed in an external file, either an AERSURFACE output file or surface characteristics listed in an AERMET stage 3 input file.
- Minimum and maximum downwind distance for receptors to be modelled or discrete distances for receptors;
- A defined flagpole height;
- Urban/rural source classification, and urban population if urban source;
- Fence line distance for receptors.

The AERSCREEN program is currently limited to modelling a source.

A.2 AERMOD

AERMOD is a regulatory straight-line, steady-state Gaussian plume dispersion model specially designed by AERMIC (American Meteorological Society/EPA Regulatory Model Improvement Committee) to support the U.S. EPA's regulatory modelling programs (Cimorelli et al., 2005; U.S. EPA, 2022(b); Paine et al., 2003; Cimorelli et al., 2004). AERMOD was developed to replace the Industrial Source Complex Model-Short Term (ISCST3) as U.S. EPA's approved model. AERMOD is a multi-source air dispersion model that incorporates concepts such as planetary boundary layer theory and advanced methods for handling complex terrain. AERMOD has many input options, and those are described further throughout this document as well as the AERMOD user's manual (U.S. EPA 2022(b)). AERMOD consist of three components: AERMET which processes available meteorological data (U.S. EPA, 2022(a)); AERMAP which processes terrain data to produce terrain base elevations for receptors and sources (U.S. EPA, 2018); and AERMOD: which calculates the concentrations.

AERMOD can incorporate the Plume Rise Model Enhancements (PRIME) building downwash algorithms, which can enhance plume dispersion coefficients due to the turbulent wake and reduce plume rise caused by a combination of the descending streamlines in the lee of the building and the increased entrainment in the wake (Schulman et al., 2000). BPIP (Building Profile Input Program) should be used to generate the necessary PRIME downwash parameters which then form part of the input file for AERMOD.

The improvements of AERMOD over the ISCST3 model are:

- AERMOD requires two types of meteorological data files; a file containing surface scalar parameters and a file containing vertical profiles. These two files are generated by the U.S. EPA AERMET.
- For applications involving elevated terrain, the user must also input a hill height scale along with the receptor elevation. The U.S. EPA AERMAP program can be used to generate hill height scales as well as terrain elevations for all receptor locations providing a more realistic treatment of terrain impacts.
- AERMOD incorporates non-Gaussian plume shapes where appropriate where dispersion is a function of horizontal and vertical turbulence that varies with height.
- It tracks any plume mass that penetrates the elevated stable layer and then allows it to re-enter the boundary layer if appropriate.
- The impact of urban heat islands on turbulence is considered.
- AERMOD has a routine for processing averages when calm winds or missing meteorological data occur.
- It contains algorithms for modelling the effects of dry deposition of large particles and for modelling the effects of wet deposition for gases or particulates.
- There are output options specifically for comparing model results to the 24-hour $PM_{2.5}$, 1-hour NO_2 and 1-hour SO_2 CAAQS (CCME, 2020(a) and 2002(b), respectively). The 1-hour NO_2 and SO_2 standards are based on ranked values from the distribution of daily maximum 1-hour averages. When these contaminants are specified in the model inputs the methodology (based on the National Ambient Air Quality Standard) is set as default and may have to be physically disabled by the user if SAAQS are considered in an assessment.

Over complex terrain, AERMOD relies on a plume splitting algorithm to estimate the amount of plume that will be transported over this terrain. The portion of the plume that is trapped on the windward side of the terrain is dispersed assuming a horizontal dispersion coefficient that is symmetric. This may not be accurate under certain meteorological conditions and the effects of the dispersion of the windward component of the plume may not be properly assessed. Because of this, it is preferable to use the CALPUFF model for assessments that involve complex terrain.

Additional details on AERMOD model formulations and options can be found in the AERMOD User Manual (U.S. EPA, 2022(b)), as well as the Revisions to the Guidelines on Air Quality Models (U.S. EPA, 2017).

AERMOD has options to output results in different ways, depending on the needs of the user. The following is a brief description of some of the options in AERMOD.

Tabular Results
The model predictions can be generated in tabular format using the RECTABLE and MAXTABLE keywords in the output. The RECTABLE keyword provides the highest, second-highest third-highest values, etc., by receptor. The MAXTABLE keyword provides a table of the overall nth highest concentrations, regardless of if these occur at the same receptor in multiple instances (i.e., on different days). For both keywords, the user has additional flexibility to specify for which averaging times the outputs are selected. For the MAXTABLE keyword, the user can also specify the number of overall maximum values (i.e., "MAXTABLE 24 10" for the top 10 values for the 24-hour averages) to summarize each averaging time selected.

Plot Files
The PLOTFILE keyword is used to generate a file that contains the maximum value or the nth highest value at each receptor included in the model inputs, for the specified averaging time. These files are mostly used to generate contour plots of the high values for graphical presentation (e.g., plots of 1-hour maximum NO_2 concentrations in the model domain). Plot files can also be imported into a spreadsheet program to easily identify the overall predicted maximum value in the model domain.

Plot files can also be generated to present the maxima for individual source groups (SRCGROUP).

Post Files
AERMOD has the option of using post files (POSTFILE) to output the model predictions for every hour in the meteorological data set at every receptor specified in the model inputs. These files are very useful for showing the time-varying trends in the model predictions at specific receptors. However, because they include all the model results, post files can be extremely large (i.e., five years of meteorological; data for just 100 receptors will use about 18 MB of disk space). It is recommended that post files be used at selected receptor locations, or over short durations or specific days. Post files can be specified to provide the hourly concentrations for all hours in the five-year meteorological period at a specific sensitive receptor, or to provide the hourly concentrations on a specific day at all receptors. POSTFILE can be used when comparing modelling results with monitoring results, or for a specific air quality event that occurred.

Threshold Files
Threshold violation files (MAXIFILE) can be specified to keep an account of exceedances of a user-specified concentration threshold. The date of the occurrence, the coordinate and the model-predicted concentration that is above a specified threshold are stored in the MAXIFILE for each occurrence. These files are useful for assessing the frequency of exceedances at specific receptor locations and are required for running the EVENT model in AERMOD. The EVENT model is used to complete source

contribution assessments of these exceedances. However, it should be noted that this option can produce large files if the runs have many receptors and there are a significant number of exceedances of the threshold.

Daytime Maximum Files

The CAAQS for SO_2 and NO_2 are based on the maximum hourly concentrations for each day. The MAXDAILY is an option to output daily maximum 1-hour values for each day processed. The MXDYBYYR provides an option to output data of daily maximum 1-hour values by year, for each year processed. Both options are only applicable for NO_2 and SO_2.

Source Grouping

In AERMOD when modelling is performed for several individual sources (i.e., point, volume, area or line) the use of source groups enables modelling results to be output for a specific group of sources. AERMOD automatically places the cumulative results from all sources into a group called ALL. Analysis of specific groups of sources may be performed by using the SRCGROUP option. Source groups enable modelling results that can be generated for specific groups of one or more sources. One example may be to assign each source to a separate source group to determine the different extent of effects from each source. This approach provides the maximum value for each source group, which may occur during different hours or days. As a result, this approach should not be used to attempt to assess the contribution of individual sources, unless the model is run for a specific hour or day in the meteorological data. For regulatory purposes, the ministry requires the use of the source group "ALL" in AERMOD, which considers all the sources at the same time.

A.3 CALPUFF

CALPUFF model is a multi-layer non-steady state Lagrangian puff dispersion model and includes three main components: CALMET, CALPUFF and CALPOST. CALMET is a meteorological model that develops a three-dimensional gridded modelling domain for the hourly wind and temperature fields based on terrain and land use information. CALMET has the option to use the output generated by a gridded numerical weather prediction model (e.g., WRF – Weather Research and Forecasting model). Typically, the spacing of the CALMET grid used in the modelling domain should be of the order of 1/10th of the dimension of the features (e.g., valleys) in that domain. CALPUFF uses the fields generated by CALMET to advect puffs of contaminants simulating dispersion and transformation along the way. CALPUFF can be used with a three-dimensional meteorological grid or with a single station. CALPOST is used to process the output files generated by CALPUFF.

The CALPUFF model treats a continuous plume as a series of puffs, so the plume can follow a terrain feature, deform, or even split apart, and it can be applied under calm conditions. CALPUFF contains algorithms that allow it to emulate AERMOD at short distances because puff models only do well at distances beyond a few kilometres. With this capability, CALPUFF can be used for short distances as well as long-range transport as far as 300 km.

The CALPUFF model can be run in different modes, which reflect the source of input meteorology used for CALMET processing. There are many options and switches that can be used in both CALPUFF and CALMET. Ministry recommendations for specific options/switches are provided in Appendix I.

APPENDIX B
B. Methods Used to Estimate Emission Rates

As part of the modelling assessment, emission rates for sources to be modelled must be determined. The accuracy of a dispersion model is strongly dependent on the input data that is provided for the model. In many cases, companies prefer to have a higher emission limit than what is expected for a certain type of equipment. The high limit helps prevent the facility from being out of compliance due to problems that may develop with a source, and it allows companies to easily increase emissions in case of productivity increases at a later date. Modelling should be done using these higher limits.

There are several methods to determine emission rates from certain processes or facilities. The usefulness of these methods will depend on whether the source is new or existing.

- **Continuous Emission Monitors (CEM)** – Large industrial facilities that emit significant amounts of air contaminants often have CEM systems on their main stacks that measure emission rates as well as exit flow rate and temperature. This can provide average flow, maximum flow and even the variation in hourly data measured, which can be used in models.

- **Equipment Manufacturer Emission Specifications** – For new facilities or new additions to existing facilities, manufacturer specifications of emission rates for certain contaminants should be available. These emission rates may be available for different loads and operating conditions. Care and professional judgement should be used if the equipment is old, has been retrofitted, modified or not operating under optimum conditions.

  NPRI (National Pollutant Release Inventory) Toolbox – Located on the Environment and Climate Change Canada web site canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/sector-specific-tools-calculate-emissions.html It is a compilation of information related to the generation of NPRI submission information. There is some general information on emission factors and emission estimation techniques. There are useful equations, conversion factors and example emission calculations.

  U.S. EPA AP-42 – The U.S. Environmental Protection Agency maintains a web-based clearinghouse for emission factors (epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors) as well as documentations (U.S.EPA, 2005). An emission factor relates the quantity of a contaminant released to the atmosphere with an activity rate, amount of product processed, or mass of fuel consumed. Each emission factor is given a rate (i.e., A to E) to reflect their uncertainty. The U.S. EPA use data from past source testing campaigns to develop emission factors for a variety of industrial processes, operations and types of equipment, both with and without emission controls. Any source modelled with a low emission factor rating will be limited in its value due to its large uncertainty.

  Data from a similar facility in another location. In some situations, companies may build their facility based on one design using the same emission controls and engines/turbines. These companies may already have several facilities operating and have gathered emission data from those existing facilities. Data from an existing facility with very similar controls and engines can be used to develop emission factors in the modelling exercise.

Emission Tools – There are several models available that calculate emissions using methodology that is specific to a source type. One source is the U.S. EPA Emission Estimation Tools website at epa.gov/air-emissions-factors-and-quantification/emissions-estimation-tools. For vehicle emission estimates the best program available is MOVES (Motor Vehicle Emissions Simulator) at epa.gov/moves. In most cases, the emissions assume there are no chemical transformations through the process.

Stack Sampling Data - Stack sampling data provides a snapshot in time of the emission rates from a facility. In many cases, stack sampling is done for compliance reasons and because of this, stack sampling tends to be done when the facility is operating at optimal conditions. The standard procedure is to take three one-hour samples per test and average those three to calculate an emission rate. If this data is to be used, all data for the past five years should be reviewed and the highest of the three samples per test should be used as the worse case emission rate, this would be considered the most conservative. The only exception is if one of the high values was considered an outlier due to sample errors or known process upsets, or if it is proven that emissions at the facility have improved over the last seven years due to upgrades or installation of emission controls. Additional information on stack sampling for $PM_{2.5}$ is found in Section 4.2.1.

Engineering Calculations – Emission rates can be developed from fundamental scientific principles and measurements. It can be based on operating conditions, data from literature, thermodynamics and physical properties or can be based on direct measurements that are not considered validated source tests. The use of derived formulae may be an acceptable emission rate estimating method if the approach is clearly demonstrated through documentation and references based on sound scientific and engineering principles.

For additional reference the Ontario Ministry of the Environment and Climate Change “Procedure for Preparing an Air Emissions Summary and Dispersion Modelling Report” (Ontario Ministry of Environment, 2018). This document contains information on the use of emission factors, engineering estimates and other methods of estimating emission rates and information on methods of assessing the negligibility of sources or contaminants.

APPENDIX C
C. Building Downwash Effects

For dispersion modelling, the stack heights based on Good Engineering Practice (GEP) are used to determine whether building downwash would be considered. Also, the area of influence of nearby buildings needs to be considered to determine whether emissions from the stack would be influenced by those buildings. A building is considered sufficiently close to a stack to cause wake effects when the distance between the stack and the nearest part of the building is less than or equal to five times the lesser of the building height or the projected width of the building (width of the building "seen" by the wind blowing in a particular direction).

For each building, there is a Structure Influence Zone (SIZ) in which any stack within that SIZ is potentially affected by the building wake effect and should be included in the building downwash assessment. The SIZ is determined based on recommendations for U.S. EPA (Tikvart, 1988 and 1989). Downwind from a structure, the SIZ will be 5L (i.e. Area of Influence) but only 2L upwind from a structure. For crosswind flow the SIZ will be 0.5L as shown in Figure C-1 (Ontario Ministry of Environment, 2017(a)). L is the lesser of the height or the projected width of the building. When determining potential building effects, 360 degrees of wind direction is checked to determine the SIZ for each 10 degrees wind direction sector and the stacks that may be affected by downwash.

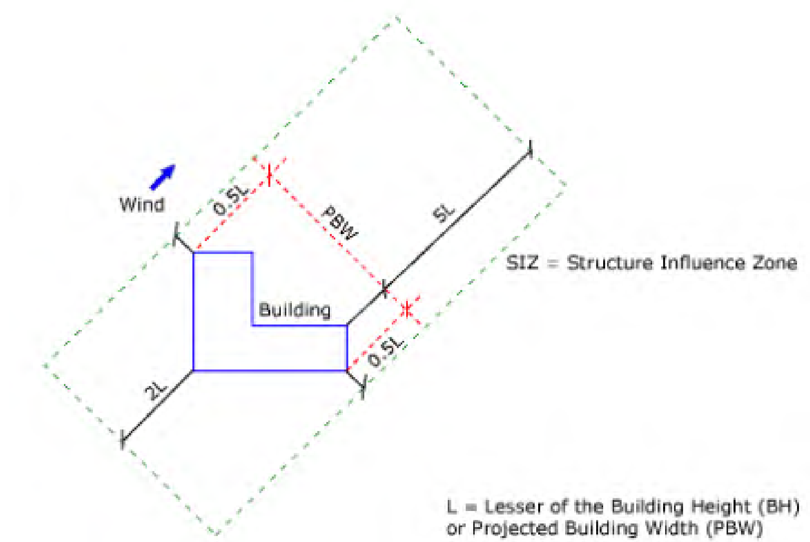


Figure C-1: Structure Influence Zone (SIZ)

C.1 Defining Buildings

To take account of local building effects, the models recommended in this guideline require information related to the dimensions and location of structures with respect to the stack. The U.S. EPA has developed a Building Profile Input Program (BPIP) for calculating downwash parameters to be used in modelling (see U.S. EPA 1995(d)). BPIPPRM is a BPIP program for PRIME (Plume Rise Model Enhancement). PRIME algorithm is the preferred method used in models to account for building downwash. The inclusion of the PRIME algorithm has generally produced more accurate results in air dispersion models compared to earlier algorithms. The improvements in PRIME include:

- Location of stacks relative to buildings is considered;
- Enhanced plume dispersion coefficients due to the turbulent wake;
- The deflection of streamlines up over the building and down the other side is considered;
- Reduced plume rise caused by a combination of descending streamlines in the lee of the building and the increased entrainment in the wake;
- The wind profile at the plume location is considered for calculating plume rise; and
- The plume captured in the recirculation cavity can be transported to the far wake downwind and treated as a volume source (Schulman, 1997).

Based on the GEP technical support document, (U.S. EPA, 1985), BPIPPRM is designed to determine whether a stack is subject to wake effects from a structure or structures. Values are calculated for GEP stack height and GEP-related building heights and projected building widths. An indication is given as to which stacks are being affected by which structure wake effects.

For multiple buildings, BPIPPRM determines building separation distances and fills in the gap between the buildings if they are sufficiently close. While BPIPPRM supports the use of tiers on a building, if there are several tiers on a single building it is often preferable to enter each tier as a separate building.

BPIPPRM uses the same input data as in BPIP, so no modification to the existing BPIP program is required. The following information is required to perform a building downwash analysis within BPIP.

- X and Y location and height (m) for all stacks;
- X and Y location for all building corners;
- Height (m) for all buildings. For building with more than one height or roofline, identify each height (tier); and
- Base elevations (m) for all stacks and buildings.

The BPIP User's Guide (U.S. EPA, 1995(b)) provides details on how to input building and stack data into the program.

In addition to the standard variables reported in the output file of BPIP (i.e., direction-specific building height (BUILDHGT) and width (BUILDWID)), BPIPPRM adds the following.

- **BUILDLEN**: Direction-specific projected length (m) of the building along the flow.
- **XBADJ**: Along-flow distance (m) from the stack to the centre of the upwind face of the projected building.
- **YBADJ**: Across-flow distance (m) from the stack to the centre of the upwind face of the projected building.

For a more detailed technical description of the U.S. EPA BPIPPRM model and how it relates to the PRIME algorithm see the Addendum to ISC3 User's Guide (Schulman, 1997).

C.2 Downwash Limitations in Models

There are several factors to consider when deciding whether BPIP or BPIPPRM should be used. One is the shape of the structures affecting the air flow and the other is the limitations of each model. The following is a brief description of how building downwash is applied to each model.

C.2.1 AERSCREEN

AERSCREEN can consider multiple buildings for a single stack. Parameters needed by AERSCREEN (U.S. EPA, 2021) for input, if downwash from only one single tier rectangle shaped building is to be accounted for, are:

- Building height (m);
- Maximum building horizontal dimension (m);
- Minimum building horizontal dimension (m);
- Orientation of maximum building horizontal dimension relative to the north;
- Angle from north of stack location relative to building centre; and
- Distance (m) between stack and building centre.

AERSCREEN has the option of reading a BPIPPRM input file for a single building. For situations where there are multiple tiers, buildings or more complicated geometries, an input file would have to be used.

An example building/stack configuration is shown in Figure C-2: AERSCREEN Building Downwash

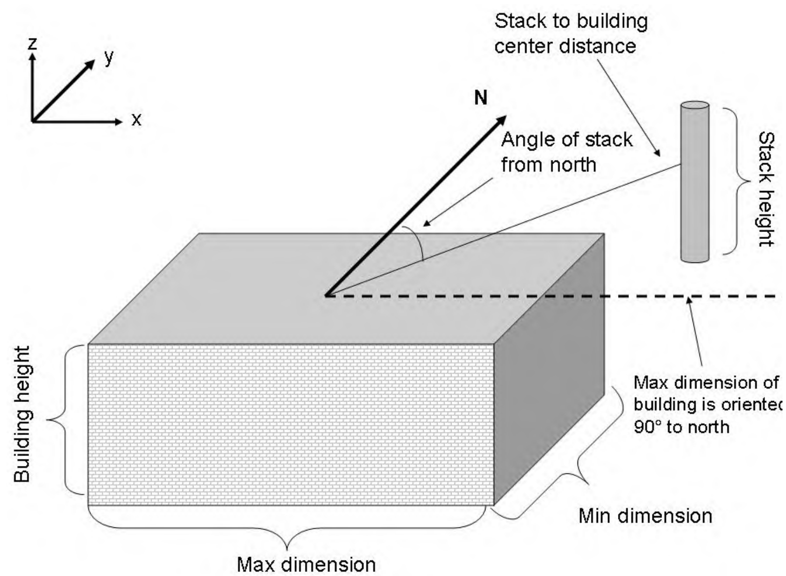


Figure C-2: AERSCREEN Building Downwash

C.2.2 **AERMOD/CALPUFF**

Both AERMOD and CALPUFF allow for the capability to consider downwash effects from multiple buildings as well as multiple stacks. It uses the same method as that used in AERSCREEN except a building need not be rectangular and may have many vertices (corners) and different tiers. This model uses direction-specific information for all building downwash cases typically at 10-degree intervals in a clockwise direction. Building downwash effects would have to be individually calculated for each stack

In most modelling cases, an output file produced using BPIP or BPIPPRM would have to be copied and pasted into the required input group for source and building information, however, there are programs available that can read the BPIP output file and write this information into the AERMOD input file.

PRIME was originally developed using a limited set of building profiles. It has been shown that in certain circumstances, particularly for complex structures, BPIPPRM may produce results that are not entirely accurate. Studies of building downwash showed that the BPIP algorithm in the ISCST3 program performed better for buildings with an aspect ratio (building width/building height) greater than five (i.e. squat buildings) (U.S. EPA, 1997). Recent field and wind tunnel studies have shown that BPIPPRM can over-predict concentrations by a factor of 2-8 for certain building types (Petersen et al., 2017). On the other hand, there can be an under-prediction using certain building and terrain configurations (Petersen and Beyer-Lout, 2012). For a very wide and long smelter in Tennessee, it was shown that annual concentrations using AERMOD were 10 times greater than field observations (Schulman and Scire, 2012). Because building downwash can cause concentration predictions that exceed ambient standards, these estimates must be as accurate as possible.

Appendix D
D. Receptor Grid Setup Options

D.1 Multi-Tier Cartesian Grid

Cartesian receptor grids are a set of receptors that are defined by an origin with evenly (uniform) spaced receptor points in X and Y directions. Except for the use of screening models, all modelling assessments should use a Cartesian grid with pre-defined grid spacing. Since each receptor point requires computational time, it is not optimal to specify a dense network of receptors over a large modelling area. However, it is important to have a dense enough network of receptors to capture the areas of maximum impact, especially near a source where a slight change in wind direction would make a big difference in the path of the plume. As the plume travels downwind from the source, it will grow, and the extent of the area affected by the plume will increase. Therefore, the number of receptors downwind of a source could decrease resulting in a coarser grid density. This change in receptor density based on distance can be done using a multi-tier Cartesian grid. The advantage of this approach is that it gives the user a specific starting point with set criteria for the design of the receptor network and minimizes the number of receptors which directly affects model run times without sacrificing sufficient resolution to capture points of maximum impact. The following are the ministry's recommendations for determining the grid spacing based on distance from the source(s):

- 20 m receptor spacing in the general area of maximum impact and the property boundary;
- 50 m receptor spacing within 0.5 km from the source;
- 250 m receptor spacing within 2 km from the sources of interest;
- 500 m receptor spacing within 5 km from the sources of interest; and
- 1000 m receptor spacing beyond 5 km.

Figure D1 is an example of a multi-tier grid with an increased density of grid points near the site. These recommended spacing of the receptors are for guidance and will depend on several factors such as source types, distance to plant boundary (e.g., mining) or sensitive receptors. For short stacks or those facilities with significant fugitive or ground-based sources, the maximum concentration will occur near the property line. The plume has had little time to spread and may be quite narrow. The close spacing of the receptors in this area is necessary to capture the maximum concentration as the modelled concentration will change rapidly with distance from the source and from the centreline of the plume. Figure D1 also shows that the receptors within the plant boundary have been removed.

For the cases where a facility has a tall stack that is clear of building downwash, the maximum ground-level concentration will occur at some distance from the facility. The maximum concentration from a tall stack will be significantly lower than if the same mass of emissions was emitted from a shorter stack or as a fugitive source as the emissions from the tall stack are spreading in the horizontal and vertical directions as the plume moves away from the stack. The resulting ground-level concentrations from a tall source generally change more slowly with distance and a more diffuse grid will still adequately capture the maximum concentration. Additional receptors may be added to this minimum grid setup as explained in the following section.

Predefined receptor placement criteria are not optimized for all modelling conditions. For this reason, justification should be provided for any deviations from the standard grid spacing.

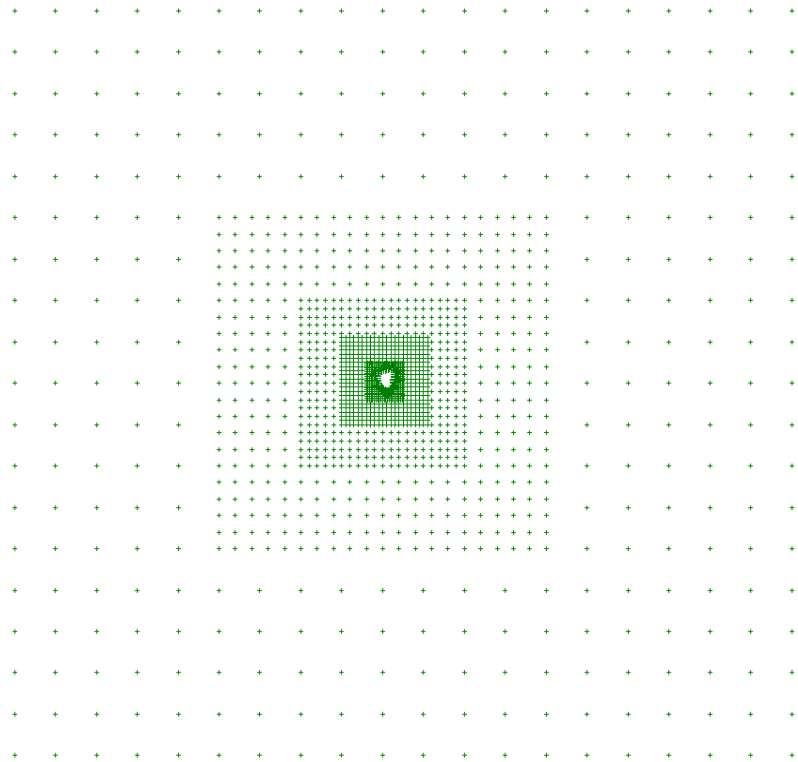


Figure D-1:Example of a Multi-Tier Grid Spacing

D.2 Cartesian Receptor Sub-Grids

In some scenarios, the model may need to be run an additional time to further refine the predictions due to the initial model showing maximum impact located in areas where there are a few receptors. Depending on the surrounding area, it may be necessary or desirable to place an additional Cartesian receptor grid, containing a finer receptor density to provide more details in that area. This can also apply to an area where there is a community or sensitive receptors, or in areas with complex terrain. The size of the additional receptor grid should be the greatest of 1 km by 1 km or large enough to sufficiently cover the area of concern. Figure D2 illustrates a sample uniform Cartesian receptor sub-grid nested inside the multi-tier grid.

The following are the ministry's recommendations for determining the grid spacing based on distance from the source(s) for areas where there are communities, sensitive receptors, complex terrain or areas of maximum impact:

- 50 m receptor spacing within 2 km from the sources of interest;
- 100 m receptor spacing within 5 km from the sources of interest; and
- 250 m receptor spacing beyond 5 km.

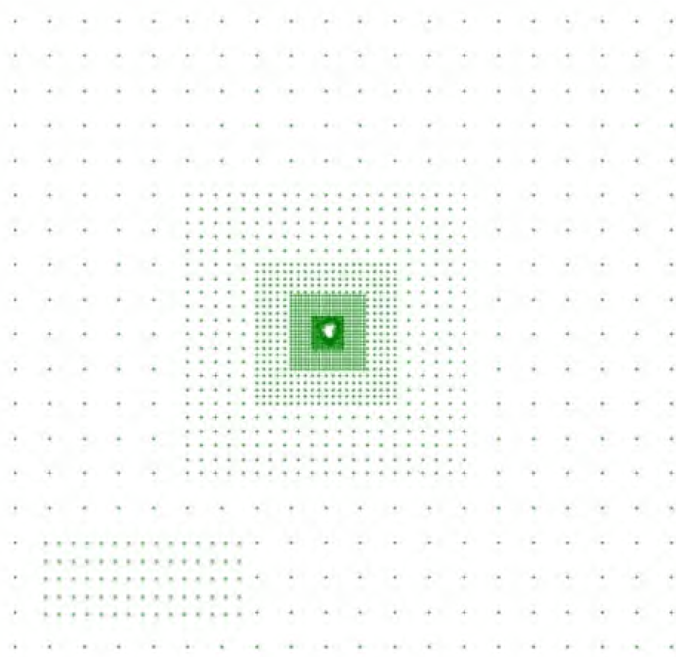


Figure D-2: Example of a Cartesian Grid Nested Inside a Multi-Tier Grid

D.3 Polar Receptor Grids

AERMOD also supports the use of polar receptor grids. These are receptor networks that are characterized by an origin with receptor points defined by the intersection of concentric rings, which have defined distances in metres from the origin, with direction radials at a specified degree spacing (typically 10 degrees). Polar receptor grids are designed primarily for single-source studies and are only suitable for cases where the maximum impact is near the facility. Unfortunately, the receptor spacing becomes too large too quickly in many studies as the distance increases from the source. This can be seen in Figure D-3

Except for screening models like AERSCREEN, the ministry does not recommend the use of polar receptors for determining compliance.

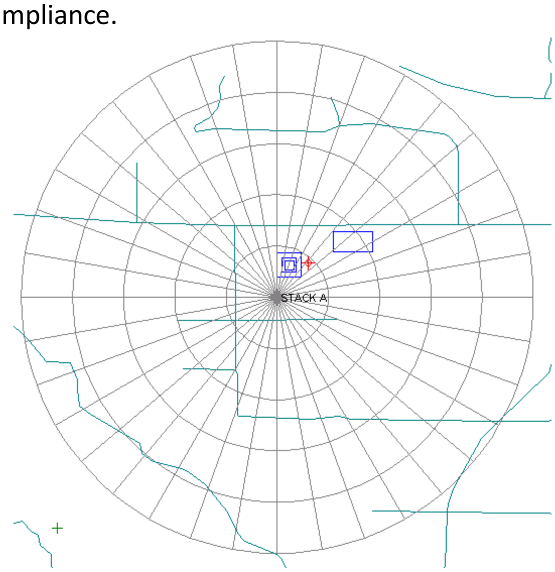


Figure D-3: Example of a Polar Grid

D.4 Fence Line Receptors

The ambient air quality objectives apply to areas where there is public access (i.e. outside of the plant boundary). The plant boundary is typically defined as the facility fence line or the perimeter of the area disturbed by the operation of the facility. The impact from receptors within the plant bound is not considered during the modelling assessment. However, some companies may choose to use those receptors for their internal assessment of their operations.

The ministry requires that receptors be placed along the fence line of the plant boundary to demonstrate compliance at the nearest possible reportable receptor to the source(s). Typically, a receptor network spaced at 20-metre intervals along the shape of the boundary is required. Figure D-4 is an example of the receptors along the fence line of the property and shows that receptors within the plant boundary were removed. This recommendation will apply to receptors along the perimeter of all public roads passing through these properties.

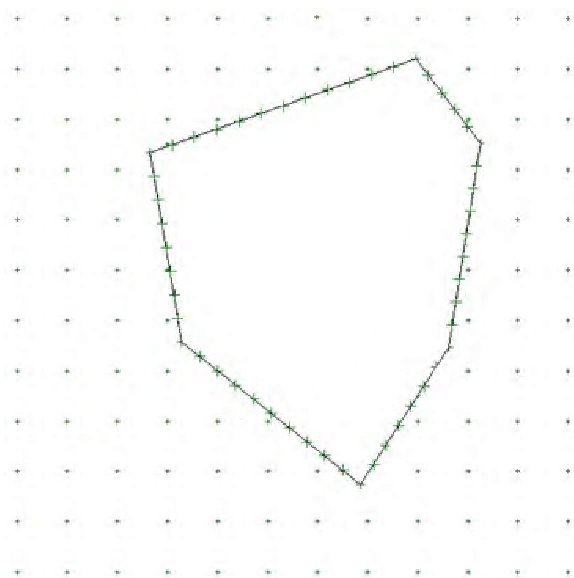


Figure D-4: Example of Fence line Receptors

The only allowed exception to the 20 m receptor spacing rule the property boundary is for very large area sources (i.e. the project boundary perimeter is larger than 50 km) where sampling at this rate will require excessive computing resources. If there are any sensitive receptors near the boundary affected by waiving the 20 m receptor spacing requirement, then the requirement for high-resolution sampling around the sensitive receptor takes precedence. All other receptor spacing rules still apply (Alberta Environment and Parks, 2021). In unusual situations, the modeller or qualified person has the option to deviate from the receptor spacing requirements where appropriate as long as adequate justification is provided.

D.5 Discrete Receptors

Receptor grids do not always cover precise locations that may be of interest in modelling projects. Specific locations of concern can be modelled by placing single receptors at desired locations. This enables the modeller to achieve data on specific points for which data is especially critical. Depending on the distance from the source, these specific points may be located several hundred metres from the nearest gridded receptor point.

Common locations of concern are known as sensitive receptors and can include, among others, the following:

- Residences;
- Schools;
- Hospitals and Health care facilities;
- Apartment buildings;
- Daycare centres;
- Air intakes on nearby buildings;
- Senior citizen’s residences or long-term care facilities;
- Community and recreational centres/areas and sports facilities;
- Parks and camping grounds;
- Sensitive species; and,
- Protected species habitat.

Depending on the project resolution and location type, these can be characterized by a single discrete receptor or a series of discrete receptors. In some cases where there is an area of many discrete receptors, it may be better to use a Cartesian receptor sub-grid.

> AERMOD makes use of receptor elevation information for all terrain studies. Receptor elevation data is commonly obtained from digital terrain data in a variety of formats. The AERMOD model obtains receptor elevation and hill height values using AERMAP, its terrain pre-processor (see Appendix A). In some situations, it may be more convenient to just use all discrete receptors generate with the output being in a format like the multi-tier Cartesian grid.

There are no restrictions in AERMOD on the location of receptors relative to area sources. Receptors may be placed within the area and at the edge of an area source. AERMOD will integrate over the portion of the area that is upwind of the receptor. The numerical integration is not performed for portions of the area that are closer than 1.0 metres upwind of the receptor. Therefore, caution should be used when placing receptors within or adjacent to areas that are less than a few metres wide.

APPENDIX E
E. CDED Terrain File Set-up

Canadian Digital Elevation Data (CDED) provided by Natural Resources Canada are terrain data in USGS DEM compatible formats at scales of 1:50,000 and 1:250,000 (Government of Canada, 2007). Each file consists of gridded data of 1201 points in the east-west direction by 1201 points in the north-south direction, for a total of 1,442,401 elevation points. The differences between the two types of DEM files are as follows:

For the 1:50000 scale CDED, the post spacing is always 0.75 arc seconds along a profile in the south-north direction and varies from 0.75 to 3 arc seconds in the west-east direction, depending upon the geographic location of the cell. Over Saskatchewan, this results in a grid spacing of about 23 m in the south-north direction and a range of about 13-16 m in the west-east direction.

For the 1:250000 scale CDED, the post spacing is always 3 arc seconds in the south-north direction along a profile and varies from 3 to 12 arc seconds in the west-east direction, depending upon the geographic location of the cell. Over Saskatchewan, this results in a grid spacing of about 93 m in the south-north direction and a range of about 45-60 m in the west-east direction.

Figure E-1 shows the location of the 1:250,000 and 1:50,000 CDED terrain files for the whole province of Saskatchewan. The 1:250,000 files covering Saskatchewan are either for the grids 062-064 or 072-074 and each of those areas includes 16 additional sub-files ranging from A (bottom right) to P (top right) for a total of 51 files covering the whole province. Each one of the 1:250,000 CDED sub-files (i.e. 072G) consists of 16 sub-files of the 1:50,000 CDED terrain data ranging from 1 to 16. In all cases, the first 1:50,000 file (i.e., 073G01) starts in the bottom right of the 1:250,000 sub-file, and the last file (i.e., 073G16) ends in the top right corner of the 1:250,000 sub-file.

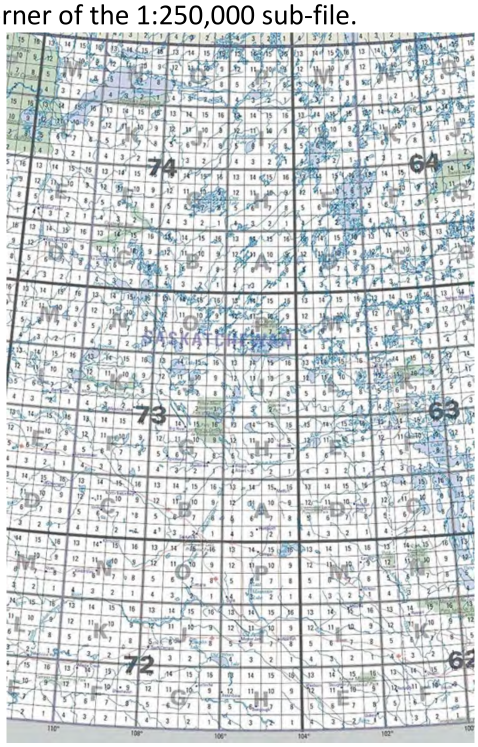


Figure E-1: CDED coordinates available for the whole province of Saskatchewan.

APPENDIX F
F. Recommended Values for Land Use Characterization

Characterization of representative land use data in the vicinity of a site is necessary to determine the appropriate surface characteristics, which govern how plumes disperse as they move away from a source. Each surface characteristic is given a numerical value in the model, which is used to determine the airflow over a terrain that would be representative of each specific land cover category. These values would vary depending on the type of land cover as well as the season. Both AERMET and CALMET have similar categories for each land type but use different codes for each type. The values used in AERMET are derived using AERSURFACE, which is based on the land type on the National Land Cover Database (NLCD) definitions. The land type category in the GEO.DAT file used in CALMET for each land type is different from that used in the User's Guide to AERSURFACE Tool. Table F.1 compares the difference in codes used in CALMET compared to NLCD.

Table F-1: Land Use Code used for each land type.

Description	CALMET land use type	NLCD Class number
Urban	10	24
Agricultural	20	81
Rangeland	30	71
Shrub	32	52
Transition Forest	40	33
Deciduous	41	41
Coniferous	42	42
Mixed	43	43
Small Water Body	51	11
Large Water Body	55	11
Wetland	60	90
Forested Wetland	61	91
Non-forested Wetland	62	92
Barren Land	70	31
Perennial Snow or Ice	90	12

Figure F.1 shows the distribution and type of land cover for the province of Saskatchewan. This data can be downloaded at the following website:
geoappext.nrcan.gc.ca/arcgis/rest/services/FGP/canada_landcover_2015_en/MapServer.

An atlas of these maps can be retrieved at: atlas.gc.ca/lcct/en/index.html. A similar distribution was used to produce the Regional Meteorological Data Sets using WRF and the MMIF program.

This section includes several tables of recommended land use values based on land type and season. The values in these tables along with the information in Figure F.1 can be used in modelling. In most modelling situations, it is recommended to use the land use parameters identified in the available Regional Meteorological Data Sets.

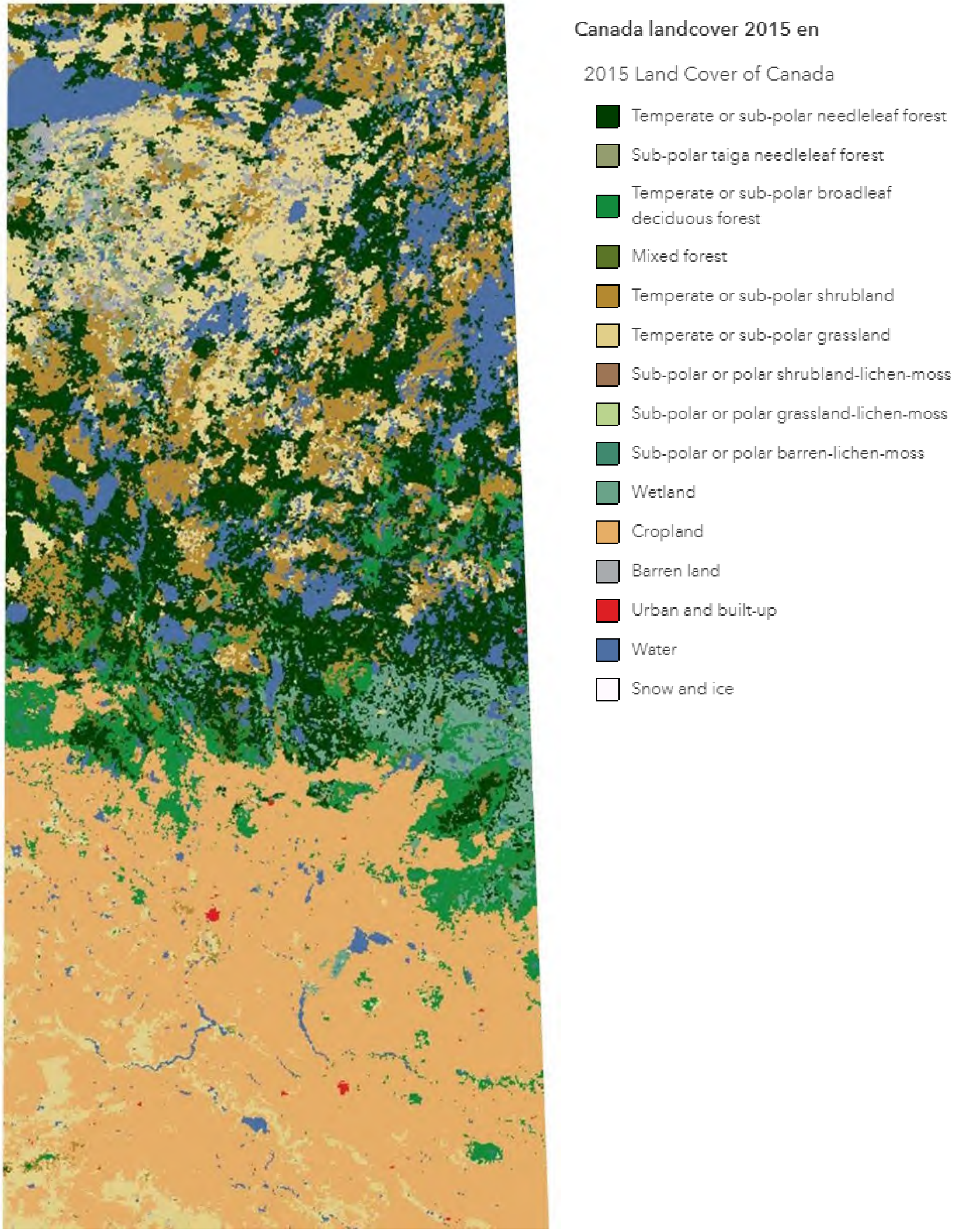


Figure F-1: Land Cover for Saskatchewan

These values are typical values based on season but may vary for each month depending on the weather in a particular year or latitude. One month may be more representative of one season for one year and another season for another year depending on the weather for each particular year. For example, snow remained on the ground a lot later in 2013 compared to 2015. Even though these tables provide values based on season, it is recommended to have monthly averages for these surface characteristics. Values should be adjusted slightly as each month transitions from one season to another.

The seasons are defined as:
1 – Wint- Late autumn after frost and harvest; or winter with very little or no snow
2 – WinS Winter with continuous snow on the ground
3 – Sprg - Transitional spring with partial green coverage or short annuals
4 – Sum - Midsummer with lush vegetation
5 – Aut - Period with unharvested cropland

Note that some values presented in Tables F.2 to Table F.4 are somewhat different from those presented in other documents like AERSURFACE User's Guide. The land characteristics in the Ministry's AERMOD-ready files were calculated based on values used in WRF. To be consistent with the WRF outputs and to avoid any conflicting parameters it was decided to use values similar to those recommended by WRF. For example, AERSURFACE recommends a surface roughness value of 1.3 m for forest areas, whereas WRF used 0.5 m as the maximum surface roughness. Using the AERSURFACE default value resulted in the daytime maximum mixing height during the winter being like that in the summer in northern latitudes.

There may be situations where values for the land use parameters need to be determined for a specific location. The following provides information on how to calculate these values. The AERMET Stage 3 input files are needed along with the revised land characteristic values to produce a new meteorological file to be used in AERMOD modelling. The Stage 3 input files are available, upon request, from the ministry. Proponents are required to explain the methodology for the determination of suitable land surface characteristics in the air quality assessment report.

F.1 Surface Roughness Length

The determination of the surface roughness length for AERMOD should be based on the land use within a three (3) kilometre upwind distance to the measurement site (U.S. EPA, 2020). This distance can be shorter for areas with high surface roughness lengths. Each land use type is given a value based on the information in Table F.2. The final value would be based on an inverse distance weighted geometric mean. The inverse distance weighted average was chosen in part due to the width of the area increases per linear sector with distance from the site. In locations where there may be several types of land use within a three-kilometre radius from a site, it may be easier to calculate a surface roughness length for different wind sectors which have the same land use rather than using a single value over the full circular area around the site. If wind sectors are chosen, the sector widths should be no smaller than 30 degrees. A different value can be applied to as many as 12 different wind sectors and none of these wind sectors should be overlapping another wind sector. These sectors must be defined in a clockwise direction from which the wind is blowing, with the north at 0°. The total sectors must cover the full circle so that the ending of one sector matches the beginning of the next sector (i.e. the beginning direction is considered a part of the sector, but the ending direction is not). Recently, a new option has been added to AERSURFACE to generate roughness length values for 16 sectors at 22.5 degrees each. As of December 2021, this option is for diagnostic purposes only and cannot be input into AERMET.

As well as having a unique surface roughness length for each wind sector, the value can vary depending on the season. The surface roughness length over a late summer crop area would be higher than that over a late winter crop area when that area is covered with snow. Table F-2 lists typical surface roughness lengths for a range of land-use types based on season. The values listed for some of the land types in Table F-2 are different from what is typically recommended in other guidelines or by the U.S. EPA (AEP, 2020, B.C. Ministry of the Environment, 2015 and U.S. EPA, 2020). For example, the surface roughness for evergreen forest in Table F-2 is 0.5 m whereas the standard value used elsewhere is 1.5 m. The values in Table F-2 were generated by WRF. The same physics that was used for calculating the surface roughness was used to calculate other parameters for AERSCREEN. It was believed that changing the surface roughness value would interfere with other parameters. A sensitivity test was done for a few sites in the forest region of northern Saskatchewan and compared to the ERA5 maximum mixing heights. Figure F-3 shows that even using values twice as high as what WRF calculated (i.e. maximum of 1.0m, lower than the default 1.3m), the daytime average maximum mixing heights were much higher and at some locations the mixing heights during the winter were as high as those during the summer. This seems to indicate that the mechanical mixing height at a higher surface roughness is more dominant than the convective mixing heights, even during the summer. This led to the decision to keep the values calculated by WRF for the surface roughness.

For AERMOD the meteorology is applied over a uniform grid covering the modelling domain. In CALMET, the meteorology will vary throughout the modelling domain based on the terrain and the type of land use. In each CALMET grid defined in the modelling domain, CALMET generates a set of meteorological conditions. Therefore, surface roughness lengths must be calculated for each of these grids. Like AERMOD, each land use type is given a value based on the information in Table F.2. A logarithmic weighting is computed for each grid based on the portion of land use type in each grid (Scire, et. al., 2000).

Table F-2: Seasonal Values of Surface Roughness (m)

	Wint	WinS	Sprg	Sum	Aut
Open Water	0.001	0.001	0.001	0.001	0.001
Perennial Ice/Snow	0.002	0.002	0.002	0.002	0.002
Developed, Open Space *	0.02	0.01	0.03	0.04	0.03
Developed, Low Intensity *	0.07	0.05	0.09	0.10	0.09
Developed, Medium Intensity *	0.30	0.20	0.30	0.30	0.30
Developed, High Intensity *	0.70	0.70	0.70	0.70	0.70
Barren Land (Rock/Sand/Clay)	0.05	0.01	0.05	0.05	0.05
Deciduous Forest	0.35	0.30	0.50	0.50	0.50
Evergreen Forest	0.50	0.50	0.50	0.50	0.50
Mixed Forest	0.45	0.40	0.50	0.50	0.50
Dwarf Scrub (Arid Region)	0.05	NA	0.05	0.05	0.05
Dwarf Scrub (non-arid Region)	0.10	0.05	0.10	0.10	0.10
Shrub/Scrub (Arid Region)	0.15	NA	0.15	0.15	0.15
Shrub/Scrub (Non-arid Region)	0.25	0.15	0.25	0.25	0.25
Grasslands/Herbaceous	0.04	0.02	0.09	0.12	0.08
Pasture/Hay	0.03	0.01	0.06	0.13	0.08
Cultivated Crops	0.04	0.01	0.07	0.14	0.09
Woody/Forest Wetlands	0.30	0.20	0.40	0.40	0.40
Shrub Wetland	0.20	0.10	0.20	0.20	0.20

* If near an airport - reduce the surface roughness length by ~50 per cent but within the range of 0.01 to 0.08 m

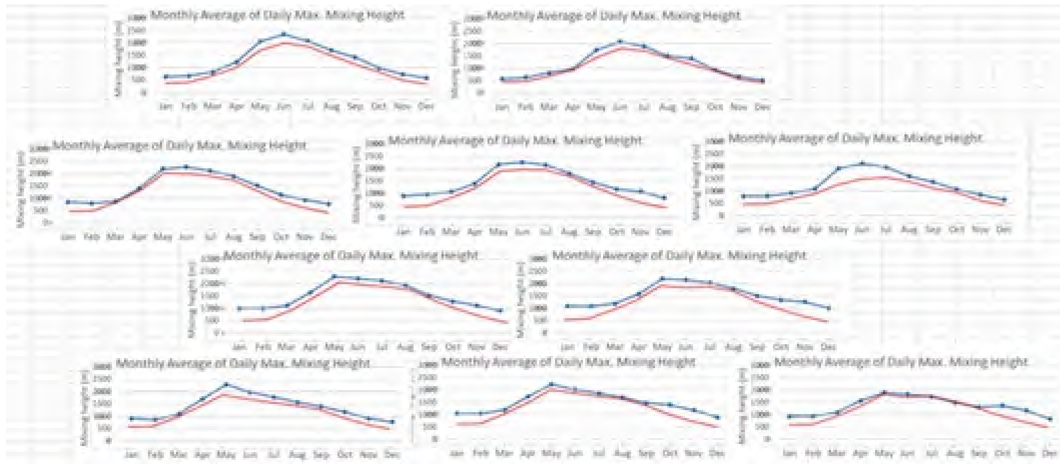


Figure F-2: Comparison of the Monthly Average of Daily Maximum Mixing Heights at sites in northern Saskatchewan using the ERA5 data and using the maximum surface roughness calculated using WRF.

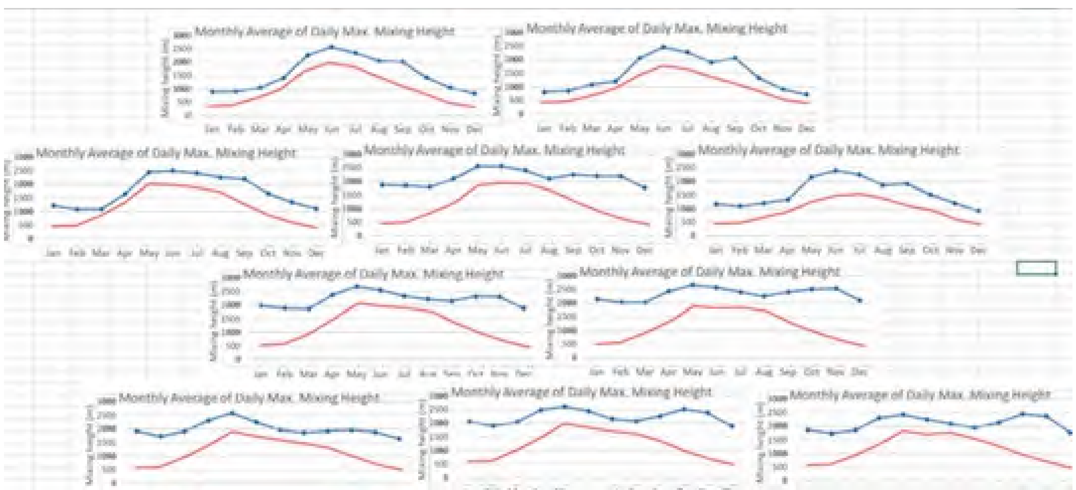


Figure F-3: Comparison of the Monthly Average of Daily Maximum Mixing Heights at sites in northern Saskatchewan using the ERA5 data and using two times the maximum surface roughness calculated using WRF.

F.2 Albedo

The ministry has compiled five years of monthly albedo values covering the province of Saskatchewan available at environment-saskatchewan.hub.arcgis.com/search?tags=air%20quality. The area covered by each value will vary depending on latitude ranging from an 11 km by 6.5 km area in the far south to an 11 km by 4.5 km area in the far north. Since it is recommended in AERMOD that the albedo should be based on a simple unweighted arithmetic mean (i.e. no direction or distance dependency) for a representative domain with a default domain defined by a 10 km by 10 km region centred on the modelling project, this data can then use as a replacement. If the modelling project is located between two or more values, then use a weighted average of those values.

Since the albedo values in CALMET are calculated for each of the grid identified in the modelling domain and those grids are typically about 1 km by 1 km, the user may wish to refer to Table F.3 to determine the albedo at each grid location. Each land use type is given a value based on the information in Table F.3. An arithmetic weighting is computed for each grid based on the portion of land use type in each individual grid (Scire, et. al., 2000).

Table F-3: Seasonal Values of Albedo

	Wint	WinS	Sprg	Sum	Aut
Open Water	0.10	0.10	0.10	0.10	0.10
Perennial Ice/Snow	0.70	0.70	0.60	0.60	0.60
Developed, Open Space	0.18	0.6	0.15	0.15	0.15
Developed, Low Intensity	0.18	0.45	0.16	0.16	0.16
Developed, Medium Intensity	0.18	0.18	0.18	0.18	0.18
Developed, High Intensity	0.18	0.25	0.18	0.18	0.18
Barren Land (Rock/Sand/Clay)	0.20	0.60	0.20	0.20	0.20
Unconsolidated Shore	0.14	0.30	0.14	0.14	0.14
Deciduous Forest	0.24	0.55	0.15	0.15	0.15
Evergreen Forest	0.18	0.40	0.11	0.11	0.11
Mixed Forest	0.21	0.48	0.13	0.13	0.13
Dwarf Scrub (Arid Region)	0.25	0.50	0.25	0.25	0.25
Shrub/Scrub (Arid Region)	0.25	0.50	0.25	0.25	0.25
Grasslands/Herbaceous	0.16	0.70	0.16	0.15	0.16
Pasture/Hay	0.17	0.77	0.14	0.16	0.18
Cultivated Crops	0.17	0.77	0.14	0.16	0.18
Woody Wetlands	0.14	0.30	0.14	0.14	0.14

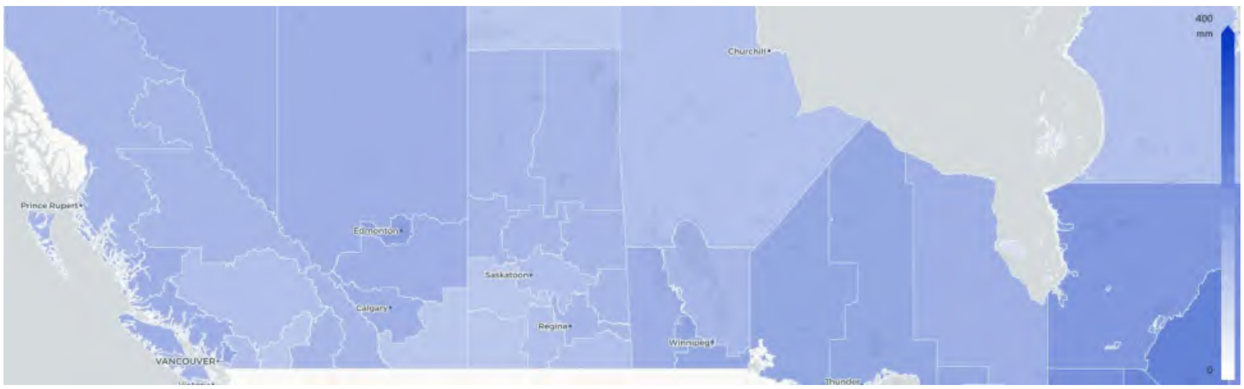
F.3 Bowen Ratio

The determination of a daytime Bowen ratio for AERMOD should be based on a simple unweighted geometric mean (i.e., no direction or distance dependency) for a representative domain, with a default domain defined by a 10 km by 10 km region centred on the measurement site. Each land use type in that domain is given a value based on the information provided in Table F.4. The user should provide the rationale for the selected Bowen ratios if the ministry's recommended Bowen ratios are not used.

The Bowen ratio values listed in Table F.4 are typically higher than those recommended in AERSURFACE or other modelling guidelines. The wet period would be considered a period when the amount of precipitation is in the upper 30th percentile expected for that period and a dry period would be considered a period when the amount of precipitation is in the lower 30th percentile for that period. All Bowen ratio values used in modelling in Saskatchewan should be based on those in Table F.4.

Spring

Summer



Fall

Winter

Figure F-4: Normal (1991 – 2020) rainfall expected for each health region across Canada

In CALMET the Bowen ratio must be calculated for each of the grids identified in the modelling domain. Like AERMOD, each land use type is given a value based on the information in Table F.4. An arithmetic weighting is computed for each grid based on the portion of land use type in each grid (Scire, et. al., 2000).

Table F-4: Seasonal Values of Bowen Ratio

	Average					Wet					Dry				
	Wint	WinS	Sprg	Sum	Aut	Wint	WinS	Sprg	Sum	Aut	Wint	WinS	Sprg	Sum	Aut
Open Water	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Perennial Ice/Snow	1.5	1.5	1.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Developed, Open Space	1.4	1.5	1.5	0.8	1.5	1.0	1.0	0.7	0.6	1.0	3.5	2.0	2.5	1.5	2.5
Developed, Low Intensity	1.7	1.5	1.8	0.6	1.6	1.1	1.0	0.9	0.3	1.0	3.5	2.0	3.0	1.1	2.7
Developed, Medium Intensity	1.8	1.5	2.2	0.7	2.0	1.2	1.0	1.1	0.4	1.2	4.0	2.0	3.5	1.3	3.0
Developed, High Intensity	2.2	1.5	2.5	1.1	2.4	1.4	1.0	1.4	0.6	1.4	4.5	2.0	4.5	1.5	4.0
Barren Land	2.2	1.5	2.7	1.7	2.3	1.6	1.0	1.5	1.3	1.5	4.0	2.0	4.0	3.0	3.5
Unconsolidated Shore	0.3	1.0	0.2	0.2	0.2	0.1	0.7	0.1	0.1	0.1	0.4	1.2	0.3	0.3	0.3
Deciduous Forest	1.5	2.0	1.43	0.4	1.2	0.6	1.0	0.6	0.3	0.6	2.5	2.0	1.7	0.7	2.2
Evergreen Forest	1.3	1.8	1.2	0.4	0.9	0.4	1.1	0.6	0.3	0.5	2.2	1.8	1.9	0.7	1.6
Mixed Forest	1.4	1.9	1.3	0.4	1.0	0.5	1.0	0.6	0.3	0.5	2.3	1.9	1.8	0.7	1.9
Shrub/Scrub (Non-arid Region)	2.0	1.4	1.7	1.3	1.5	1.3	1.0	1.5	1.1	1.2	4.0	1.5	3.0	3.0	4.0
Grasslands/Herbaceous	2.2	2.0	2.0	1.0	2.2	0.9	0.8	1.1	0.7	1.4	3.2	2.5	3.0	1.7	3.2
Sedge/Herbaceous	2.2	2.0	2.0	1.0	2.2	0.9	0.8	1.1	0.7	1.4	3.2	2.5	3.0	1.7	3.2
Pasture/Hay	1.4	2.0	1.5	0.5	1.6	1.0	1.2	0.7	0.3	0.9	3.5	3.0	2.5	0.9	2.5
Cultivated Crops	1.4	2.0	1.5	0.5	1.5	1.0	1.2	0.7	0.3	0.9	3.5	3.0	2.5	0.9	2.5
Woody Wetlands	0.3	1.0	0.2	0.2	0.2	0.1	0.6	0.1	0.1	0.1	0.4	1.2	0.3	0.3	0.3

The Bowen ratio in Table F-4 was determined based on guidance using observational data from studies in Saskatchewan and Alberta. These observations were based on hourly daytime values, where the definition of daytime was the period ranging from approximately three hours after sunrise to approximately three hours before sunset. Hourly values near sunrise and sunset can at times be negative resulting in very low Bowen values average for a particular month. Figure F-5 shows the diurnal pattern of the Bowen ratio values, calculated using measured sensible and latent heat flux values, for a short period from November 2018 to December 2019 at two sites near Calgary (crop and grassland) from sunrise to sunset. Values start increasing just after sunrise and peak just after noon and then steadily decrease until sunrise.

Table F-5 shows calculated monthly average Bowen ratios because on measured sensible and latent heat flux values at several sites in Saskatchewan from January 2012 to December 2016. All sites were located north of Prince Albert except for the agricultural site which was located southeast of Saskatoon. This table shows that monthly averages can be as high as nine during late winter.

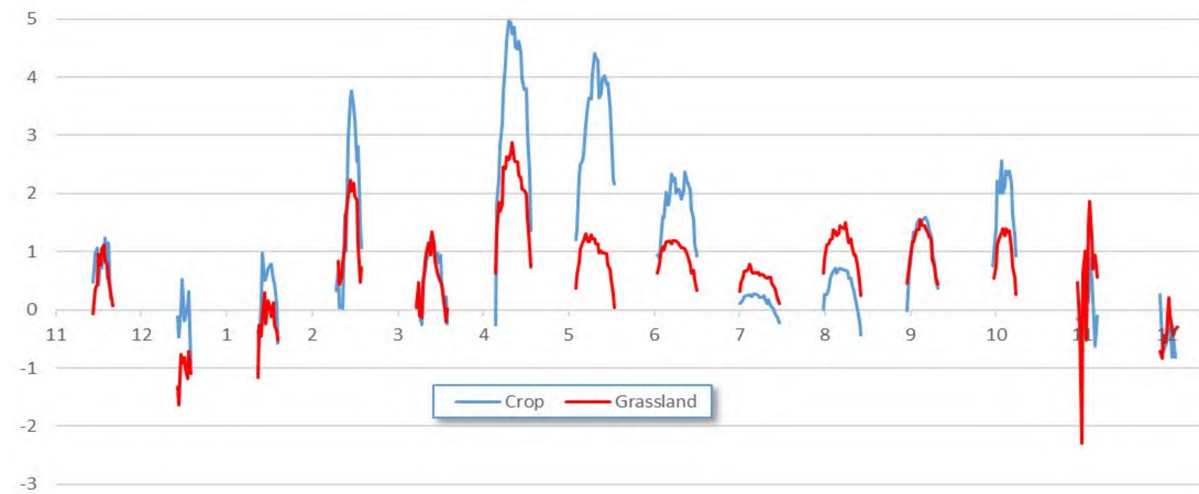


Figure F-5: Daytime Trend in Bowen Ratio at two sites near Calgary, Alberta from November 2018 to December 2019

Table F-5: Seasonal Values of Bowen Ratio

	BlackSpruce	Jackpine	Aspen	Fen	Agricultural
Jan	4.37	6.71	7.27	-0.43	2.78
Feb	7.36	9.37	9.16	0.35	2.46
Mar	8.11	9.30	7.87	0.73	1.73
Apr	6.06	6.66	5.67	0.75	2.12
May	2.87	3.85	3.11	0.68	2.09
Jun	1.52	1.83	0.87	0.61	0.85
Jul	1.10	1.37	0.43	0.46	0.44
Aug	1.04	1.55	0.41	0.56	0.57
Sep	1.36	1.82	0.83	1.12	1.68
Oct	1.80	2.14	2.85	1.75	2.15
Nov	2.57	3.73	4.31	1.54	1.69
Dec	5.34	6.56	5.61	3.38	2.41

F.4 Surface Heat Flux

The surface heat flux is only required for CALPUFF modelling. In CALMET the soil heat flux must be calculated for each of the grids identified in the modelling domain. Like the Bowen ratio approach, each land use type is given a value based on the information in Table F.5. An arithmetic weighting is computed for each grid based on the portion of land use type in each grid (Scire, et. al., 2000).

Table F-6: Seasonal Values of Soil Heat Flux

	Wint	WinS	Sprg	Sum	Aut
Urban	0.25	0.15	0.25	0.25	0.25
Agricultural	0.15	0.15	0.15	0.15	0.15
Rangeland	0.15	0.15	0.15	0.15	0.15
Shrub	0.15	0.15	0.15	0.15	0.15
Forest	0.15	0.15	0.15	0.15	0.15
Small Water Body	1.00	0.15	1.00	1.00	1.00
Large Water Body	1.00	0.15	1.00	1.00	1.00
Wetlands	0.30	0.30	0.30	0.30	0.30
Barren Land	0.15	0.15	0.15	0.15	0.15
Perennial Snow or Ice	0.15	0.15	0.15	0.15	0.15

F.5 Leaf Area Index

The leaf area index is only required for CALPUFF modelling when the deposition is a concern. In CALMET the leaf area index must be calculated for each of grids identified in the modelling domain. Like the Bowen ratio approach, each land use type is given a value based on the information in Table F.6. An arithmetic weighting is computed for each grid based on the portion of land use type in each grid (Scire, et. al., 2000).

Table F-7: Seasonal Values of Leaf Area Index

	Wint	WinS	Sprg	Sum	Aut
Urban	0.1	0	0.2	0.3	0.2
Agricultural	1	0	1	2	1.5
Rangeland	1	1	1	1	1
Shrub	0	0	0	0	0
Deciduous	0.1	0	0.8	3.4	1.9
Coniferous	5	5	5	5	5
Mixed	2.3	2.3	3.3	4.5	3.5
Water Body	0	0	0	0	0
Wetlands	0.1	0	0.1	0.2	0.2
Barren Land	0.1	0.5	0	0	0
Perennial Snow or Ice	0	0	0	0	0

APPENDIX G

G. Development of Saskatchewan Regional Meteorological Data Sets

In Saskatchewan, the recommended air dispersion model to be used for most air quality assessments is AERMOD. To expedite modelling and to provide consistency, the Ministry of Environment in Saskatchewan prepared a series of fully processed AERMOD-ready meteorological data sets for the period of January 2012 to December 2016. The latest version of the Weather Research and Forecast (WRF) model was configured to produce representative meteorological output over the province of Saskatchewan. WRF is a prognostic mesoscale meteorological model that contains separate modules to compute different processes, such as surface energy budgets and soil interactions, turbulence, cloud microphysics and atmospheric radiation. The final WRF output was processed through the U.S. EPA's Mesoscale Model Interface Program (MMIF) to convert the meteorological fields into input formats that can be read directly by the AERMOD and CALPUFF dispersion models (Ramboll Environ, 2018).

OVERVIEW

Even though MMIF can write AERMOD input files (.sfc/.pfl) directly for use with AERMOD, current U.S. EPA Guidance requires that AERMET be run. Studies have shown that AERMOD performs better when AERMET is used for most situations. To have a better understanding of the strength and weaknesses of this data, sensitivity analyses were done on both data sets. The findings concluded to use only the AERMOD files generated using AERMET. Using only one set of data helps reduce the workload and makes it more manageable in maintaining the files. As well as applying consistency to the approach in running AERMOD in Saskatchewan.

The AERMOD-ready meteorological data sets were generated using a 12 km spaced grid data, resulting in an increase of five to over 3800 available AERMOD-ready meteorological data sets in Saskatchewan (Figure G-1). Considering the lack of complex terrain over most of Saskatchewan there should be little change in the wind pattern of most adjacent sites as shown in Figure G-2 for the Estevan area, which has more complex terrain based on the river valley. Having meteorological data every 12 km for most of Saskatchewan is not necessary for most regions, so the number of stations was reduced to a more manageable size with a resolution of about 100 km.

As a first step to setting up this new database, a select number of files were available for download. The number of files was kept to a manageable size to work with in case there are problems with the meteorological input files or if the files need to be adjusted using more recently available data. Twenty sets of data were used across the province at about 100 km separation (Figure G-3). These files were chosen so that nearby terrain would not have major influences on airflow and the radius of coverage for each site would cover most of the province without having an overlap of adjacent sites. Any sites located over or near water were replaced with an adjacent site if that site was not also affected by water or other obstructions. AERMET files over water are not representative of the airflow over a location intended to be modelled.

Each location has five files zipped for free download. The zipped files include the .sfc and .pfl files used in AERMOD as well as a .kml, .png and .dat files. The .png file shows the wind rose, stability distribution, monthly total precipitation amount, monthly average daily maximum mixing heights, sensible heat flux, monthly average wind speed, temperature, and cloud cover calculated at the site. The .dat file identifies the monthly average surface roughness, Bowen ratio and albedo files which were used to generate the AERMOD-ready input files. Depending on the exact location to be modelled, there may be times when the albedo, surface roughness or Bowen ratio are not representative of the modelled area (i.e. urban vs rural or half the modelled domain is forest, and the other half is agricultural). If the modeller believes that more representative values should be used for the modelling location, they can contact the ministry and request all the input files used to generate the .sfc and .pfl files, and reproduce these .sfc and .pfl files for their modelling domain.

Figure G-1: AERMOD-ready meteorological files available in Saskatchewan

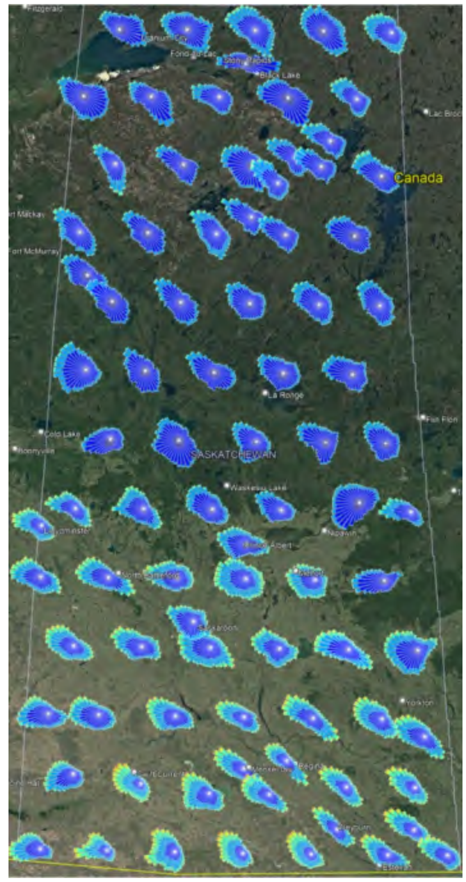


Figure G-2: AERMOD generated wind roses (2012-2016)

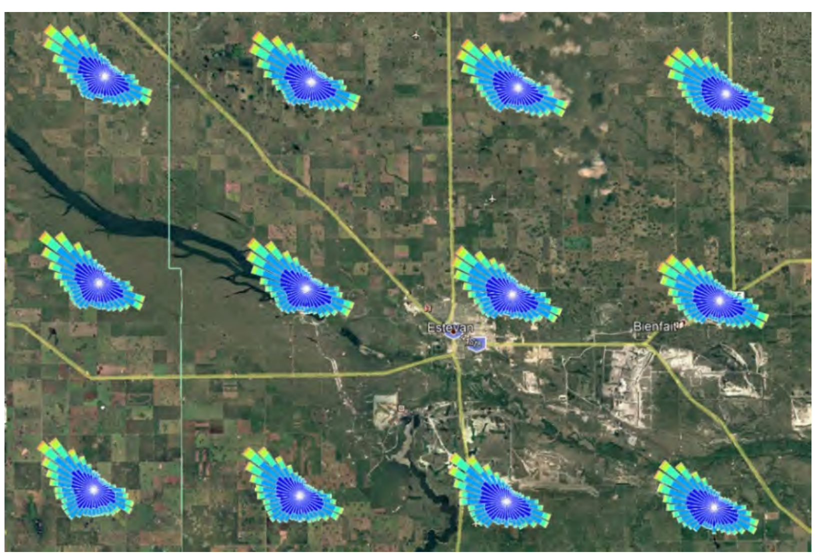


Figure G-3: AERMOD generated wind roses (2012-2016) at 12 km resolution near Estevan, Saskatchewan

There are two options to download data on the geohub.saskatchewan.ca web page. One option is to click on the “View Table” tab located in the top right of the map. The tab will display a list of all available sites to download. Click on the link next to the latitude and longitude that best represents the area to be modelled. The other option is the click on one of the dots displayed on the map. This will result in a small popup window providing additional information for that location. Click on the link labelled “Download File” to download the zipped file containing the relevant files.

Presently, there are 72 sites located approximately 100 km apart. The number of available sites will be increased depending on the complexity of the terrain, population (i.e. major urban locations) and the amount of industry activity (e.g. oil and gas activities in southeastern Saskatchewan).

The AERMOD-ready files were produced for the ministry by a third party. Several alterations were made to the files after they were received. These alterations included:

- The AERMOD-ready files were produced using the U.S. EPA regulatory default options. Before placing these files on the ministry’s website, each file was reproduced using the latest version of the MMIF program, which enabled a beta option. This beta option allows for more deviation in the plume during light wind speeds and helps in the over-prediction in concentrations during these conditions.
- All light wind speeds (i.e. < 0.5 m/s), originally set to 0 m/s were changed to 0.5 m/s. Having wind speeds set to 0 m/s resulted in hours being ignored in modelling. The number of hours ignored in a year can range from 50 hours to 200 hours depending on the location and year. In most cases, the highest concentrations can occur under light wind conditions. By ignoring the hours with light winds, the model may miss some of the highest hourly concentrations and the 24-hour or annual averages will be lower than expected.
- Since the albedo of a surface can change hourly depending on the solar angle as well as the wavelength, the monthly albedo values used represent the noontime albedo in the visible spectrum. Monthly average albedo was calculated based on the amount of snow on ground predicted in the WRF files values but using data from the NASA Earth Observations website at neo.gsfc.nasa.gov/ was thought to provide more accurate results. It will also provide consistency, since monthly average albedo data for the province of Saskatchewan were taken from this web page and placed on the ministry’s website at geohub.saskatchewan.ca/ to be used if the modeller believes that the existing land use data is not representative of the proposed modelling domain.
- The parameters in the .sfc file affected by changing the albedo value are only affected during the daytime when stability conditions become unstable (i.e. Monin-Obukhov Length < 0). Increasing the albedo would typically result in lower concentrations from stack source emission when considering averages longer than one hour, however, at times the maximum hourly concentrations may be higher depending on the stack parameters (Grosch and Lee, 1999). Albedo has little to no effect on maximum concentrations from sources emitted near the surface. This is due to the maximum impacts from low-level sources tend to occur at night whereas albedo only affects daytime parameters.
- The monthly average surface roughness values were calculated using the values provided in the MMMIF-generated AERMOD files, which were extracted from the WRF files. The maximum monthly average surface roughness recorded over forest areas was 0.5 m, which is much lower than the 1.3 m typically recommended for evergreen forests (U.S. EPA, 2020). Surface roughness values play a major role in the maximum predicted concentrations (Igri et al., 2011 and Meyers-Cook et al., 2010). Increasing the surface roughness usually results in higher daily and annual concentrations from stack sources, but lower concentrations from area or low-level sources (Grosch and Lee, 1999). Using the recommended value of 1.3 m as the maximum surface roughness resulted in unusual patterns in the

mixing heights, in which the maximum daytime mixing height during the winter was typically higher than those during the summer for areas in northern Saskatchewan. Therefore, the ministry recommends future modelling for forest areas to use a maximum default value of 0.5 m to be consistent with the meteorological data set available on the ministry's website.

- Bowen ratios were recalculated and readjusted, and some points with unexplained high values were removed from the database. The latest version of the MMIF program has the Bowen ratios calculated based on the daytime average rather than the daily average. However, daytime was defined as sunrise to sunset, and hourly Bowen ratios near sunrise and sunset can result in very high or low values for several hours as the latent heat flux approaches zero at those times (transitions from a negative to positive). Therefore, the Bowen ratios were recalculated to include the daytime period starting a few hours after sunrise and ending a few hours before sunset. Unfortunately, this results in using only three hours of values per day for northern sites during the winter. Another problem with the latest MMIF program is that all Bowen ratio values less than zero were converted to -1 rather than having all values <-1 converted to -1. However, this is expected to have only a minor effect on the daytime averages but may result in lower values for months when the average Bowen ratio is less than 0.5.
- Another problem with the Bowen ratio is the unexplained high values at selected grid locations. Figure G-4 shows the monthly average Bowen ratio at grid points across Saskatchewan near 51.3-degree latitude. There were several locations to the west in which the values for the Bowen ratio would increase considerably even though there was no indication of sudden changes in the vegetation. The receptor points with elevated values would have higher than average values for each month and all five years. These elevated levels occur at several latitudes but not at the same longitude and the problem appears to occur only in the southwest section of the province. The decrease in values around 105.3 degrees longitude in this figure occurred because that receptor point was located over a body of water where the dominant heat flux is the latent heat flux.

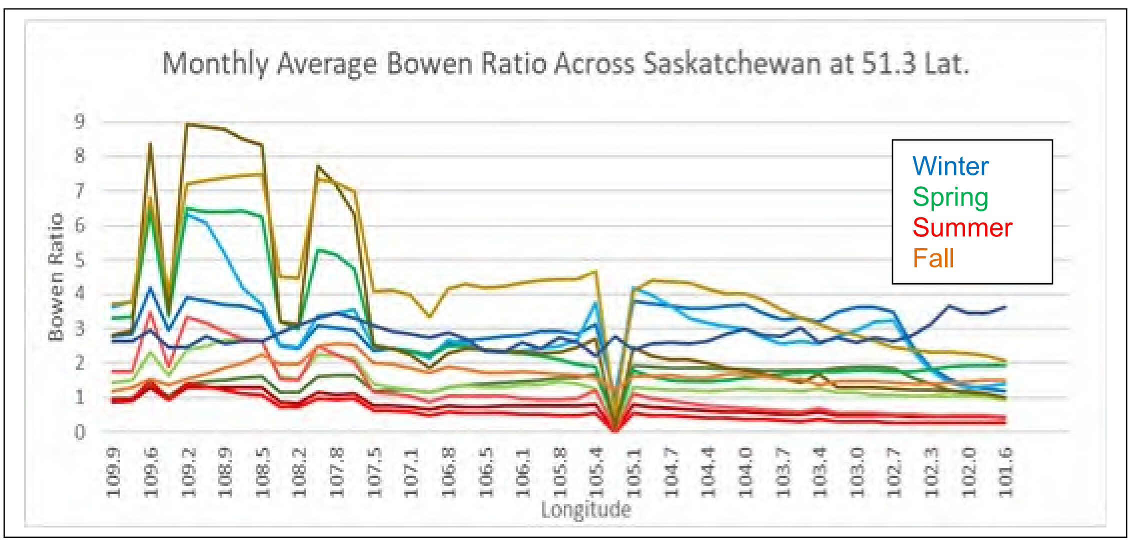


Figure G-4: Monthly Average Bowen Ratio Calculated for Receptors Across Saskatchewan at 51.3 Lat.

- Literature review as well as an examination of observational data was conducted to determine if the calculated Bowen ratio values were similar to what has been calculated based on ambient conditions (Lin et al., 2016) or observed over the Prairies. Over an agricultural area, the summer values for Bowen ratio can vary depending on the crop. Over southwestern Saskatchewan, the Bowen ratio over grasslands would range from 0.7 to 1.1 from May to October, whereas over a wheat field, the Bowen ratio would be about 3.5 in May and drop to below 0.5 in June and July before increasing to 2.0 by mid-September (Raddatz, 1998). Another study showed areas located in the extreme southwest can have Bowen ratios as high as 2 in late May but increases to 3.5 by September, and near Saskatoon, levels can be about 1 in June and increase to 2 by September whereas agricultural regions just south of the Boreal Forest can have Bowen ratios around 0.4 in June and increasing to about 1 in September (Shrestha et al., 2012). The Bowen ratio over the Boreal Forest is also dependent on the type of vegetation. Near Prince Albert the vegetation can be mainly aspen whereas near Nipawin the forest could consist mainly of jack pine. At midday, during the summer, the aspen may have a lot of latent heat resulting in a Bowen ratio being as low as 0.13, whereas for jack pine the sensible heat tends to be to dominant heat flux and the Bowen ratio may be as high as 1.45 (Bonan, 2016). However, in other areas in the Boreal Forest over Prince Albert the Bowen ratio can range from about 0.75 in May and June to 0.85- 0.92 in July and August (Granger and Bussieres, 2005).

- The cloud cover fraction was calculated using a method which looks at the relative humidity at selected levels in the atmosphere (Angevine et al., 2012). AERMOD-ready files prepared using MIFF or AERMET did not provide representative cloud cover values when compared to surface data from airport observation sites. Since cloud cover plays an important role in the stability and hence the plume behaviour it is important to have the cloud cover represent the area as accurately as possible. The files were recompiled to read the hourly ERA5 cloud cover from the website cds.climate.copernicus.eu/cdsapp#!/search?type=dataset, which appears to be more representative of cloud cover conditions.
- The mixing heights were read from the MIFF-generated mixing heights. This resulted in over 4000 hours in five years being recorded with a mixing height between 8-10 m and the next lowest mixing height was 24 m. These low mixing heights occurred even when the wind speed was recorded up to 4 m/s. AERMET can calculate both the convective and mechanical mixing heights on its own. After the ministry received the data, the U.S. EPA shifted toward this as the best-performing option (Brashers, March 28, 2019). Using this approach and the beta option for adjustment for frictional velocity resulted in less than 200 hours with mixing heights <24 m, and less than 10 hours with mixing heights <10 m.
- For most locations in Saskatchewan, the monthly average maximum daytime mixing heights were typically less than 2200 m with, either similar mixing height throughout the summer or the highest mixing heights occurring during May and gradually decreasing throughout the summer. This height is similar to, or slightly higher than, those shown in other studies in the Prairies. More recent studies showed a similar pattern with the highest boundary layer heights for the Midwest US being slightly higher in May (1250 m) than in June (Lee and Pal, 2017). Other studies showed the Convective Boundary height to be higher ranging from 1300 m to 1900 m (Wang and Wang, 2014) or even higher, ranging from 1700 m to 2800 m (Lee and Pal, 2017 and McGrath-Spangler and Denning, 2012) depending on location.
- The Monin-Obukhov Length is used to determine the stability of the atmosphere which is used for plume behavior. The Monin-Obukhov Length originally had several minor issues. In some files, there were times in which the Monin-Obukhov Length was perfectly neutral (i.e., 8888) for 18 consecutive hours during the nighttime even when winds were less than 2 m/s. During summer, just after sunrise, the Monin-Obukhov Length would jump to 8888 at the same time the cloud cover jumped to 10-tenths. This was a bug in the program as the stability was changing from stable conditions at night to unstable conditions in the morning. No issues with the Monin-Obukhov Length were noticeable after alterations were made to the files and the updated MMIF program was used.

SUMMARY

As expected, when comparing adjacent sites most of the output parameters in the AERMOD-ready meteorological input files are consistent with little bias. There are three areas of concern when comparing adjacent sites: the cloud cover, the Bowen ratio, and the Monin-Obukhov Length. The effect those parameters have on the dispersion modelling output will depend on many factors such as the emissions parameters and the meteorological conditions. After testing two adjacent stations it was believed that the option to run AERMET to produce the meteorological data set provided better results than those produced by MMIF. To reduce confusion and issues in future modelling and to reduce the workload in preparing these files it was decided to only have one AERMOD set of files available for AERMOD modelling.

After reviewing this set of AERMOD meteorological data, it was decided to improve the accuracy when using these files by making several alterations to the data which included reading existing data like cloud cover and albedo rather than using calculated values. Readjusting the light winds help reduce the number of hours of missing data and recalculated the Bowen ratio for a shorter daytime period than what was used in the revised MMIF program.

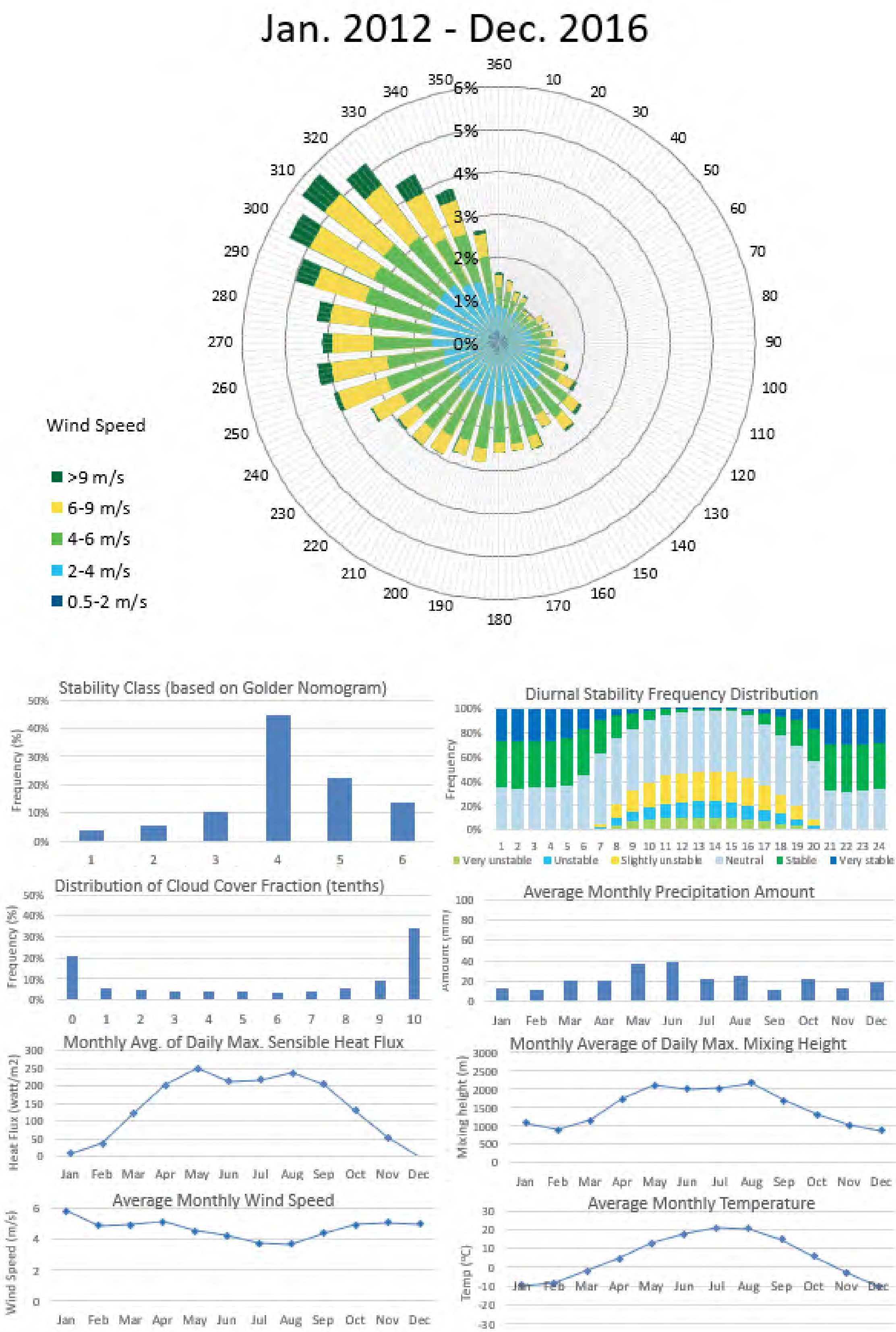


Figure G-5: Sample of the AERMOD .png input file

APPENDIX H
H. Alternate Surface Meteorological Data

If the purpose of the modelling is being undertaken to assess impact at specific receptors or to match modelled and monitored data, the choice of surface meteorological data becomes important. The choices for more representative surface data include:

- Use of on-site data from a meteorological tower; or
- Use of an existing nearby Environment and Climate Change Canada site, or similar monitoring station; or
- Use of numerically generated meteorological data for that specific location.

The following parameters are required by AERMET and CALMET to be collected at a surface meteorological station.

- Wind speed (m/s).
- Wind direction (degrees blowing from).
- Temperature (degrees Celsius).
- Relative humidity (per cent).
- Cloud cover (tens of per cent).
- Atmospheric Pressure (kPa) (only if a wet or dry deposition is modelled).
- Precipitation amount (mm) and type (only if a wet deposition is modelled).

Airport stations generally collect all these parameters, although smaller airports may collect some data during daylight hours only or collect certain parameters once every three hours. Typically, on-site stations collect only temperature, wind speed, wind direction, relative humidity and pressure. Data like cloud cover and precipitation are only available at selected stations. When using on-site data, it may be necessary to blend the meteorological data from the nearest airport for the exact time periods. If there are no representative data available for cloud cover, an equivalent cloud cover can be calculated by AERMET using the Bulk Richardson Number approach provided. Temperature measurements are available at two levels. Additional near-surface data such as net radiation, insolation and temperature difference may be included if available.

AERMET can read hourly meteorological data in varied formats. Some of the parameters in these formats have units different from what AERMOD requires (e.g. wind speeds in CD-144 are recorded as knots). A brief description of the formats accepted by AERMET is as follows.

- **CD-144 (National Climatic Data Center (NCDC) Surface Data)**: This file contains one record for each hour of data, with all weather elements reported in an 80-column card image.
- **SCRAM**: This is an older format specifically for use by air dispersion models. It does not include surface pressure and precipitation type and amount, which are required for particle deposition modelling.
- **SAMSON Surface Data**: This file contains all the required meteorological variables for both concentration and deposition modelling.
- **ISHD (Integrated Surface Hourly Data)**: This file is in the TD-3505 format and is available for download from the US National Oceanic and Atmospheric Administration (NOAA) website. This data is reported in Greenwich Mean Time (GMT) and contains many data sets which are not used by AERMET.

Table H-1 compares the format of the SCRAM data file with that of the CD-144 data file. Some Fortran programs require certain data to be in specific locations in each line when reading a data file. These specific locations, or character spaces in the line, are referred to as columns (i.e. Column 14-16 means the data is in the 14th, 15th, and 16th character space in that line)

Table H-1: Comparison between the CD-144 format and the SCRAM format

	Column	
Element	SCRAM	CD-144
Surface Station Number	1-5	1-5
Year	6-7	6-7
Month	8-9	8-9
Day	10-11	10-11
Hour	12-13	12-13
Ceiling Height (hundreds of feet)	14-16	14-16
Wind Direction (tens of degrees)	17-18	39-40
Wind Speed (knots)	19-21	40-42
Dry Bulb Temperature (°F)	22-24	47-49
Total Cloud Cover (tens of per cent)	25-26	-
Opaque Cloud Cover (tens of per cent)	27-28	79

All stations to be used as a source of meteorological data for air dispersion modelling should be representative and have similar geophysical conditions, have minimal missing data, have been Quality Assurance and Quality Controlled (QA/QC'd) for accuracy including calibration, and have been correctly sited (away from buildings and trees that mask certain wind directions). The purpose of the alternate meteorological site must meet the needs for dispersion modelling (U.S. EPA 2000) and the type of instruments are suitable (e.g. low wind speed thresholds and wind direction sensitivity). It is recommended that the exact site location in relation to any structures that may influence the data, as well as all QA/QC procedures, be included in all air quality assessments. A high percentage of missing data or calm winds which don't define a wind direction will result in the meteorological data being unreliable for modelling.

The height of all anemometers should be confirmed before any modelling. The standard height of the anemometer at a meteorological station is 10 m, however, 7 m towers are common. In urban areas, quite often the meteorological tower is located on top of a building, which may be as high as 25 m. In many cases, this height is not identified in the metadata when accessing this meteorological data. This height must be corrected in the input file of the air dispersion model since most models use a default height of 10 m for the meteorological tower.

Sites may record wind speed as scalar, vector or both. Occasionally the method of archiving the wind speed was not recorded. If possible, scalar wind speeds should be used in all dispersion modelling. The scalar wind direction should never be used. A sign of scalar wind direction being used is the lack of wind direction from the northwest to the northeast sector.

The anemometer height for most meteorological stations owned and operated by Environment and Climate Change Canada is 10 m without any surrounding obstacles. Even though this data has commonly been used for dispersion modelling, it is not the preferred data to use because this data is mainly designed to generate long-term climate statistics and for NAV Canada. It is used for aviation safety. When using this data there are a few items worth noting.

- Most stations are located at airports surrounded by an open field.
- Wind information is not based on hourly averages. Wind data is mainly based on a two-minute average recorded a few minutes before each hour. This will increase the uncertainty in the hourly values.
- Wind directions are recorded to the nearest 10 degrees. Therefore, for AERMOD the option to randomize the wind speed in a 10-degree sector (RANDON) should be enabled.
- Wind speeds are recorded as knots and archived as an integer resulting in wind speeds, when converted to m/s, to be in intervals of about 0.5 m/s.
- The anemometer starting threshold may be as high as 2 knots (about 1 m/s), so all wind speeds less than 2 knots are archived as 0 m/s.
- Wind direction is assigned a zero when the wind speed is zero. Depending on the dispersion model being used, this may result in a problem. All wind directions should be reported as missing or changed to a representative wind direction based on the adjacent hours whenever wind speeds are recorded as zero. For CALMET, a zero-wind direction is interpreted as a northerly flow which may result in CALMET nudging the wind direction over that area to be more northerly even when wind speeds are 0 m/s.

A full assessment of all meteorological parameters and a comparison to the nearby ministry-approved meteorological AERMOD-ready file should be made. The comparison should include a full assessment, including scattered plots, frequencies analysis and wind roses. A description of any QA/QC should be provided, including a description of any obstruction that may affect the monitoring data.

APPENDIX H-2
H-2. Meteorological Data for CALMET

CALMET merges all available meteorological files, including a surface data file (SURF.DAT), upper air file (UP.DAT), precipitation file (PRECIP.DAT) and the NWP file (PROG.DAT) into one binary file. Quality assurance checks can be done either manually or by using a utility called METSCAN (for CD-144 formatted data) or other equivalent methods.

A pre-processing utility called SMERGE is used to combine all individual surface files into a singular SURF.DAT file to be used by CALMET. The SMERGE pre-processor can read data in a variety of U.S. data formats (including CD-144), as well as a comma delimited (.csv) format. This latter format is most convenient for on-site meteorology since that data are normally stored in a text file (.txt) or spreadsheet. A spreadsheet can easily be manipulated to SMERGE requirements (described as follows) and then saved in the .csv format.

1. Each parameter should be placed into a specific column in an Excel file as follows, with the proper units as listed.
   - Column 1 – month (mm, e.g. 1, 2, ..., 12).
   - Column 2 – day (dd, e.g. 1, 2, 3, ..., 31).
   - Column 3 – year (yyyy, e.g. 2010).
   - Column 4 – hour (hhmm, e.g. 0000, 0100, 0200, ..., 2300).
   - Column 5 – temperature (degrees Celsius).
   - Column 6 – precipitation amount (mm).
   - Column 7 – pressure (mb).
   - Column 8 – relative humidity (per cent).
   - Column 9 – wind direction (degrees).
   - Column 10 – wind speed (m/s).
   - Column 11 – cloud cover (tenths).
   - Column 12 – ceiling height (hundreds of feet).
2. A missing value of a real variable must be replaced with 9999.0 and for an integer variable: 9999 except for the station ID, month, day, year, and hour.
3. No blank cells are allowed.
4. Ceiling height and cloud cover are typically not available at most on-site meteorological stations. These parameters can be obtained elsewhere and combined with other parameters from the on-site measurement program if they apply to the site under consideration.
5. Use 888 for unlimited ceiling height (i.e. cloud opacity is less than 6/10ths).
6. Save the Excel file as a text file in a comma-delimited format (.csv file) with no spaces between the commas

The file must contain the following as the first three lines in the file exactly as shown except for the Station ID number. In this example, it is 1432 but could be any integer number.

```
GENERIC, Version,'2.0', Manually generated, Time as ending hour
Station, ID,=',1432,Temp,Precip,Pressure,RH,Wdir10m,Wspeed10m,Ccover,Cheight
Month, Day, Year, Hour, DegC, mm, mb, degrees, deg,ms-1, tenths, hundreds_of_feet
```

For each set of hourly data in the SURF.DAT file created by SMERGE, the first line is the date (i.e. 12 125 15 (year 2012, 125 Julian day, 15th hour in the day)), followed by each line representing meteorological data from each surface station data in the order of wind speed, wind direction, cloud ceiling, cloud cover, temperature, relative humidity and pressure. The ceiling, cloud cover and relative humidity are recorded as integers. All meteorological data must be included for all hours in the SURF.DAT file. CALMET will only run if each hourly data is available for any of the available meteorological stations in the SURF.DAT file.

For wet deposition modelling, CALMET requires hourly precipitation and precipitation code (i.e. frozen vs. liquid precipitation). For hourly precipitation data, the pre-processors, PXEXTRACT are used for quality assurance of precipitation data and PMERGE is used to merge data from multiple stations into a PRECIP.DAT file. The hourly precipitation data must be in U.S. NWS TD-3240 format. Unfortunately, this format is not used in Canada. Therefore, to prepare precipitation data, users can select the free-formatted option by creating the PRECIP.DAT file directly in free format (Exponent, 2011).

NWP models can also generate data which can be used in CALMET. One issue with the NWP model is the limitations of the relatively coarse grid resolution which means some smaller terrain effects may only be partly resolved or completely ignore. Therefore, the coarse scale NWP output should be used as an initial guess field for the finer scale CALMET model.

The MMIF program can act as an alternative to CALMET to process NWP model output directly to a suitable format for CALPUFF. However, the terrain effects that CALMET applies to produce a final wind field will not be used and MMIF can only provide output with the same grid resolution provided with the NWP model. Therefore, it is recommended to use the CALMET program to generate the meteorological data file for CALPUFF.

There are three options in which CALMET can generate a meteorological data file for CALPUFF.

1. **No-Obs (no observations)**: CALMET relies solely on the NWP model output. Recommended only when there are no appropriate surface observations available, or the available surface observational data is unreliable or missing too much data.
2. **Obs-Only (Observations only)**: CALMET relies entirely on available observational data. Several observational sites can be used together, but there should be nearby upper-air data available. Should only be used if the expected area of impact is within a few kilometres from the emitting sources to simulate an incident. For this option, all required meteorological parameters must be available for every hour.
3. **Hybrid**: CALMET uses a combination of available observational data and the NWP model output. Data from a nearby upper air station is optional. The observational data used should be within 20 k of the emitting sources.

The Hybrid approach uses the strength of both NWP and observational data to produce better results and is the preferred option when modelling using CALPUFF. One common problem associated with using the Hybrid option is the doughnut pattern which may occur around a surface observation station during low wind speed conditions. This is due to a difference in the wind speed at the meteorological station being lower than the surrounding area as defined by the NWP model output. The NWP tends to predict wind speeds to be too high whereas the anemometer at the surface station may have high starting thresholds so low winds are reported as zero. The doughnut pattern can be eliminated or minimized by adjusting the R1 and RMAX1 switches in CALMET. An explanation of these switches is provided in the following Appendix I. For cases when there are several observation stations available and during periods when the wind speeds are reported as zero at one station the wind direction at that station should be reported as missing or replaced using procedures outlined in Sections 9.3 and 9.4.

APPENDIX I

I. CALPUFF/CALMET Recommended Model Options

There are numerous user-defined variables and options in CALMET and CALPUFF which require professional judgment. To provide consistency in Saskatchewan modeling the following guidance is provided on switches and options.

For switches or options in the CALMET or CALPUFF input files that are not included in this Appendix, the default values should be used. A justification should be provided for changing any of these switches/options and all changes should be identified in the assessment.

I.1 CALMET Recommended Options

There are several key wind field options and parameters in CALMET that should not be modified in the input file and the default values must be used. These input options and parameters are IWFCOD, IFRADJ, IKINE, IOBR, ISLOPE, and ISTEPPGS.

Option	Parameter	Value	Explanation & Justification
Extrapolate surface wind observations to upper levels	IEXTRP	-4	Use similarity theory. If <0: ignore layer 1 data of upper air stations
Min. distance (km) between upper air stn and surface stn for which extrapolation of surface winds will be allowed.	RMIN2	-1	(-1) when IEXTRP = ±4 to ensure extrapolation of all surface stations (i.e., unlimited distance). Option designed to avoid extrapolated surface data “competing” with upper air measurements when both surface and upper air measurements are co-located. Only considered when upper air data is used.
Use gridded prognostic wind field (NWP) model output as input to the diagnostic field	IPROG	14	Use winds from NWP output as the Initial Guess field.
Use varying radii of influence?.	LVARY	F	(F) the switch is off. The radius of influence is expanded when no stations are within the fixed radius of influence value. Caution: RMAX is effectively enlarged to incorporate the “nearest” station regardless of its suitability.
Min. radius of influence used in the wind field interpolation (km)	RMIN	0.1	Use a small value (0.1 km). Prevents a divide-by-zero error when a grid point and station are co-located.
The relative weighting of the prognostic wind field data.	RPROG	0	Used only if IPROG=1
Type of meteorological data used.	NOOBS	1 or 2	(1) a combination of observations and NWP output, (2) or just NWP output.
Cloud Data Option	MCLOUD	4	Compute the gridded cloud cover from prognostic relative humidity at all levels for the gridded NWP model.
Critical Froude number.	CRITFN	1	If Froude no. < CRITFN, the wind has an uphill component and direction is changed to be tangent to the terrain. If Froude no. > CRITFN, no adjustment is made.

Option	Parameter	Value	Explanation & Justification
The number of barriers to interpolation of the wind fields.	NBAR	0	Usually not used. Use barriers to block out certain station effects. Commonly used in complex terrain.
Level (1 to NZ) up to which barriers apply.	KBAR	varies	Used only if NBAR > 0. User-defined switch to control the vertical extent of barriers from the surface layer to user-defined upper layer limit. Requires careful examination of the resulting wind field at each level.
X and Y coordinates of barriers.	XBBAR YBBAR XEBAR YEBAR	varies	Use only if NBAR > 0 to define the coordinates of the barrier.
Depth (m) through which the domain-scale lapse rate is computed.	ZUPT	200	Units: Meters. Only used if IDIOPT2 = 0.
Upper air station to use for the initial guess winds.	IUPWND	-1	Use 3-D initial guess fields. Used only if IDIOPT3 = 0 and NOOBS = 0.

The following model options should use the default options recommended in the CALMET input file.
INPUT GROUP: 5 -- Wind Field Options and Parameters.
ICALM, IGFMET, LVARY, DIVLIM, NITER, NSMTH, NINTR2, ALPHA, FEXTR2, NBAR, IDIOPT (1,2,3,4 and 5), ISURFT, IUPT, ZUPT, IUPWND, ZUPWND, LLBREZE.

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters.
CONSTB, CONSTE, CONSTN, CONSTW, IAVEZI, MNMDAV, HAFANG, ILEVZI, IMIXH, THRESHL, THRESHW, DPTMIN, DZZI, ZIMIN, ZIMAX, ZIMINW, ZIMAXW, ICOARE, DSHELF, IWARM, ICOOL, TRADKM, NUMTS, IAVET, TGDEFB, TGDEFA, NFLAGP, SIGMAP, CUTP.

When surface observations are used in CALMET, there are several user-defined parameters (BIAS, IEXTRP, RMAX1, RMAX2, R1, R2, and TERRAD) that require professional judgements. Due to their importance in creating a realistic CALMET wind field over the modelling domain, it is recommended that the user have attended the CALPUFF advanced training course or have a strong background in boundary latey meteorology.

The following is an explanation of critical user-defined, site-specific parameters when using observational data in CALMET (Barclay & Scire, 2011). These parameters have no default values (except for BIAS) and require skill and knowledge in boundary layer meteorology.

TERRAD - Terrain radius of influence (km)
The distance CALMET is considered when determining the terrain effects on the airflow. This distance will depend on the width of a valley. If TERRAD is too small, valley walls which contribute to the slope flow will not be considered. If TERRAD is too large, terrain on the lee side or hills may influence the airflow. TERRAD can be estimated as the typical ridge-to-ridge distance divided by two and usually rounded up. Typical values of TERRAD are between 5-15 km and should not exceed the modelling domain (TRC, 2010).

BIAS (NZ) Layer-dependent weighting factor of surface vs. upper air wind observations in defining the Initial Guess Field winds.
Default (NZ * 0) means the inverse distance squared (1/R2) weighting is given equally to the surface and upper air data. A BIAS value is applied to each vertical layer and ranges from -1 to +1. Where -1 means the surface station has 100 per cent weight for that layer, while +1 means the upper air station has 100 per cent weight for that layer. BIAS values are very important in complex terrain situations. In simple terrain situations, BIAS is often set to zero (0) for each vertical layer.

The values used in the BIAS will depend on how narrow and complex a valley may be or the distance the upper-air observation is from the receptor. For steep valleys, it is recommended to set the BIAS to -1 for all levels within the valley forcing surface data only to be used for the lowest layers, and gradually change the BIAS from -1 to near +1 from the top of the valley to the highest layer. BIAS is only used when using observations to develop an initial guess field. Not active when NO-OBS = 1 or 2.

R1 and R2 - Weighting parameter for Step 1 wind field vs. observations in Layer 1 (R1) and Layer 2 and above (R2).
The values used in R1 and R2 represent the distance from a surface observation station and the layer 2 aloft, respectively, at which the surface observation and the Step 1 wind field are weighted equally.
It is important to note that all the results of the diagnostic wind model (kinematics, slope and blocking effects) are contained in the Step 1 wind field, thus if too much weight is given to the observations, then all the information generated in creating the Step 1 winds may not be used. Typically, in flat terrain, values of R1 and R2 are larger than in mountainous terrain where a station's flow is limited by the valley segment, and that value may be as low as 0.1 km.
Only one value is used and that value represents all stations. This parameter is not used in the No-Obs mode.

RMAX - Maximum radius of influence for meteorological stations in layer 1 (RMAX1), layers aloft (RMAX2) and layers over water (RMAX3).
The values of RMAX determine the distance from the observation station where the observed winds are 'blended' in with the Step 1 winds. Any receptors from the observational station greater than RMAX1 in the surface layer or RMAX2 aloft are excluded from the 'blending' formula. RMAX1 and RMAX2 can be used to exclude observations from being inappropriately included (as they are in the next valley, on the other side of a mountain, etc.).
If RMAX1 and RMAX2 are used to exclude observations, then do not set LVARY to T, as CALMET will increase the values of RMAX1 and RMAX2 to at least capture the nearest observation. RMAX3 should be large enough so that all grid points over water are within the radius of influence of at least one observation. R1 and R2 values should always be smaller than RMAX1 and RMAX2, to prevent 'sharp' boundaries between the Step 1 wind field and the weighted observation station. Only one value is used and that value represents all stations. This parameter is not used in the No-Obs mode.

I.2 CALPUFF Recommended Options

Option	Parameter	Value	Explanation & Justification
Map projection	PMAP	UTM	Universal Transverse Mercator
UTM zone (1 to 60)	IUTMZN	11,12, or 13	UTM zones for Saskatchewan
Hemisphere for UTM projection	UTMHEM	N	Northern Hemisphere projection

Option	Parameter	Value	Explanation & Justification
Datum-Region for the coordinates	DATUM	NAR-C	NAD83 – North American 1983 GRS Spheroid
Near-field puffs modelled as elongated slugs	MSLUG	0	(0) No slug model except (1) for area sources with receptors in the very near field or for episodic time-varying emissions such as accidental releases.
Stack-tip downwash	MTIP	0 or 1	(1) Stack-tip downwash modelled, particularly if the ratio of stack gas exit velocity to wind speed is < 1.5. (0) No stack tip downwash for flares if pseudo-stack parameters are calculated using the AERflare/ABflare spreadsheet.
Method used to simulate building downwash	MBDW	1 or 2	(2) PRIME method. (1) ISC method if building aspect ratios of W/H are > 5
Puff splitting allowed	MSPLIT	0	No puff splitting for short-range modelling. In long-range transport, puff splitting may be necessary.
Chemical mechanism flag	MCHEM	0 or 6	(0) if no chemical transformation or (6) transformation calculated using RIVAD/ ISORROPIA scheme.
Aqueous phase transformation flag	MAQCHEM	1	Transformation rates and wet scavenging coefficients adjusted for in-cloud aqueous phase reactions. Used only if MCHEM = 6
Concentrations modelled	ICON	1	Output concentrations
Wet removal modelled	MWET	0 or 1	(0) no, (1) if wet deposition modeling. Important for long-range transport but may be used for near field if appropriate.
Dry deposition modelled	MDRY	0 or 1	(0) no, (1) if dry deposition modelled. Important for long range transport but may be used for near field if appropriate.
Relative Humidity	IVIS	1	Only if visibility analysis is required. Otherwise, 0
Gravitational settling (plume tilt)	MTILT	0 or 1	(0) recommended for small particles. (e.g. combustion size particles less than 10 µm). (1) recommended for very large particles with substantial gravitational settling effects.
Methods used to compute the dispersion coefficients.	MDISP	2	Dispersion coefficients from internally calculated sigma v and w using micrometeorological variables.
Probability Distribution Function used for dispersion under convective conditions	MPDF	0 or 1	(1) only if MDISP = 2 (turbulence-based dispersion coefficients).
Sub-grid TIBL module used for shoreline	MSGTIBL	0 or 1	(0) do not use, however, may be used for applications located along a coastline. If used, a coastline file (COASTLN.DAT) should be prepared to specify the location of the land-water boundary.

Option	Parameter	Value	Explanation & Justification
Configure for FOG Model output?	MFOG	0, 1 or 2	(1) PLUME mode format or (2) RECEPTOR mode format if visible plume assessment is required. Otherwise, 0
Test options specified to see if they conform to regulatory values.	MREG	0	No checks recommended, but still can be done.
Minimum turbulence velocities, sigma v for each stability class over land and water	SVMIN	σv =0.2 for A, B, C, D, E or F	For applications where calm wind and stagnation events are significant, set SVMIN = 0.2 to better represent lateral spread of the plume. Otherwise use default values.
When using RIVAD/ISOROPPIA Option			
Ozone data input option	MOZ	0	use a monthly background ozone value
Monthly ozone concentrations	BCKO3		specify an ozone value for each month (ppb) as provided in Appendix J
Monthly ammonia data input option	MNH3	0	use a monthly background ammonia value for all layers
Ammonia vertical averaging option	MAVGNH3	1	Average NH_3 values over vertical extent of puff.
Monthly ammonia concentrations	BCKNH3		used only if MCHEM = 1 or 3 and MNH3 = 0 specify a NH3 value for each month (ppb) as provided in Appendix J
H_2O_2 data input option	MH2O2	0	read monthly background H_2O_2 value. Used only if MCHEM = 6 or 7 and MAQCHEM = 1
Monthly H_2O_2 concentrations in ppb	BCKH2O2	12*1.0	Used only if MAQCHEM = 1 Specify H_2O_2 value (ppb) for each month.

The following model options should use the default options recommended in the CALPUFF input file.

- **INPUT GROUP: 2 -- Technical options:** MGAUSS, MCTADJ, MCTSG, MTRANS, MRISE, MTIP_FL, MRISE_FL, MLWC, MTURBVW, MSHEAR, MDISP2, MTAULY, MTAUADV, MCTURB, MROUGH, MPARTL, MPARTLBA, MTINV, MBCON, MSOURCE.
- **INPUT GROUP: 6 – Complex Terrain Input**: XHILL2M, ZHILL2M.
- **INPUT GROUP: 9 -- Miscellaneous dry deposition parameters**: RCUTR, RGR, REACTR, NINT, IVEG
- **INPUT GROUP: 11 – Chemistry Parameters:** RNITE1, RH_ISRP, SO2_ISRP, (RNITE2, RNITE3, BCKPMF, OFRAC, VCNX, NDECAY – Not used when using RIVAD/ISOROPPIA Option).
- **INPUT GROUP: 12 – Miscellaneous dispersion and computational parameters**: SYTDEP, MHFTSZ, JSUP, CONK1, CONK2, TBD, IURB1, IURB2, XSAMLEN, MXNEW, MXSAM, NCOUNT, SYMIN, SZMIN, SZCAP_M, SWMIN(12), CDIV(1), CDIV(2), NLUTIBL, WSCALM, XMAXZI, XMINZI, TKCAT(11), WSCAT(5), PLX0(6), PTG0(2), PPC(6), SL2PF, FCLIP, NSPLIT, IRESPLIT(24), ZISPLIT, ROLDMAX, NSPLITH, SYSPLITH, SHSPLITH, CNSPLITH, EPSSLUG, EPSAREA, DSRISE, HTMINBC, RSAMPBC, MDEPBC.

APPENDIX J

J. Saskatchewan Background/Baseline Concentrations

Baseline air quality includes substances from anthropogenic and biogenic sources that are not directly included in the dispersion model. The correct choice of a representative baseline value requires considerable professional judgement. When selecting the appropriate ambient monitoring station to use to derive the baseline values it is important to consider the nature of the missing emissions that will be represented by the baseline values and the similarity of baseline monitor location to the project, i.e., similar topography, climate normals and air quality regime.

For example, if a modelling assessment is conducted for a project in a heavily industrialized area and the modelling domain is quite extensive then a monitoring station that operates under similar climatological conditions that also captures similar traffic and residential/commercial heating emissions as well as biogenic emissions in the area, but not industrial emissions would be an appropriate choice. On the other hand, for an assessment in a relatively pristine area where all of the relevant industrial emissions associated with the project are included then the choice of a monitoring station from a small rural community under similar meteorological conditions would be appropriate.

When comparing to air quality standards, the background concentrations are to be added to all appropriate concentrations. Assessing the effects of the baseline component becomes more complex when short-term objectives (1-hour, 24-hour averages) are being considered.

The following method should be used to determine a baseline concentration:

1. All monitoring data should be subjected to validation and quality control to ensure its accuracy. Hourly, continuous ambient monitoring data is preferred over passive monitoring data where available.
2. The most recent three years of hourly ambient data should be averaged to form a baseline provided each year is at least 75% complete. If more than 25% of the hourly ambient data is missing (blanks) from a given year then it is acceptable to use the next most recent year of ambient data, provided it meets the 75% completeness criteria. Some additional considerations to the selection of the appropriate ambient data include:
    a. If less than three years of hourly ambient data is available, then average over the available data provided at least one complete year of data is available. If one complete year of data is not available, then the monitoring station cannot be used to construct a baseline.
    b. If an analyzer is changed during the period being used to construct a baseline the statistics of the monitoring data may change. This can be checked by visually comparing the mean and variance of monitoring data before and after the analyzer change. A noticeable step change in the mean value and/or a noticeable increase in the variance suggests the monitoring data statistics are different and the data from the two analyzers should not be combined. If there is a noticeable difference in analyzer performance and there is not sufficient data to form a baseline with the current analyzer (at least one full year) then a different station must be used to form the baseline.
3. Air assessments for all averaging periods should be based on average of the reduced hourly data set for each year, i.e., the top hourly values above the 90th percentile non-blank ambient baseline data are removed. This allows for some variability in the baseline due to anthropogenic or unusual local sources. Do not include blank data as zero values when determining the 90th

percentile. For all averaging periods greater than one hour, the maximum calculated average for each averaging period, to be used as the baseline value for modelling purposes, must then be based on the reduced hourly ambient data sets. No further removal of maximum values for other averaging time periods is allowed.

Example. An air monitor station is measuring NO_2 over a three-year period. The 90th percentile of valid hourly data for each year is as follows:

2020 – 15.4 ppb NO_2
2021 – 15.4 ppb NO_2
2022 – 16.2 ppb NO_2
Average – 15.7 ppb NO_2 (to be used for one-hour models)

In forming the 24-hour baseline value for the assessment, the hourly values above the 90th percentile should be set to blank. All 24-hour averages for each year must then be calculated using the reduced data set with the blank values in place as they occur. Once this is determined then each year's 24-hour averages may then be ranked separately with the 24-hour average baseline for the assessment being the average of the top ranked 24-hour average from each year. The highest 24-hour average per year and final average are as follows:

2020 – 13.5 ppb NO_2
2021 – 14.1 ppb NO_2
2022 – 14.3 ppb NO_2
Average – 14.0 ppb NO_2 (to be used for 24-hour models)

Similar to the 24-hour baseline, the annual average is taken from the same reduced data set. No further reduction is allowed. Annual concentrations are as follows:

2020 – 5.7 ppb NO_2
2021 – 5.3 ppb NO_2
2022 – 5.9 ppb NO_2
Average – 5.6 ppb NO_2 (to be used for annual models)

Note: Modelling assessments that include PM_{10} or TSP also require a baseline value to be added to the modelling results. Monitoring of PM_{10} or TSP is not widely available so baseline values should be derived from the most representative available $PM_{2.5}$ monitoring data based on a paper comparing ratios of $PM_{2.5}$:PM_{10}:TSP across Canada (Brook et. al. 1997). For models in Saskatchewan the following formula can be used:

$PM_{10} = PM_{2.5} * 2.56$
$TSP = PM_{10} * 2 = PM_{2.5} * 5.12$

If suitable PM_{10} or TSP monitoring data is available, it should be used to form a representative baseline rather than a derived baseline.

Note: For substances of concern modelled in an assessment that are not commonly monitored the proponent should apply a representative baseline value based on best available information from the literature.

Modelling reports must contain details, rational and data to support baseline concentrations used.

Where no appropriate monitoring stations are available, or for screening models, the following baseline concentrations in Table J-1 can be used.

Table J-1: Regional Background Air Contaminant Concentrations (all µg/m^3)

Pollutant	Period	Land Area	Concentration
CO	1-Hr	Urban	380
		Rural	300
	8-Hr	Urban	320
		Rural	290
NO_2	1-Hr	Urban	26.0
		Rural	6.2
	24-Hr	Urban	23.4
		Rural	6.2
	Annual	Urban	9.1
		Rural	2.0
SO_2	1-Hr	Urban	1.3
		Rural	0.8
	24-Hr	Urban	1.2
		Rural	1.0
	Annual	Urban	0.3
		Rural	0.2
$PM_{2.5}$	24-Hr	Urban	16.0
		Rural	12.1
	Annual	Urban	6.3
		Rural	4.0

Table J-2 is a summary of O_3 and NH_3 concentrations for each month that can be used in air dispersion modelling in Saskatchewan to represent background concentrations.

Table J-2: Regional One-hour Background Air Contaminant Concentrations (all µg/m^3)

Pollutant	Land Area	**Max**	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
O_3	Urban	**59**	48	51	56	59	55	50	49	47	45	41	40	43
	Rural	**72**	60	65	73	72	56	48	45	45	44	52	54	56
NH_3		**2.3**	1	1	1	1.8	2	2.3	2.3	2	1.8	1.5	1	1

Where local areas have unique background concentrations, additional research will be required to produce background levels.

APPENDIX K
K. Flare Pseudo Parameters Calculations

AERMOD, CALPUFF and AERSCREEN contain a FLARE source option, which calculates stack pseudo-parameters (i.e. stack height and diameter and exit velocity) to appropriately characterize the flare in order to ensure that the resulting plume rise and spread are reasonably representative. Other models do not have the capability to model flares directly and most model them as point sources using the pseudo stack parameters should be calculated manually to compensate for the flame height, and initial dispersion from the flame. There are buoyancy flux reductions associated with radiative heat losses when estimating plume release height (U.S. EPA, 1992).

When determining pseudo parameters, the biggest unknown, which has been debated for years, is the radiative heat loss of a flare. Radiative heat loss has a large influence in determining the pseudo parameters to compensate for the flame height. Several studies have tried to develop a relationship between the burn conditions and the radiative heat loss. The 25 per cent radiative heat loss value used by Alberta Ministry of Environment and Protected Areas is more consistent with values published in literatures for flare gas streams (Alberta Environment, 2003).

Other papers published (Tan, 1967) considered the relationship between the molecular weight of the flare gas stream and the fraction of the heat loss due to radiation. Some jurisdictions like the state of Texas and the Ontario Ministry of Environment adopted this approach based on studies conducted and published. The Saskatchewan ministry of Environment is recommending the following equation the be used in determining the percent of radiative heat loss:

$$R = (MW)/3 + 21 \qquad \text{(eq M-1)}$$

Where:
R = radiative heat loss (per cent).
MW = Molecular weight of the gas stream.

The molecular weight of the flare gas stream should be calculated based on documented or measured composition including all components (i.e. combustible and inert components as well as any lift gas). The composition of the flare gas stream including any lift gas should be consistent with the scenario(s) being assessed. In the absence of sufficient information to calculate the molecular weight of the flare gas stream, a radiative heat loss values of 55 per cent should be used in the calculation to determine the net heat release value.

The effective stack height is the physical height of the flare plus the height of the tip of the flame. The tip of the flame is dependent on the flame length which depends on the amount of fuel burned and the net heat release rate, and the flame tilt which depends on the wind speed and exit velocity. For consistency in most models, it is assumed that the flame is tilted at a 45-degree angle. In CALPUFF, the angle of the flame can vary hourly depending on wind speeds (Exponent, 2019). The net heat release rate considers the total amount of heat available due to combustion minus the amount lost through radiation. The amount of heat loss through radiation can vary considerably depending on the gas composition burned and the plume behaviour. A very efficient flare would have no visible flame and no smoke, whereas an inefficient flare would have a yellow or orange flame and emit visible smoke.

Considering the 45-degree angle and using Milton Beychok best fit equation gives the following equation for the effective stack height.

$He = Hs + 0.00456\ (Q)^{0.478}$ (eq M-2)

Where:
He = Effective stack height above ground (m).
Hs = Physical stack height above ground (m).
Q = Total heat available for combustion (cal/s).

The effective diameter is much larger than the original inner diameter of the open flare or flare nozzle tip due to the combustion process and the air entrainment in the plume. The effective diameter, which is calculated at the flame tip, can be calculated knowing the actual buoyancy flux of the combusted gas. The buoyancy flux is a measure of the vertical momentum that the exhaust gas has due to the amount of heat released through combustion.

$F_b = (gQ(1\text{-}r))/(\pi c_p p\ T_a)$ (eq M-3).

Where:
F_b = Buoyancy flux
r = Fraction of heat lost through radiation (R/100)
g = Acceleration due to gravity (9.81 m/s^2)
c_p = Specific heat of dry air 0.24 cal/gK
p = Density (1205 g/m^3)
T_a = Ambient air temperature (K)

The buoyancy flux can also be estimated using the Briggs plume rise equation (Briggs, 1969) as follows.

$F_b = (gvd^2 / 4)[(T_s - T_a) / T_s]$ (eq M-4)

Where:
d = effective diameter (m)
v = effective exit velocity (m/s)
T_s = effective stack temperature (K)

Assuming both buoyancy fluxes are equal and merging both equations (M-3 and M-4) the effective diameter can be calculated as:

$d = [(4T_sQ(1\text{-}r))/(\pi c_p p T_a v(T_s - T_a)]^{0.5}$

or, assuming c_p and p are constant:

$d = 0.066[T_sQ(1\text{-}r)/(T_a v(T_s - T_a))]^{0.5}$ (eq M-5)

Similar to the effective diameter, the effective velocity is calculated as a representative value at the flame tip.

To determine an effective velocity both the buoyancy flux and the momentum flux calculations need to assume they are conserved. The momentum flux is a measure of vertical momentum that a gas has due to the amount of physical momentum as it exits a stack, which is based on the exit velocity. Assuming the exhaust stream at the flare nozzle tip behaves similar to a traditional stack and this momentum is conserved, so that it is applicable at the flame tip, the effective velocity can be calculated as:

$V_{eff} = gF_m/F_b\ (T_s - T_a)/T_a$ (eq M-6)

Where:
V_{eff} = Effective velocity (m/s)
F_m = Momentum flux

Where the momentum flux of the exhaust stream at the nozzle tip prior to combustion can be calculated as:
$F_m = \rho_g(D_nV_n)^2/4p$ (eq M-7)

Where:
ρ_g = Density of the gas to be flared (g/m^3) at actual flare gas temperature and pressure at the nozzle.
D_n = Flare nozzle diameter (m)
V_n = Actual exit velocity of the gases at flare nozzle before combustion corrected to actual gas temperature and pressure (m/s).

Using the momentum flux equation (eq M-7) and the buoyancy flux equation (eq M-3), the effective velocity in eq. M-6 becomes:

$V_{eff} = \pi c_p \rho_g (T_s - T_a)(D_nV_n)^2/(4Q(1-r))$ (eq. M-8)

The pseudo parameters calculated account for stack tip downwash. Therefore, the modeller should disable this option when using either AERMOD or CALPUFF. To prevent stack tip downwash during low wind speed events, the minimum value for the effective velocity is set to 1.5 m/s.

Some flares are designed to handle both routine and non-routine flare events. Flows during non-routine flare events are much larger than those during routine flare events. This would lead to modelled plume rise being much higher for non routine flare events which may result in the locations of maximum impacts being at different locations. Therefore, it is important to model all scenarios expected for a particular flare.

APPENDIX L
L. Modelling Report Checklist

Modelling Report Checklist

A report describing the air quality analysis performed should be submitted. The purpose of the report is to provide the ministry with ample information to demonstrate that the new or modified source will not adversely affect ambient air quality. The content of the report should be adequate for the reviewer to establish that the analysis was accomplished in a manner consistent and defensible with respect to best practices and available modelling guidance.

At a minimum, applicants should refer to the following checklist to ensure the air quality analysis report is complete.

Table N-3: Modelling Report Check List

1	BACKGROUND AND SOURCE INFORMATION
1.a	Project background requirements. • General description of the plant processes. • Purpose of the modelling. • Proposed new sources or modification of existing sources including number and type of sources.
1.b	Project location requirements

1.b.i	Plot plan that includes the following.
	• UTMs on horizontal and vertical axis.
	• Property lines, including fence lines.
	• Roads and railroads that pass-through property line.
	• Location of all emission sources.
	• Buildings and structures (on or off property) which could cause downwash including:
	    • Location.
	    • Length/Width/Height.
	    • Building tiers and tier heights.

1.b.ii	Area map(s) that include the following. • Map of adjacent area (typically 10 km radius from plant). • UTMs on horizontal and vertical axis. • Location of all receptors used in the modelling. • Location of all sources that were modelled including nearby sources emitting same pollutant. • Location of all sensitive receptors including communities. • Topographic features. • Location of any existing or proposed meteorological or ambient monitoring stations. • Relevant roads and railroads.
1.c	Emissions of Proposed New / Modified Source Requirements.
1.c.i	Emission source descriptions and capacities (including proposed emission controls) Include fugitive, condensable and secondary emissions when applicable.
1.c.ii	Emission calculation.: • In stack ratio of NOx to NO_2 if applicable. • Describe how emissions were calculated / estimated. • Include sample supporting calculations. • Include references as needed.
1.c.iii	Discussion of potential operating scenarios for emission units. • Maximum emissions scenario. • Refined emissions scenario.

	• Start ups and shutdowns. • Upsets and Emergency situations.

1.c.iv	Include parameter table(s) for each operating scenario of each emission unit, which may include, but not be limited to the following.
	• Source type (Stack, Area, Volume, Line or Flare).
	• Location (UTM Coordinates).
	• Emission rate.
	• Exit height above ground.
	• Source parameters required for modelling.
	• If stack:
	  • Orientation (vertical, horizontal).
	  • Rain cap.

2	ANALYSIS.
2.a	List and discuss the model(s) chosen as well as supporting models and input programs.
2.b	Modelling procedure reporting requirements.
2.b.i	Description of the domain size. Source of terrain data. Flagpole height used. UTM zone.
2.b.ii	Identify all land use characteristic values used that were different from those recommend by the ministry. Justification for using different land use values.
2.b.iii	Meteorological data used. Identify which ministry prepared Regional Meteorological Data set was used. If regenerating the meteorological data discuss land use characterization include Bowen ratio, albedo, surface roughness values which were used. If using other sources of meteorological data. • Identified source and location of the data. • Comparison of meteorological site to modelling site. • Wind rose. • Graphs showing monthly patterns of other meteorological parameters. • Discussion of what quality assurance was done on the data.
2.b.iv	If applicable, a description of how each of the following were assessed. • Flares. • Odour. • Fogging. • Icing. • Acid deposition. • Lake effect. • Particle deposition. • Secondary PM and ozone.
2.b.v	Specify setting utilized within the model(s), which may include: • Default regulatory setting utilized within model. • Flat or elevated terrain. • Include discussion on non-default settings utilized and reasons.
2.c	Ambient condition requirements, including competing sources. Discuss the ambient background / baseline concentration. Data to support background / baseline concentrations. Conversion factor used for different averaging time (if applicable). Conversion factor utilized for converting NO_X to NO_2.
3	RESULTS DOCUMENTATION.

3.a	Identify all Standards and criteria to be used as indicator of potential impact (i.e. SAAQS or other jurisdictions criteria).
3.b	The model results to be documented as follows.
3.b.i	Table(s) of results including: • Source. • Contaminant(s). • Averaging time(s). • Operating scenario. • Receptor location and elevation of maximum impact (UTM coordinates). • Maximum impact from new / modified source. • Background concentration. • Maximum modelled cumulative concentration (all sources + background). • Applicable ambient air quality standards. • Number and frequency of concentrations exceeding the standards.
3.b.ii	Figure(s) showing ambient impacts of facility alone (and all sources). For each operating scenario and averaging time. • UTMs on horizontal and vertical axis. • Modelled facility. • Facility boundary. • Emission location (include non facility sources). • Topography features. • Isopleths of impact concentrations. • Location and value of maximum (cumulative) impact.
3.b.iii	All exceedances of the ambient air quality standards or criteria should be clearly identified.
4	SUPPORTING FILES.
4.a	Required electronic files to be submitted with report. • Input files for models. • Input & output files for pre-processors (if applicable.) • Input for post-processors (if applicable.) • Digital terrain files. • Plot files. • Threshold violation files. • Final report.

Public Participation in Environmental Assessment under the Canadian Environmental Assessment Act, 2012

This document provides guidance on federal environmental assessments commenced under the former *Canadian Environmental Assessment Act, 2012*. It is retained for the completion of transitional environmental assessments commenced prior to the *Impact Assessment Act*. For more information on transitional environmental assessments, please consult the Legislation and Regulations page.

Interim Reference Guide

March 2018
Version 1

Document Information

Disclaimer

Please be advised that this draft guidance piece is an interim document. The Agency is currently reviewing the Environmental Assessment process and as a result of the review, EA (environmental assessment) practice, policies and procedures may change. This draft guidance document reflects current practice under the Canadian Environmental Assessment Act, 2012 (CEAA (Canadian Environmental Assessment Act) 2012).

This Reference Guide is for information purposes only. It is not a substitute for the Canadian Environmental Assessment Act, 2012 (CEAA (Canadian Environmental Assessment Act) 2012) or its regulations. In the event of an inconsistency between this Reference Guide and CEAA (Canadian Environmental Assessment Act) 2012 or its regulations, CEAA (Canadian Environmental Assessment Act) 2012 or its regulations would prevail.

For the most up-to-date versions of CEAA (Canadian Environmental Assessment Act) 2012 and regulations, please consult the Department of Justice website.

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Updates

This document may be reviewed and updated periodically. To ensure that you have the most up-to-date version, please consult the Policy and Guidance page of the Canadian Environmental Assessment Agency's website.

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Alternative formats may be requested by contacting: info@ceaa-acee.gc.ca.

This document is also available in Adobe's Portable Document Format (1.1 MB (megabytes)).

TABLE OF CONTENTS

Introduction

Purpose

This Guide describes the key public participation opportunities during an environmental assessment conducted by the Canadian Environmental Assessment Agency (the Agency) or by a review panel under the Canadian Environmental Assessment Act, 2012 (CEAA (Canadian Environmental Assessment Act) 2012). CEAA (Canadian Environmental Assessment Act) 2012 has legislated requirements to provide opportunities for public participation, providing certainty and clarity on how your voice can be heard during the environmental assessment process.

Application

Under CEAA (Canadian Environmental Assessment Act) 2012, an environmental assessment may be required for designated projects – those projects described by the Regulations Designating Physical Activities or designated by the Minister of the Environment (the Minister) because of potential adverse environmental effects or related public concern (subsection 14(2)).

The term “project” refers to designated projects under CEAA (Canadian Environmental Assessment Act) 2012 for which the Agency is the responsible authority.

Throughout the document, the term "environmental effects" refers to environmental effects as described in section 5 of CEAA (Canadian Environmental Assessment Act) 2012.

Depending on the nature of the designated project, the environmental assessment is carried out by one of three responsible authorities: the Agency, the National Energy Board or the Canadian Nuclear Safety Commission. Other federal authorities may be designated as responsible authorities in the future. Projects for which the Agency is the responsible authority are described in the Regulations Designating Physical Activities. This Guide focusses on how the public can participate in environmental assessment processes where the Agency is the responsible authority. Information on processes by the National Energy Board or the Canadian Nuclear Safety Commission is available on their respective websites.

Predictable opportunities for public participation enable members of the public to better plan their involvement and manage resources more efficiently. After reading this Guide, you will understand how and when to participate in an environmental assessment when the Agency is the responsible authority, as well as the general roles and responsibilities of the Agency and other participants in the environmental assessment process.

CEAA (Canadian Environmental Assessment Act) 2012 allows the federal environmental assessment process to be substituted for a provincial environmental assessment process. In this case, the public needs to follow the province's public participation process (see Annex 1).

The Environmental Assessment Process under CEAA (Canadian Environmental Assessment Act) 2012

Environmental assessment is a planning and decision-making tool used to minimize or avoid adverse environmental effects of proposed initiatives before they are carried out.

An environmental assessment identifies possible adverse environmental effects and mitigation measures to lessen those effects and assesses whether a project is likely to cause significant adverse environmental effects after mitigation measures are implemented.

Comments received from the public throughout the environmental assessment process influence the identification and assessment of adverse environmental effects, the development of mitigation measures, the determination of significance and the development of a follow-up program.

When the Agency is the responsible authority, there are two possible types of environmental assessment:

Environmental Assessment by the Agency: The Agency reviews all of the information submitted by participants (e.g. the project proponent, the public and Indigenous groups) to prepare an environmental assessment report. This report is advisory in nature, contains the Agency's conclusions and recommendations, and is submitted to the Minister to support the Minister's decision.

Environmental Assessment by a review panel: A panel of independent experts appointed by the Minister reviews all of the information submitted by participants (e.g. the project proponent, the public and Indigenous groups) to prepare a panel report. This report is advisory in nature, contains the review panel's conclusions and recommendations and is submitted to the Minister to support the Minister's decision.

Both approaches allow the Agency or the review panel to conduct the environmental assessment in cooperation with another jurisdiction, such as a province, when the jurisdiction also has a responsibility to conduct an environmental assessment (see Annex 1).

For more information about the environmental assessment process and timelines under CEAA (Canadian Environmental Assessment Act) 2012, please consult the Basics of Environmental Assessment.

Public Participation and Environmental Assessment

CEAA (Canadian Environmental Assessment Act) 2012 (paragraph 19(1)(c)) requires that comments from the public be considered in the environmental assessment of a designated project. Public participation is an important aspect of an open, balanced process and strengthens the quality and credibility of an environmental assessment. It encourages and supports project planning and decision-making by sharing information with, and gathering input from, members of the public who may have an interest in a proposed project.

By sharing your comments and concerns, you are giving the decision-maker the benefit of your views, experience and knowledge. As a participant, you can contribute to discussions on improving or adapting the project to avoid potential adverse environmental effects. Your input contributes to a fully informed decision.

Who can participate?

During an environmental assessment, anyone with an opinion, information or expertise relevant to a project and its potential environmental effects, can provide comments. Comments on specific documents must generally be received within the defined public comment periods to be considered by the Agency or a review panel.

CEAA (Canadian Environmental Assessment Act) 2012 states that a review panel must hold public hearings in a manner that offers any interested party an opportunity to participate. CEAA (Canadian Environmental Assessment Act) 2012 defines an interested party as any person that, in the opinion of the review panel, is directly affected by the carrying out of the designated project or has relevant information or expertise. The review panel determines who is an interested party.

Aboriginal groups may provide input through Aboriginal consultation activities and/or public participation opportunities. More information on the Crown's legal duty to consult Aboriginal groups is available in the Updated Guidelines for Federal Officials to Fulfill the Duty to Consult and on the Agency's Aboriginal Consultation in Federal Environmental Assessment webpage.

Support for meaningful participation

The Agency and review panels ensure that meaningful opportunities for public participation occur during an environmental assessment. This is done through notification of opportunities for public participation, reasonable timing, provision of accessible information, transparent reporting of results, financial support for participants, and coordination with other jurisdictions. Please consult Annex 1 for more information on support for participants.

Structure of the Guide

This Guide is divided into five parts to better direct you to the most relevant public participation opportunity for a particular environmental assessment.

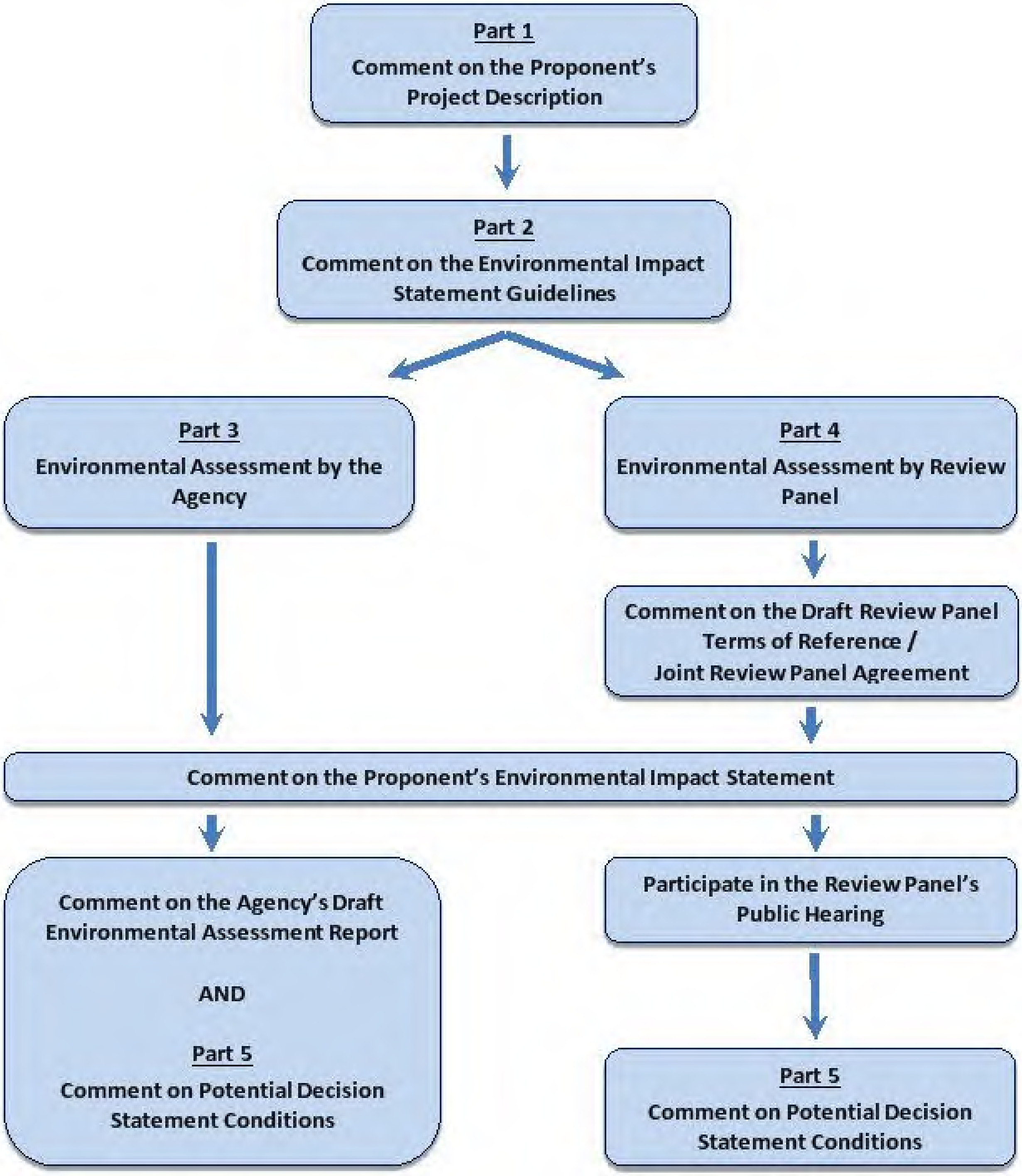
- Project Description (Part 1);
- Draft Environmental Impact Statement Guidelines (Part 2);
- Environmental Assessment by the Agency (Part 3);
- Environmental Assessment by Review Panel (Part 4); and
- Potential Decision Statement Conditions (Part 5).

Parts 1, 2 and 5 outline public participation opportunities in the environmental assessment process that are common to both an environmental assessment by the Agency and an environmental assessment by review panel. Part 3 focuses on the key public participation opportunities for an environmental assessment by the Agency. Part 4 explains the key public participation opportunities for an environmental assessment by review panel. Both environmental assessment by the Agency and environmental assessment by review panel provide public comment opportunities on important information such as the proponent's environmental impact statement.

Figure 1 illustrates the five parts of this document relative to the environmental assessment process.

Figure 1: Key Opportunities for Public Participation in an Environmental Assessment under CEAA (Canadian Environmental Assessment Act) 2012

Note: This diagram sequentially illustrates the stages presented for public participation during an environmental assessment led by the Agency or by a review panel. There are five key possibilities during and Agency-led process, and six for a Review Panel.



▶ Description for diagram - Key Opportunities for Public Participation

Part 1: Opportunities to Comment on a Project Description (20 Days)

When a proponent proposes a project that is described in the Regulations Designating Physical Activities, they are required to submit a project description to the Agency that complies with the Prescribed Information for the Description of a Designated Project Regulations. Generally a project description will include the following information:

- activities involved in carrying out the proposed project;
- timelines for the project life cycle, including construction, operation, decommissioning, and abandonment;
- description of any public or Indigenous engagement planned and/or carried out;
- information on any relevant environmental studies being carried out in the project area;
- maps showing the location of the project in relation to various landscape features (e.g. wetlands, water sources, sensitive areas, etc.), residential areas, and federal lands, including Indigenous communities and traditional territories;
- if there is any financial support from federal authorities and if any federal land would be used in carrying out the project;
- anticipated required permits or authorizations (federal and provincial);
- description of any changes that may be caused to the environment, should the project be carried out, specifically to fish and fish habitat, aquatic species, and migratory birds;
- effects that may occur on federal lands;
- effects that may cross provincial or international boundaries; and
- description of how potential changes to the environment could impact Aboriginal peoples in terms of health, socio-economic conditions,

physical and cultural heritage, current use of lands and resources for traditional purposes, or on anything of historical, archaeological, paleontological or architectural significance (e.g., burial sites, ceremonial lands, teaching sites).

Once the Agency determines that the project description is complete, it is posted on the Registry Internet site, and a 20-day public comment period will begin.

What should your comments focus on?

The purpose of public participation at this stage is to provide input early in the environmental assessment process and gather information which may help determine if an environmental assessment is required and to define the scope of issues to be considered. As such, your comments should focus on the project and its potential environmental effects.

How are your comments used?

Your comments will help the Agency:

- determine whether an environmental assessment is required and, if so, whether the project should continue to be assessed by the Agency or be recommended for referral to a review panel;
- identify issues of importance to the public in relation to the project; and
- prepare the draft environmental impact statement guidelines.

Part 2: Opportunities to Comment on Draft Environmental Impact Statement Guidelines (30 Days)

Once it has been decided that an environmental assessment is required for the project (and before the Minister decides whether the project should be referred to a review panel), the Agency will prepare draft environmental impact statement guidelines and make them available on the Registry Internet site for a public comment period, generally for 30 days.

The environmental impact statement guidelines identify the information that must be included in the proponent's environmental impact statement and specify the nature, scope and extent of that information.

Within 60 days of the start of an environmental assessment, the Minister may refer the project to a review panel. Opportunities for public participation in an environmental assessment by a review panel are explained in Part 4.

If the Minister does not refer the project to a review panel, the Agency will continue to conduct the environmental assessment. Opportunities for public participation in an environmental assessment by the Agency are explained in Part 3.

What should your comments focus on?

Your comments should focus on which aspects of the environment may be affected by the project and what should be examined during the environmental assessment. If you believe that an important component of the environment is missing or may not be adequately assessed you should let the Agency know.

How are your comments used?

Your comments will be used to strengthen the draft environmental impact statement guidelines which may include the identification of additional valued components and/or studies to be undertaken in the environmental impact statement. Taking into account the comments received, the Agency will finalize the environmental impact statement guidelines, issue them to the proponent, and post them on the Registry Internet site for the public.

The public comments received at this stage may also inform whether or not the designated project is recommended for referral to environmental assessment by review panel.

Part 3: Opportunities during an Environmental Assessment by the Agency

This section focuses on the key opportunities for public participation once it has been decided that the environmental assessment will be conducted by the Agency, specifically:

- Opportunities to comment on the environmental impact statement; and
- Opportunities to comment on the draft environmental assessment report.

3.1 The Environmental Impact Statement (30 Days)

The Agency is responsible for a technical review of the proponent’s environmental impact statement. Both the full version and a summary of the environmental impact statement are made available on the Registry

Internet site and a public comment period is held, generally for 30 days.

The environmental impact statement includes detailed information, such as:

- a list of stakeholders and summaries of engagement sessions with the public and Indigenous groups;
- information on the project’s activity throughout its life cycle (construction, operation, decommissioning, and abandonment);
- a description of the current environment;
- an assessment of alternative ways to carry out the project;
- an analysis of potential environmental effects;
- proposed mitigation measures;
- a determination of the significance of the residual adverse environmental effects remaining after mitigation;
- response plans for accidents and malfunctions;
- cumulative environmental effects; and
- a follow-up program.

In some cases, the Agency may hold public meetings or open houses in areas that are likely to be affected by the project. The Agency would consider factors such as the degree of public concern, complexity of the project and coordination with a provincial environmental assessment process in making the decision to hold public meetings or open houses. These events provide the public with an opportunity to provide oral comments and are advertised through local media and in local communities, at places such as community halls or libraries.

What should your comments focus on?

Your knowledge of the project area and local environment can contribute to the evaluation of the environmental impact statement.

Your comments can assist the Agency in determining whether information provided in the environmental impact statement is sufficient and technically appropriate or whether additional information, studies, analyses or advice are required. You should provide comments on the key questions below and advise the Agency if you identify any information gaps (i.e. missing information or analysis):

- Are the methods appropriate?
- Is the environmental impact statement factually correct and is sufficient technical detail available?
- Are effects predictions correct? Should additional effects be assessed?
- Is the project likely to cause significant adverse environmental effects?
- Are the mitigation measures and follow-up program clearly stated, appropriate and likely to function as designed?

Your comments may take the form of a request for additional information. Such requests should be clear and concise, providing enough information to ensure the Agency understands exactly what part of the environmental impact statement is incomplete and what information is requested. If you have more than one request, you should number them, identify the sections of the environmental impact statement in question, and clearly reference the relevant requirements from the environmental impact statement guidelines.

How are your comments used?

Your comments can assist the Agency in determining if the environmental impact statement is sufficient and technically appropriate. They can also assist the Agency in identifying and formulating information requests to be addressed by the proponent.

3.2 The Draft Environmental Assessment Report (30 days)

After careful analysis of the environmental impact statement and all comments received, the Agency prepares a draft environmental assessment report. This document includes the Agency's conclusions and recommendations regarding the potential environmental effects of the project, the mitigation measures that were considered, the significance of any residual adverse environmental effects, and the proposed follow-up program.

The draft environmental assessment report includes a summary of the key comments received with a description of what the proponent did to address the public's concerns. This allows you to see how public comments influence the environmental assessment process.

The draft environmental assessment report is generally subject to a public comment period of 30 days. In some cases, in addition to the written comment period, the Agency may also hold targeted public meetings or open houses in the project area. These meetings provide the public with an opportunity to provide oral comments.

What should your comments focus on?

When reviewing the environmental assessment report, your comments should focus on:

- the Agency's conclusions and recommendations regarding the project's potential environmental effects;
- proposed mitigation measures;
- the significance of any remaining adverse environmental effects; and
- the follow-up program.

How are your comments used?

The Agency will consider all comments received when finalizing the environmental assessment report. This report informs the Minister’s environmental assessment decision.

Part 4: Opportunities during an Environmental Assessment by Review Panel

The review panel process begins once the Minister refers the environmental assessment of a designated project to a review panel, generally following public comments on the draft environmental impact statement guidelines. The Agency notifies the public of this decision by posting a notice on the Registry Internet site.

This section focuses on the key opportunities for public participation once it has been decided that the environmental assessment will be conducted by a review panel, specifically the opportunities to:

- comment on the draft review panel terms of reference and/or joint review panel agreement;
- comment on the proponent’s environmental impact statement; and
- participate in the public hearing.

Some of these opportunities are offered by the Agency prior to appointment of the review panel, and some are offered by the review panel once it is appointed. Once appointed, the review panel is responsible for the conduct of the environmental assessment process.

4.1 The Draft Review Panel Terms of Reference (Typically 30 Days)

Prior to panel appointment, the Agency will prepare, and make available on the Registry Internet site, the draft Terms of Reference for the review panel. The Terms of Reference outline the mandate of the review panel, the scope of the review and the process and timelines for the review panel to follow during the environmental assessment.

In the case of joint review panels, the Agency will also prepare a draft Joint Review Panel Agreement, in consultation with the other jurisdiction. The Joint Review Panel Agreement is an agreement between the Agency and a partner jurisdiction that outlines how the environmental assessment by review panel will proceed, taking into consideration the requirements of both jurisdictions. The Joint Review Panel Agreement typically outlines the following:

- the process and timelines of the review;
- definitions of terminology;
- responsibility for maintenance of the Registry;
- the composition of the review panel and the secretariat;
- considerations related to the decision-making process; and,
- how contributions and considerations of Indigenous groups will be addressed by the review panel.

What should your comments focus on?

Comments on the draft Terms of Reference, or Joint Review Panel Agreement if applicable, should address the mandate, the scope of the review, processes and timelines outlined in the documents. You are encouraged to provide comments with rationale and suggestions to ensure that a sound review process is followed.

How are your comments used?

Your comments can assist the Agency in providing a comprehensive and complete document for the consideration of the Minister, who will approve the final versions. Any comments received will be posted on the Registry Internet site and made public.

4.2 The Environmental Impact Statement

Once appointed, the review panel must determine if it has sufficient information to schedule the public hearing. The panel will conduct a review of the proponent's environmental impact statement to determine whether information provided is sufficient and technically appropriate or whether additional information, studies, analyses or advice are required.

The environmental impact statement includes detailed information, such as:

- a list of stakeholders and summaries of engagement sessions with the public and Indigenous groups;
- information on the project's activity throughout its life cycle (construction, operation, decommissioning, and abandonment);
- a description of the current environment;
- an assessment of alternative ways to carry out the project;
- an analysis of potential environmental effects;
- proposed mitigation measures;
- a determination of the significance of the residual adverse environmental effects remaining after mitigation;
- response plans for accidents and malfunctions;
- cumulative environmental effects; and
- a follow-up program.

The review panel typically requests public comments on the environmental impact statement and any supplemental information gathered to date, and will generally provide a minimum of 45 days for the public comment period.

There may be additional opportunities for public participation in relation to the environmental impact statement. These opportunities may include technical meetings or a site visit.

Any comments received will be posted on the Registry Internet site and made public.

What should your comments focus on?

Your knowledge of the project area and local environment can contribute to evaluation of the environmental impact statement.

Your comments can assist the review panel in assessing the technical merit and sufficiency of the information presented in the environmental impact statement and any supplementary information. You should provide comments on the key questions below and advise the review panel if you identify any information gaps (i.e., missing information or analysis):

- Are the methods appropriate?
- Is the environmental impact statement factually correct and is sufficient technical detail available?
- Are effects predictions correct? Should additional effects be assessed?

Your comments may take the form of a request for additional information. Such requests should be clear and concise, providing enough information to ensure the review panel understands exactly what part of the environmental impact statement is incomplete and what information is requested. If you have more than one request, you should number them, identify the sections of the environmental impact statement in question and clearly reference the relevant requirements from the environmental impact statement guidelines.

How are your comments used?

Your comments can assist the review panel in determining if the environmental impact statement is sufficient and technically appropriate.

4.3 The Public Hearing

The review panel conducts a public hearing to determine if the project is likely to result in significant adverse environmental effects, and to ensure that the panel has all of the information that it needs to complete its report to the Minister.

The public hearing provides opportunities for:

- the proponent to explain the designated project and respond to concerns and questions raised by participants;
- participants to provide their views and ask questions on the potential environmental effects of the designated project; and
- the review panel to receive information that would help it complete its assessment of the potential environmental effects of the designated project.

The review panel must conduct the public hearing in a manner that promotes a thorough examination of relevant issues and encourages participation and input from interested parties and other participants. The public hearing should follow a fair and orderly process, but is generally not bound by the strict rules of procedure and evidence applicable to judicial proceedings.

The review panel’s Terms of Reference may specify the timeline in which the review panel must conduct its public hearing. For instance, the review panel may be directed to use its best efforts to complete the public hearing in 30 days.

The review panel will issue a Notice of Hearing, outlining the start date and location(s) of the public hearing, the deadline to register as a presenter, and the deadline for written submissions. The review panel’s Terms of Reference may outline the timelines for the public hearing, but the Notice of Hearing is usually made public at least 45 days in advance to give participants time to prepare.

Following the release of the Notice of Hearing, the review panel will issue a detailed hearing schedule with the times and locations of all hearing sessions. In determining the locations for the public hearing, the review panel will consider the communities most likely to be affected by the project, locations of interested participants, local culture and customs of potentially affected Indigenous communities, and the need to complete the review in a timely and cost-efficient manner.

Although hearing sessions are open to anyone wishing to observe the proceedings, the review panel may require you to register in advance if you wish to make a presentation during the hearing sessions. Advance registration allows the public hearing to be planned and conducted in a logical and organized manner.

Public hearing procedures, issued by the review panel, will outline any requirements with respect to the public hearing, including details regarding registration.

Typically there are three types of hearing sessions that a review panel may hold:

1. Community hearing sessions: Encourage the full and open participation of people living in, or adjacent to the project area and provide a more informal setting in which community members are able to make presentations to the review panel on any matters within the scope of the review and present community knowledge or Aboriginal traditional knowledge.
2. General hearing sessions: Provide an opportunity for interested parties and the proponent to make presentations to the review panel on both the technical and non-technical subjects that are within the scope of the review. They also provide the opportunity for participants to question the information submitted during the review process.
3. Technical hearing sessions: Allow participants who possess specialized knowledge or expertise in a specific topic to present the results of their analysis of the potential environmental effects of the designated project to the review panel. They also allow for scrutiny of the designated projects by participants who have conducted a technical review of the project. This includes participants who have hired technical experts to assist them with their review.

Transcripts of the public hearing will be produced and made public through the Registry Internet site.

At the end of the public hearing, the review panel may reserve time for closing remarks by participants or interested parties. Closing remarks are not intended for the presentation of new information. Instead, you may summarize your position on the project and the types of recommendations that the review panel should make in relation to the project.

All comments and presentations from hearing sessions are considered part of the record of the review and will be posted on the Registry Internet site and made public. The record of the review is the body of information on which the review panel will rely in writing its report.

Once the review panel has all the information it requires to write its report, it will close the record of the review and post a notice on the Registry Internet site. New information cannot be accepted once the record is closed.

The review panel's report is advisory in nature and contains the review panel's conclusions and recommendations with respect to the project. The review panel submits its report to the Minister and any partnering jurisdictions (as appropriate). Typically, a review panel will issue a news release on the Registry Internet site when it has submitted its report. Under CEAA (Canadian Environmental Assessment Act) 2012, the Minister is responsible for making the report available to the public.

What should your comments focus on?

Your comments can assist the review panel in their consideration of key questions such as:

- Is the project likely to cause significant adverse environmental effects?
- Are mitigation measures and the follow-up program appropriate and likely to function as designed?

How are your comments used?

Your comments are used to inform the review panel's conclusions and recommendations with respect to the project. These conclusions and recommendations are contained in the panel report submitted to the Minister.

Part 5: Opportunities to Comment on Potential Decision statement Conditions (Typically 30 days)

After analysis of the environmental impact statement and consideration of comments received, the Agency prepares a document containing potential decision statement conditions for the project. These potential conditions relate to proposed mitigation measures and a follow-up program. The final conditions would become legally binding on the proponent if the Minister issues a decision statement indicating that the project may proceed. The potential decision statement conditions are posted on the Registry Internet site for public comment, generally for 30 days.

What should your comments focus on?

Your comments should focus on the adequacy and sufficiency of the potential decision statement conditions, suggestions for improvement and any additional measures you would like to see included.

How are your comments used?

The Agency will consider all written comments received when finalizing its recommendations to the Minister on potential conditions for inclusion in the environmental assessment decision statement. The Agency's recommendations will inform the Minister's decision-making.

Annex 1: Support for Meaningful Public Participation

The Agency and review panels ensure that meaningful opportunities for public participation occur during an environmental assessment. This is done through notification of opportunities for public participation, reasonable timing, provision of accessible information, transparent reporting of results, financial support for participants, and coordination with other jurisdictions.

Notification

The Agency or review panel will inform the public of participation opportunities, including information on any timelines, the public hearing schedule, how comments may be submitted or how to register for a hearing. This is often done through the issuance of a public notice and/or news release. You may also subscribe (by completing a short form on the Agency's website) to receive a weekly bulletin of Agency news, including updates on environmental assessments and opportunities for public participation. The Agency and review panels also maintain email distribution lists that are used to update participants on the status of an environmental assessment and opportunities for participation.

Reasonable timing

The Agency or review panel will provide the public with a fair and reasonable amount of time to engage in participation opportunities such as needed for evaluating information, providing and submitting comments on that information, planning and preparing for information sessions and public hearings.

Accessible information

The Canadian Environmental Assessment Registry (the Registry) consists of both an internet site and project files, established for the purpose of facilitating access to records related to current and potential environmental assessments of projects subject to CEAA (Canadian Environmental Assessment Act) 2012. It is operated in a manner that provides the public with convenient and timely access to information in support of public participation.

Within the Registry Internet site, there is a dedicated page specific for each project. This page includes any information regarding public comment periods, documents for public comment, and contact information specific to the environmental assessment of the project.

Transparent results

The environmental assessment report, prepared by the Agency or a review panel, documents the results of the environmental assessment and includes the rationale, conclusions and recommendations regarding:

- the potential environmental effects of the designated project;
- the mitigation measures that were taken into account;
- the significance of adverse environmental effects after mitigation measures are implemented; and
- follow-up program requirements.

For an environmental assessment by the Agency, the environmental assessment report reflects the comments received during the comment period on the environmental impact statement. Generally, the key comments received are summarized and accompanied by a description of what the proponent did to address the public's concerns. This allows you to see how public comments influenced the environmental assessment process.

For an environmental assessment by review panel, the panel's report summarizes the views of the public and Indigenous groups on key issues, as well as the views of the proponent.

The Agency also seeks public comment on any draft potential conditions with which the proponent must comply, should the Minister include these conditions in a decision statement.

Financial support

The Agency administers the Participant Funding Program that supports individuals, Indigenous groups, and non-profit organizations interested in participating in an environmental assessment, both by the Agency and review panel. Funding supports eligible expenses, such as travel costs and fees for experts.

Please visit the Participant Funding Program webpage for more information on the program, eligibility and the application process.

Coordination with other jurisdictions

For environmental assessments involving both the federal government and another jurisdiction with environmental assessment responsibilities, such as a province, opportunities to coordinate efforts are pursued to increase efficiency and reduce the potential burden on participants.

CEAA (Canadian Environmental Assessment Act) 2012 allows the federal environmental assessment process to be substituted for a provincial environmental assessment process, in the event that the province makes a request. The Agency consults the public for their views on whether substitution should occur. If a federal environmental assessment process has been substituted for a provincial environmental assessment process, the public needs to follow the province's public participation process. For more information on substitution under CEAA (Canadian Environmental Assessment Act) 2012, refer to Substitution of the federal environmental assessment process under CEAA (Canadian Environmental Assessment Act) 2012.

Resources

Practitioners Glossary for the Environmental Assessment of Designated Projects under the Canadian Environmental Assessment Act, 2012

- This document defines or explains terms that are commonly used in relation to environmental assessments under CEAA (Canadian Environmental Assessment Act) 2012. It supports Agency training and guidance materials.

Basics of Environmental Assessment

- This document provides information on the purpose and steps of environmental assessments under CEAA (Canadian Environmental Assessment Act) 2012.

Canadian Environmental Assessment Registry

Participant Funding Program Guide and Forms

Policy and Guidance Instruments for CEAA (Canadian Environmental Assessment Act) 2012

Acts and Regulations

Substitution Backgrounder

Date modified: 2024-04-12

Government of Canada / Gouvernement du Canada

Wheeler River Project

Public Notice: Environmental Assessment Report Posted for the Wheeler River Project

August 20, 2025: The Canadian Nuclear Safety Commission (CNSC) has now posted the Environmental Assessment (EA) Report for the Denison Mines Corp.'s proposed Wheeler River Project The EA report is part of the Commission Member Document (CMD) package, related to Denison's licence application to Prepare Site and Construct.

The EA Report presents CNSC staff's findings on the potential environmental effects of the proposed in-situ recovery uranium mining project located in northern Saskatchewan. It reflects a comprehensive technical review by the Federal Indigenous Review Team and incorporates feedback received from:

- Indigenous Nations and communities
- Other federal departments and agencies

The report evaluates whether the project is likely to cause significant adverse environmental effects, taking into account proposed mitigation measures and the implementation of follow-up programs.

The EA Report and supporting documents are available here:

- Commission Member Document (CMD) 25-H9 CNSC Staff Submission (including EA Report and Indigenous Consultation Report) (Added Sept 3, 2025)
- EA Report

Next Steps

The CMD, EA Report and Consultation Report will be considered by the Commission during a public hearing, where interested parties—including Indigenous Nations and communities, stakeholders, and members of the public—will have the opportunity to participate.
Details on the hearing, including how to register to participate or submit written interventions can be found here.

For more information, please contact:

The CNSC Wheeler River Project Team
Canadian Nuclear Safety Commission
Email: WheelerRiver@cnsc-ccsn.gc.ca
Web: Wheeler River Project (iaac-aeic.gc.ca)
Document reference number: 208

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