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**Revised written submission from
Northwatch**

**Mémoire révisé de
Northwatch**

In the Matter of

À l'égard de

**Regulatory Oversight Report for Uranium
Mines, Mills, Historic and Decommissioned
Sites in Canada: 2017**

**Rapport de surveillance réglementaire des
mines et usines de concentration d'uranium et
des sites historiques et déclassés au Canada :
2017**

Commission Meeting

Réunion de la Commission

December 12, 2018

Le 12 décembre 2018

NORTHWATCH

November 20, 2018

Canadian Nuclear Safety Commission
280 Slater Street, P.O. Box 1046, Station B
Ottawa, ON K1P 5S9

Ref. CMD 18-M48

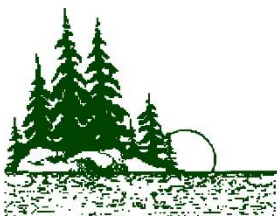
Dear President Velshi and Commission Members:

Re. **Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017**

On 29 June 2018 the Secretariat for the Canadian Nuclear Safety Commission provided notice that the Commission would hold a public meeting in December 2018 during which CNSC staff will present its *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017*.

The notice further indicated that the Report would be available after October 12, 2018, online or by request to the Secretariat, and that members of the public who have an interest or expertise on this matter are invited to comment, in writing, on the Report by November 13 2017. Northwatch provides these comments further to that Notice. Northwatch appreciates the extension of the deadline for submission of our comments by one week in response to delays in finalizing the contribution agreement which had to be in place prior to our technical experts beginning their review.

Northwatch is a public interest organization concerned with environmental protection and social development in northeastern Ontario. Founded in 1988 to provide a representative regional voice in environmental decision-making and to address regional concerns with respect to energy, waste, mining and forestry related activities and initiatives, we have a long term and consistent interest in the nuclear chain, and its serial effects and potential effects with respect to northeastern Ontario, including issues related to uranium mining, refining, nuclear power generation, and various nuclear waste management initiatives and proposals as they may relate or have the potential to affect the lands, waters and/or people of northern Ontario. Northwatch has a dual mandate that includes public interest research, education and advocacy to promote environmental awareness and protection of the environment, and support and promotion of public participation in environment-related decision-making.



Northwatch's interest in the *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017* is primarily with respect to the manner and the degree to which the Report addresses issues related to the storage and safekeeping of hundreds of millions of tonnes of radioactive uranium mine tailings in northeastern Ontario, including and primarily those found in the Serpent River watershed (and associated with the Stanleigh, Quirke, Panel, Spanish-American, Milliken, Lacnor, Buckles, Pronto, Denison I, Denison II and Stanrock mines) and the Pronto Mine in Algoma District, and with the Agnew Lake mine in Sudbury District. Northwtach also has an interest in closed uranium mines and mine waste areas in northeastern Ontario that are not under license by the CNSC, including the mining wastes from the Nova Beaucage Mine that were deposited on the lands of Nipissing First Nation.

In preparing these comments we reviewed the *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2016*, related submission to the CNSC from Northwatch on previous years, several of the reports listed in the technical review prepared for Northwatch by Hutcheson Environmental Sciences Inc.¹ as well as additional background material.

Technical Review of *Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2016*

In addition to the general observations included in this letter, Northwatch is submitting to the Commission for their consideration a technical review of the *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017* and related documents. This technical review was prepared by Hutchinson Environmental Sciences Ltd, and is appended to this letter. While we commend the report in its entirety to the Commission, key findings of the HES review include the following:

- The CNSC reports commonly lacked sufficient details and supporting information to clearly communicate the rationale for conclusions, issues of concern, potential environmental effects context, and actions required or requested by licensees to remedy concerns.
- Reports prepared by the licensees were generally detailed and substantiated, especially regarding license compliance, but were commonly unclear on broader environmental effects and commitments to resolution of concerns, in some cases.
- Unresolved potential sources of contaminants at Agnew Lake and in the Elliot Lake area included:
 - Ongoing care and maintenance of the Agnew Lake tailings cover, potential environmental effects to surface water near the TMA, and unknown effects from the potential import of tailings from the Beaucage Mine;
 - Continuing uranium in effluent of the Denison TMA-1 site, at concentrations above Provincial Water Quality Objectives (PWQO);
 - Radium instability and compliance limit exceedances in effluent at the Rio Algom Stanleigh TMA facility; and
 - Unknown effects of potential tailings import from the Beaucage Mine to the Denison Pronto TMA.

¹ See Appendix 1

- In all cases except the Pronto TMA for which there was limited information, the licensees implemented response actions to the potential contaminant sources, but the results of the actions were not reported in the documents reviewed.
- Common areas for improvement in environmental effects monitoring and reporting include:
 - Seasonal water quality monitoring and data interpretation could provide additional insight into periods of the year when contaminant presence in surface water is higher (i.e., runoff during spring, fall and storm events), and contribute to further improving water quality. Water quality is currently reported as annual averages with summary statistics, which can mask the effects of seasonality;
 - Comparisons between measured conditions and predictions could inform adaptive management activities, but it is not clear if predictions are a requirement of the CNSC regulatory process and therefore if the absence of comparisons is an issue of non-compliance or of there being no requirement to make predictions;
 - Groundwater and porewater quality criteria should be clearly established and used to identify environmental concerns; and
 - Surface water, sediment and biota sampling locations should be placed to measure possible contamination near TMA outfalls where environmental effects could occur in mixing zones, in addition to the current sample locations which generally measure ambient or fully mixed conditions further afield.

Northwatch's General Review

Northwatch's general review focussed primarily on the closed uranium mines in northeastern Ontario, as noted above. Our comments and observations with respect to *Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017* include the following:

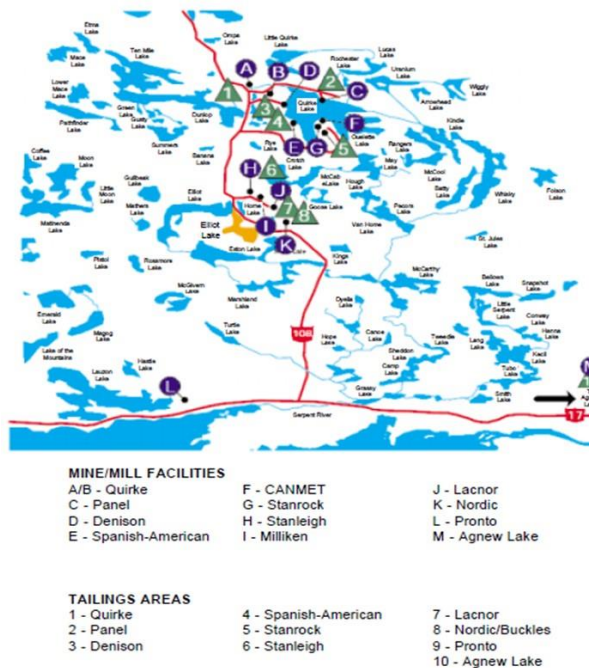
- CNSC's decision to report on the "historic and decommissioned" sites only every two years is unexplained, and is not supported by Northwatch; particularly for the sites which are under perpetual licenses, the Regulatory Oversight Report is the only regular occasion for an exchange of information between the CNSC and the public, and the sole means of public reporting on these sites
- The report describes "regulated sites" including five operating facilities in Saskatchewan, for sites that are undergoing remediation, and what it lists as nine "decommissioned sites" (Beaverlodge, Cluff Lake, Rayrock, Port Radium, Agnew Lake, Bicroft, Dyno, "Elliot Lake", and "Denison and Stanrock" but in the case of the northeastern Ontario sites (referred to as "Elliot Lake", and "Denison and Stanrock") the catchall descriptors are inaccurate and potentially misleading; in addition, there is insufficient information provided on a site-by-site basis
- For readers who are unfamiliar with the Elliot Lake area or with the CNSC grouping of the closed uranium mine sites on the north shore of Lake Huron, the geographic relationship between the sites and the linkages to the licensees may not be apparent from this report; in addition, observations are frequently made about a group of mines (such as "Elliot Lake")

when it would be more informative and more transparent to name the specific mines.

Licensed Closed Uranium Mines, Mills and U-Waste Sites in Northeastern Ontario				
License	First Issued	Most Recent Amendment	Licensee	Mines/ Properties
UMDL-MINEMILL-STANROCK.02/indf		2010	Denison	Stanrock
UMDL-MINEMILL-DENISON.01/indf	1995	2004	Denison	Denison Mines (TMA's 1 and 2)
WFOL-W5-31 01.03/indf		2007	Rio Algom	Spanish-American Milliken Lacnor Nordic/Buckles Pronto Quirke Mine Panel Mine Stanleigh Mine
WNSL-W5-3102.3/2021		2012	Ontario	Agnew Lake

Figure 1 Licenced Uranium Mine, Mill or Waste Sites in Northeastern Ontario

Figure 4.8: Uranium Mine and Mill Tailings Sites near Elliot Lake, Ontario



Source: Inventory of Radioactive Waste in Canada, LLRWMO-01613-041-10001, 2004

- The report makes very generalized statements and excludes important specifics, such as in the statement “In some cases, LCHs for historic and decommissioned sites are currently being developed”²; in such cases, a specific statement of which sites are currently having LCH’s developed would be appropriate
- Similarly, the report indicates that there have been inspections, there have been incidents of non-compliance, but within the sites on the north shore of Lake Huron region it does not co-relate the inspections with the actual sites; this information was provided by CNSC in response to a request from Northwatch and it was helpful in understanding the report, but the information would be unavailable to most readers
- In some cases, the report makes statements which are overly general and may create false impressions with some readers; for example, the report states that “In 2017, licensees and CNSC staff continued regular communication with interested communities” and some communication events are listed; CNSC staff confirmed that no such events took place in northeastern Ontario, but this was not clear nor the impression created by the report text
- The report purports that providing Total annual load of uranium (kg) and relevant uranium-238 progeny (MBq) released in liquid effluent to surface waters from the northern Saskatchewan uranium mines and/or mills from the years 2013–17 ((Table K-1) and Total annual load of uranium (kg) and radium-226 for the tailings waste management facilities in the Elliot Lake region for the years 2013–17 (Table K-2) provides equivalency with reporting in the National Pollutant Release Inventory; quite clearly it does not, for reasons well known to CNSC staff
- The Agnew Lake site was reported as being below expectations for the year 2016:

During a 2015 inspection, CNSC staff found sections of the tailings areas were exposed where the TMA cover had degraded and some locations measured dose rates of greater than 1 µSv/h. In 2016, MNDM conducted a gamma dose rate survey and public dose assessment of the Agnew Lake TMA and found incremental dose rates ranged from 0 to 8.1 µSv/h, with an average of 1.085 µSv/h.

Northwatch is concerned about the overall stability of this site, and the level of oversight being provided at the Agnew Lake Mine; this is of particular concern given that the immediate area has been the subject of a high level of mineral exploration over the last several years, which introduces the potential for both increased levels of disturbance to the site and increased levels of human exposure to those working in the vicinity

- The report states - almost in passing – that MNDM is proposing to transfer historic uranium mine waste from the Nova Beaucage Uranium Mine to the Agnew Lake TMA:

Repair to the cover of the TMA is planned and MNDM has proposed to add niobium ore and tailings classified as naturally occurring radioactive material (NORM) from the former Beaucage Mine near North Bay to cover these tailings. MNDM has proposed that the placement of the niobium waste will provide shielding for the existing tailings and the soil cover over the niobium waste will prevent contact with the niobium waste and reduce gamma doses to background levels.³

Northwatch has a concern about unlisted and unlicensed uranium mine sites in northeastern Ontario, including the Nova Beaucage Mine on Newman Island in Lake

² CMD, Page 4

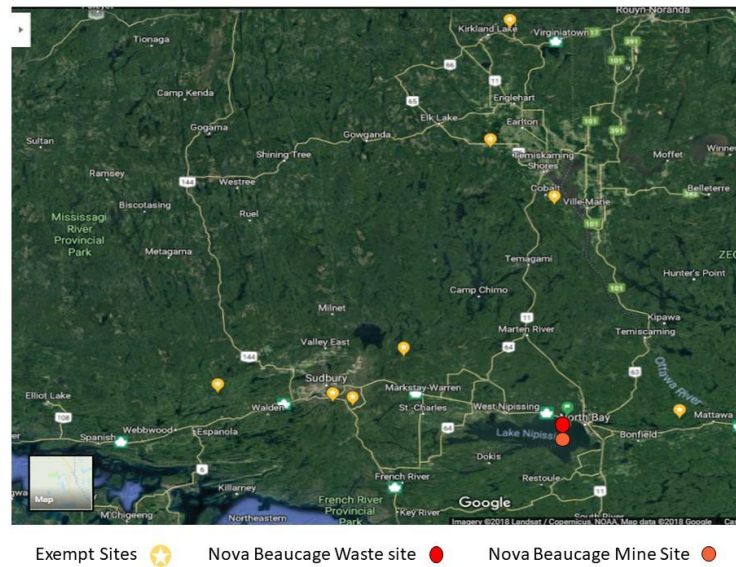
³ Section 7.1

Nipissing, and the mine wastes that were deposited – uncontained and unmanaged – in Yellek, on the Nipissing First Nation lands. We fully support remediation of the uranium mine wastes on Nipissing First Nation lands. However:

- This report provides insufficient information about the waste materials from the former Nova Beaucage Uranium Mine, or plans for the full remediation of that site as part of this project
- This report presents an assumption that these wastes are to be transferred to the Agnew Lake Mine, while Rio Algom Limited’s *Operating Care and Maintenance 2017 Annual Report* indicates that the tailings from the Nova Beaucage uranium mine may be relocated to the Pronto mine site
- The report does not acknowledge the many unlicensed uranium mines and mine sites, including the eight sites in northeastern Ontario that are included in the CNSC "Idle Mines without Tailings Exemption List", or the two sites associated with the Nova Beaucage Uranium Mine (Nova Beaucage (Uranium) Mine, Newman Island and the Nova Beaucage (Uranium) tailings area, Yellek)

Unlicensed Closed Uranium Mines, Mills and U-Waste Sites in Northeastern Ontario				
License	First Issued	Most Recent Amendment	Licensee	Mines/ Properties
"Idle Mines without Tailings Exemption List" CMD 01-M77 CMD-04-M47 CMD: 12-H108	2004	2012	No Licensee	Agnew Lake mill and mine Bidgood Cane Silver Mines Cubar Uranium Mines Loughrin Feldspar Mayfair Purdy Vaillancourt Feldspar Quarry
Unlisted/Unlicensed	Unlisted	Unlisted	Unlisted	Nova Beaucage (Uranium) Mine, Newman Island Nova Beaucage (Uranium) tailings area, Yellek

Figure 2 Unlicensed and Unlisted Uranium Mines, Mills or Waste Areas in Northeastern Ontario



- The report indicates that there has been access to the Agnew Lake site, suggesting that there is insufficient access control and signage about the radiation and mine hazards on site; while two additional signs have been installed, Northwatch questions the timeliness and adequacy of these measures
- The radium-226 exceedances at the Stanleigh effluent discharge location indicate that the site is not chemically stable; an observation that is supported by even the very generalized discharge reporting provided in Appendix K; in Northwatch's view this warrants more rigorous oversight and more regular public reporting on these sites
- In addition to the information provided in the very general Regulatory Oversight Report, information included in related documents provide multiple indications that neither chemical or physical stability have been achieved at the closed uranium sites in northeastern Ontario. For example, the *2016 Geotechnical Inspection of the Denison and Stanrock Tailings Management Areas* identified numerous instances of physical and chemical instability, including seeps and physical degradations; this information is not communicated via the Regulatory Oversight Report, but is potentially of large significance in terms of safety and stability of these sites, both physically and environmentally

Conclusion

As has been noted in comments by Northwatch on other Regulatory Oversight Reports and invited public comment on these reports, Northwatch is of the view that increased predictability and transparency with this respect this report series is in order. We would again encourage the Commission to direct staff to make the Regulatory Oversight Reports more available and to develop an overall matrix of the Regulatory Oversight Report indicating which topics are addressed by which Report and how the reports within the series interrelated, as well as publishing a schedule for the release and comment periods of each of the Reports.

While the Regulatory Oversight Reports are potentially useful as overview reports, they are inadequate to the task – or CNSC’s responsibilities – of providing reliable reporting on closed and decommissioned uranium mine sites. They provide insufficient information and analysis for either the interested public or the Commission. As first steps, Northwatch requests the following:

- The reports be issued on at most an annual basis
- The reports include hyperlinks to all supporting information
- The reports are more readily available through the CNSC web site and through other means
- The comment period is extended from the current thirty days to at least sixty days

Thank you for your consideration.



Brennain Lloyd
Northwatch Project Coordinator

Northwatch Submissions on CMD 18-M48

APPENDIX 1

Technical review was prepared for Northwatch by
Hutchinson Environmental Sciences Ltd



November 19, 2018

Project No.: 180092

Ms. Brennain Lloyd
Project Coordinator
Northwatch
Box 282, North Bay ON
P1B 8H2

Dear Ms. Lloyd,

Re: Technical review of the Canadian Nuclear Safety Commission's "Regulatory Oversight Report on Uranium Mines, Mills, Historic and Decommissioned Sites in Canada" (2017) and associated information

This letter presents comments and questions on several information sources related to and including the Canadian Nuclear Safety Commission's (CNSC) "Regulatory Oversight Report on Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017". The review was conducted for Northwatch on the following nuclear sites, that the organization identified as a priority for the review:

- Pronto and Agnew Lake tailings management areas (TMA) as potential receiving facilities for waste from the Beaucage Mine; and
- Rio Algom and Denison Mines sites in the Elliot Lake area.

Key overall findings and areas for CNSC improvement are provided first, with additional detailed review findings provided by site and area presented after. The detailed findings are important to consider for potential improvements in TMA monitoring, environmental effects monitoring, data analysis, findings presentation and follow-up actions. Our scope and limitations of the review effort are also discussed to provide context for the results.

We trust this review will provide constructive feedback on information collection, analysis and communication for the uranium mines in the Agnew Lake and Elliot Lake areas.

Sincerely,

Per. Hutchinson Environmental Sciences Ltd.

David Leeder, P. Geo. (Limited)
Senior Environmental Scientist
david.leeder@environmentalsciences.ca



1.0 KEY REVIEW FINDINGS

The review found overall that the CNSC reports commonly lacked sufficient details and supporting information to clearly communicate the rationale for conclusions, issues of concern, potential environmental effects context, and actions required or requested by licensees to remedy concerns. The reports prepared by the licensees were generally detailed and substantiated, especially regarding license compliance, but were commonly unclear on broader environmental effects and commitments to resolution of concerns.

Definition of CNSC's regulatory responsibility and relationship with licensees was sparse and unclear as to what ability CNSC had to enforce compliance or mitigation/remediation action. Terms such as "expectation", "request" and "recommendation" to licensees from CNSC on apparent non-compliance issues, gave the impression – whether correct or not – that some areas of concern were open to interpretation or voluntary compliance. This, combined with a paucity of supporting information for CNSC's evaluations of the sites of interest to Northwatch, made it difficult to know how licensees would be monitored and concerns (if any) remedied.

A critical recommendation from the review for CNSC communication, was to provide more complete background and rationale for CNSC decisions, a more clear definition of CNSC's regulatory role, and references to publicly available information that would substantiate CNSC's findings.

Unresolved potential sources of contaminants at Agnew Lake and in the Elliot Lake area included:

- Ongoing care and maintenance of the Agnew Lake tailings cover, potential environmental effects to surface water near the TMA, and unknown effects from the potential import of tailings from the Beaucage Mine;
- Continuing uranium in effluent of the Denison TMA-1 site, at concentrations above Provincial Water Quality Objectives (PWQO);
- Radium instability and compliance limit exceedances in effluent at the Rio Algom Stanleigh TMA facility; and
- Unknown effects of potential tailings import from the Beaucage Mine to the Denison Pronto TMA.

In all cases except the Pronto TMA for which there was limited information, the licensees implemented response actions to the potential contaminant sources, but the results of the actions were not reported in the documents reviewed. It was not clear if CNSC was aware of these potential concerns, or how the Commission would respond to them.

The review identified common areas for improvement in environmental effects monitoring and reporting:

- Seasonal water quality monitoring and data interpretation could provide additional insight into periods of the year when contaminant presence in surface water is higher (i.e., runoff during spring,



fall and storm events), and contribute to further improving water quality. Water quality is currently reported as annual averages with summary statistics, which can mask the effects of seasonality;

- There was an absence of comparisons between measured conditions and predictions in order to address NorthWatch's question: *"How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?"* This is a useful question which could inform adaptive management activities, but it is not clear if predictions are a requirement of the CNSC regulatory process and therefore if the absence of comparisons is an issue of non-compliance or of there being no requirement to make predictions;
- Groundwater and porewater quality criteria should be clearly established and used to identify environmental concerns; and
- Surface water, sediment and biota sampling locations should be placed to measure possible contamination near TMA outfalls where environmental effects could occur in mixing zones, in addition to the current sample locations which generally measure ambient or fully mixed conditions further afield.

Again, it was unclear if CNSC understood the potential limitations of the environmental effects monitoring conducted to date, or how it could be improved to better inform the public of changes in the effected watersheds or inform licensing. Improvements in CSNC's rationale and context for their findings, and regulatory oversight role, could reduce these uncertainties.



2.0 DETAILED REVIEW FINDINGS

2.1 SCOPE OF REVIEW

The readily available information sources on the sites were provided by Northwatch and reviewed to evaluate:

- How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?
- Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?
- Are the chemical and physical conditions of the former Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?
- How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?

The information reviewed varied in purpose and technical depth. The following documents were reviewed, they are listed by site:

- All sites:
 - Canadian Nuclear Safety Commission (2018a). Regulatory Oversight Report for Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017. October 12, 2018.
 - Northwatch (2017). Re: Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2016. November 13, 2017.
- Agnew Lake Tailings Management Area:
 - Canadian Nuclear Safety Commission (2018b). CNSC Compliance Inspection Report, Inspection No.: MNDM-ALTMA-2017-01, Type II Baseline Compliance Inspection of Agnew Tailings Management Area. February 1, 2018.
 - Ministry of Northern Development and Mines (2017). Memorandum: Re: 2016 Annual Report – Agnew Lake Tailings Area, License Number WNSL-W5-3102.3/2021. June 15, 2017.
 - Canadian Nuclear Safety Commission (2004a). Waste Nuclear Substance Licence, Agnew Lake Tailings Management Area. December 15, 2004.
- Elliot Lake Sites:



- Canadian Nuclear Safety Commission (2018c). Memorandum: Status Update on Exceedance of Monthly Average Discharge Limit for December 2017 for Radium-226 for the Elliot Lake Historic Sites. January 17, 2018.
- Canadian Nuclear Safety Commission (2015). History of uranium mining in the Elliot Lake region of Ontario and associated effects on water quality and fish intended for human consumption. January, 2015.
- Canadian Nuclear Safety Commission (2012). Uranium Mine Decommissioning Licence, Denison Mines Ltd., Stanrock Mining Facility. December 18, 2012.
- Canadian Nuclear Safety Commission (2010). Uranium Mine Decommissioning Licence, Denison Mines Ltd., Stanrock Mining Facility. September 17, 2010.
- Canadian Nuclear Safety Commission (2007). Amendment, Radioactive Waste Facility Operating Licence, Rio Algom Limited Elliot Lake Historic Sites Facility. June 7, 2007.
- Canadian Nuclear Safety Commission (2004b). Uranium Mine Decommissioning License, Denison Mines Inc., Denison Mining Facility. December 15, 2004.
- Denison Mines (2018). 2017 Operating Care and Maintenance Annual Report. March 29, 2018.
- Denison Mines (2017a). 2016 Operating Care and Maintenance Annual Report. March 31, 2017.
- Minnow Environmental Inc. (2017). Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report. November, 2017.
- Minnow Environmental Inc. (2018). Stanleigh Effluent Radium-226 Impact Assessment Report. Prepared for Rio Algom Limited. January 2018.
- Rio Algom Limited (2017). Operating Care and Maintenance 2016 Annual Report. March 31, 2017.
- Rio Algom Limited (2018). Operating Care and Maintenance 2017 Annual Report. March 31, 2018.
- Rio Algom Limited and Denison Mines Inc. (2018). Serpent River Watershed Monitoring Program, 2017 Annual Water Quality Report. March 31, 2018.

There were no documents on the Beaucage Mine site, and the nature of tailings potentially relocated to the Agnew Lake and/or Pronto Tailings Management Areas (TMA) could therefore not be evaluated.

The review was conducted from the perspective of assessing actual and potential environmental concerns for human and ecological receptor health, and did not include reviews of occupational health and safety,



industrial processes, compliance audits, wildlife and human health assessments, or other non-environmental related issues.

Critical limitations of the review were the short timeline available to conduct it from project approval notice (~ 2 weeks), limited opportunity to present questions and requests for clarification to CNSC and/or mine operators to clarify points of uncertainty, reports from different organizations with a wide range of technical rigour and difficulty identifying references to source information. This review provides comments and questions to clarify future regulatory oversight and supported reporting, and encourage improvements in monitoring, reporting and response to actual or potential environmental concerns. Hutchinson Environmental Sciences Ltd. does not guarantee that all environmental concerns related to the sites identified by Northwatch were captured in this review.

2.2 2017 CNSC REGULATORY OVERSIGHT REPORT

CNSC (2018a): "Regulatory Oversight Report on Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017"

The report presented CNSC staff's assessments of licensee performance for operating historic and decommissioned uranium mines and mills regulated by the Commission. The report focussed on three safety and control areas (SCAs) of the 14 that CNSC evaluated. The three SCAs, according to CNSC, presented the majority of the key performance indicators for the facilities: radiation protection, environmental protection, and conventional health and safety.

This review found that the CNSC report provided a good general context and overview of the Commission's role in nuclear safety in Canada, and a high-level summary of their 2017 oversight findings. Sections specific to each site were included in the report, but the information on the sites of interest to Northwatch – Agnew Lake, and the Rio Algom and Denison Mine Elliot Lake sites – lacked sufficient detail for the reviewer to determine if the CNSC assessments of the sites were reasonable, and if the sites were operating in a way that protected human and environmental receptor health. Appendices to the report contained limited additional information, and clear links or references to supporting material were not provided.

Future reports should provide sufficiently robust technical information or clear references to publicly available information, for reviewers to determine if CNSC findings were reasonable and the sites were operating in a way that protected human and environmental receptor health. CNSC should seek to clarify their oversight and enforcement roles, and when concerns are identified, clarify how and when the concerns will be remedied

The report's evaluation summary is provided in Table 1. Specific review findings for the Agnew Lake TMA and Elliot Lake sites from CNSC (2018a) are presented in Table 2.



Table 1. Evaluation summary of CNSC (2018a): Regulatory Oversight Report on Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report provided information to the public from CNSC. A good general overview of the sites in Canada was provided, but there was a substantial lack of information supporting CNSC’s findings and remedies for a “below expectation” evaluation, on the Agnew Lake TMA, and Rio Algom and Denison Mines Elliot Lake sites.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	It was unclear from the report, if CNSC had sufficient information to understand site conditions and conduct appropriate follow-up oversight, because the evaluation was poorly substantiated.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report did not contain sufficient information to determine the stability or the change in the Agnew Lake TMA, and Rio Algom and Denison Mines Elliot Lake sites. A summary of previous reports or conditions would provide additional valuable context.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	A comparison of predictions vs. observed conditions was not conducted in the report for the Agnew Lake TMA, and Rio Algom and Denison Mines Elliot Lake sites.



Table 2. Findings of CNSC (2018a): Regulatory Oversight Report on Uranium Mines, Mills, Historic and Decommissioned Sites in Canada: 2017, and review comments and questions.

Report finding	Comment or question
<p><i>Section 8.2, pages 107 to 109; and</i></p> <p><i>Section 8.4, page 111</i></p> <p>In 2016, Elliot Lake Environmental Protection was rated “satisfactory” (Table 8.3) and was rated “below average” in 2017 (Table 8.4). The change was due to radium-226 exceeding guidelines at the Stanleigh effluent treatment plant. CNSC reported that the exceedance did not have any effect on water quality or aquatic biota (described in Section 20).</p>	<p>Limited information on the radium-226 exceedance and follow-up was provided. See review comments on Section 20 of the report (below).</p>
<p><i>Section II-B, page 126</i></p> <p>The report identified that given the limited nature of onsite work, outdoor setting and low radiation levels following remediation activities, the potential for radiation exposure to workers and the public is very low at the nine uranium mine and mill sites that have been decommissioned and are in the long-term maintenance and monitoring phase. CNSC staff reportedly reviewed the risk assessments and monitoring data for all decommissioned sites and concluded that levels of exposure are much lower than regulatory radiation limits to non-nuclear energy workers (NEWs).</p>	<p>The risk assessments and monitoring data CNSC reviewed to establish their low-risk position, were not referenced or summarized for further consideration by reviewers. References and summary findings of risk assessments conducted by Laurentian University and CNSC were found during this review in CNSC (2015 – review comments provided in subsequent sections). Persons familiar with background information may understand the information’s relevance, but it is not apparent otherwise.</p> <ul style="list-style-type: none"> - Will CNSC provide reference(s) to the supporting risk assessments and monitoring data in subsequent years, to assist reviewers and interested parties in better understanding the rationale for identifying low-exposure potential?



Report finding	Comment or question
<i>Agnew Lake Tailings Management Area</i>	
<p data-bbox="256 341 709 370"><i>Section 17.1 - Performance, page 143</i></p> <p data-bbox="256 409 1062 695">The Agnew Lake TMA cover was found to be degraded in 2015 and 2016, exposing tailings. CNSC inspectors measured dose rates greater than 1 µSv/h (2015) and 8.1 µSv/h (2016). CNSC reported that repair to the cover is planned: niobium ore and tailings classified as naturally occurring radioactive material (NORM) from the former Beaucage Mine will be brought to site to will shield the existing tailings, and soil will cover the niobium waste and reduce gamma doses to background.</p>	<p data-bbox="1100 341 1965 406">The degraded TMA cover (soil – CNSC, 2015) and proposed remediation is concerning.</p> <ul style="list-style-type: none"> <li data-bbox="1100 448 1965 513">- Why were exposed tailings in the TMA permitted to persist from 2015 to 2016, allowing the measured dose rates to increase? <li data-bbox="1100 555 1965 620">- What was the cause of the degraded cover, and what measures will be taken to prevent the new cover from degrading in a similar way? <li data-bbox="1100 662 1780 691">- What is the timeline to remediate the degraded cover? <li data-bbox="1100 734 1965 902">- Erosion is a common cause of cover degradation. If this was the case here, where did the eroded materials settle, was there any evidence of the tailings eroding, and what were the dose rates measured in the eroded material depositional area? Did eroded materials reach water or other sensitive features? <li data-bbox="1100 945 1965 1081">- What is the measured dose rate from the niobium ore proposed to be relocated to Agnew Lake, and why is it expected to shield the existing tailings? NORM – classified as naturally occurring – can also be a human and environmental health concern. <li data-bbox="1100 1123 1965 1188">- How was the “background” dose rate established, and why is it acceptable to protect human and environmental health? <li data-bbox="1100 1230 1965 1334">- What are the construction details of the new cover, and how will the construction ensure that human and environmental health are protected?



Report finding	Comment or question
<p data-bbox="256 266 802 298"><i>Section 17.2 – Radiation Protection, page 143</i></p> <p data-bbox="256 337 1075 626">In 2016, CNSC staff rated the radiation protection SCA at the Agnew Lake TMA as “below expectations” due to the lack of a documented radiation protection program. In 2017 the licensee added a radiation warning sign at each of the north and south end of the TMA, removed hunting blinds near the TMA, conducted a public dose survey and implemented non-specified “interim measures”. After the interim measures and improvements to radiation protection on the site were established, CNSC rated the SCA as “satisfactory” in 2017.</p>	<p data-bbox="1100 266 1974 483">CNSC did not provide a description of the “interim measures” or why the improvements were expected to change public use of, and increase protection from, the TMA. The TMA will or has undergone work in 2018 that introduced NORM and may have exposed tailings, which is outside of the scope of public impact assessment conducted in 2017. CNSC did not identify that a radiation protection program was implemented. Therefore:</p> <ul data-bbox="1100 522 1961 876" style="list-style-type: none"> - What evidence exists that the warning signs reduced public use of the TMA and increased public protection? - If NORM was introduced to the TMA or tailings were exposed as part of cover repair in 2017, what assurances are there that there was not public impact? - What constitutes an acceptable radiation protection program, and when must the licensee have the program completed and implemented?



Report finding	Comment or question
<p><i>Section 17.3 – Environmental Protection, page 144</i></p> <p>CNSC reported that surface water quality was measured at several locations around the Agnew Lake TMA, and that the 2017 results were acceptable and below PWQOs.</p>	<p>Rationale was not provided on where and when water quality samples were collected, how the sampling program was protective of the environment and human receptors, which parameters were measured and how the results were interpreted to indicate no risk (PWQOs for radionuclides are complicated and interpreted differently depending on receptor). This level of detail is the minimum expectation for environmental surface water quality monitor reporting.</p> <p>During the course of the review, the information on Angew Lake TMA water quality monitoring was identified and reviewed, however it was not apparent in the CNSC report.</p> <ul style="list-style-type: none"> - Will CNSC provide more clear references to supporting material, and improve the detail in subsequent reports to assist the reader in understanding the context and pertinence of the findings?
<p><i>Elliot Lake Sites</i></p>	
<p><i>Section 20.1 – Performance, Page 150; and</i></p> <p><i>Section 20.3 – Environmental Protection, page 150</i></p> <p>In 2016, CNSC rated Rio Algom Limited’s performance in the environmental protection SCA as “satisfactory”; however, in 2017 their performance was rated as “below expectations” due to a licence limit exceedance for radium releases from the Stanleigh effluent treatment plant. Follow-up actions included an information request pursuant to subsection 12(2) of the General Nuclear Safety and Control Regulations, analysis of past corrective actions, and a corrective plan and timeline to address the exceedance.</p>	<p>The follow-up actions reported by CNSC did not include an assessment of impacts to receptors in the receiver of the effluent, even though detailed assessments were conducted by Rio Algom, identified during the course of this review.</p> <ul style="list-style-type: none"> - Will CNSC provide more clear references to supporting material, and improve the detail in subsequent reports to assist the reader in understanding the context and pertinence of the findings?



Section 20.3 – Environmental Protection, page 151

On January 11, 2018 Rio Algom reported an exceedance of the monthly average discharge limit for radium-226 at the Stanleigh effluent discharge for the December 2017 period. The monthly average limit in the licence is 0.37 Bq/L and the reported value for December 2017 was 0.415 Bq/L. Rio Algom notified the CNSC duty officer and also notified the Ontario Ministry of the Environment and Climate Change. The monthly average limit in the licence is based on the Metal Mining Effluent Regulations to be protective of the environment.

CNSC reported that radium-226 concentrations in the undiluted effluent were below Health Canada's Canadian Drinking Water Guidelines (0.5 Bq/L) and Canadian Environmental Quality Guidelines (no radium guideline). CNSC staff requested Rio Algom to carry out a toxicity test of the effluent. RAL confirmed all tested fish survived when exposed to effluent.

CNSC staff concluded there were no radiological impacts to members of the public or the environment from the limit exceedance. All annual mean concentrations of constituents of concern in the receiving environment, including radium-226 were below the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines and Health Canada's Canadian Drinking Water Guidelines.

Prior to the licence limit exceedance, RAL reported an action level exceedance for radium-226 in November 2017.

CNSC reportedly increased compliance oversight but did not describe what the effort included. CNSC also reported that the licensee implemented supplementary monitoring protocols, which

The radium-226 average monthly limit exceedance and the CNSC's reporting and reactions are concerning. Radium exceedances at Stanleigh occurred several times in 2017, starting in April, and have been a known concern since 2015 (Rio Algom, 2018), but were reported here as first occurring in November 2017.

The monitoring prior to the incident, effects monitoring, response and mitigation are thoroughly documented in Rio Algom (2018) – discussed in subsequent sections. CNSC incompletely reported this work and provided overly brief descriptions of the environmental impact evaluations.

CNSC (2018) is a summary report, but the context, history and response to the concern is important to understand – the information absence causes unnecessary uncertainty about CNSC's response to concerns and Rio Algom's corporate capabilities.

- Why did CNSC not provide important information on the concern, its history, monitoring and response?

CNSC compared radium-226 concentrations to Canadian Environmental Quality Guidelines when in fact there is no radium-226 CCME guideline. This oversight indicates a poor understanding of environmental guidelines, regardless of how well CNSC understands the guidelines.

CNSC indicated dissatisfaction with Rio Algom's responses to their requests, but did not describe how as the regulator, the Commission would respond, or when compliance would be required.

- Was a compliance date for corrective action to CNSC's request established? If so, CNSC should provide this detail in future reports of these incidents, and if not, CNSC should explain why it is not necessary.



Report finding	Comment or question
<p>include toxicity testing of the effluent at the discharge location, and additional downstream monitoring. No further details on the programs were provided.</p> <p>CNSC submitted a request for a description of steps and a plan to decrease radium-226 to below compliance limits, and received a corrective action plan. CNSC reported that the licensee has not provided all requested information, and the request remains open.</p>	
<p><i>Appendix K. Annual Releases of Radionuclides to the Environment, Table K-2, page 191</i></p> <p>Table K-2 lists the total annual load of uranium and radium-226 from the Elliot Lake region sites. The table does not include the discharge from the Stanleigh effluent.</p>	<p>The Stanleigh effluent may be a significant source of radionuclide materials to the local watershed, indicated by the 2017 compliance limit exceedance.</p> <ul style="list-style-type: none"> - What is the annual loading from Stanleigh to the surface water receiving its effluent? Why was it not included in the Table K-2?
<p><i>General</i></p> <p>Rio Algom operates 6 other licensed TMAs in the Elliot Lake area, in addition to the Stanleigh TMA, but these were not identified and did not appear to be evaluated as part of the Rio Algom Elliot Lake sites.</p>	<ul style="list-style-type: none"> - Did CNSC include the other Rio Algom sites in the evaluation? If so, why were they not reported? If not, why are they not included in the evaluation?



Report finding	Comment or question
<i>Denison Tailings Management Areas</i>	
<p><i>Section 21 – Denison and Stanrock, pages 153 - 155</i></p> <p>CNSC reported that Denison Stanrock was last reported on in the Regulatory Oversight Report for Uranium Mines and Mills in Canada: 2016, since then there have been no significant changes to the site and the site remains stable. Denison and Stanrock were rated as “satisfactory” in all three categories for 2017, with limited description of the monitoring programs and compliance measures that supported the rating.</p>	<p>There was insufficient information to allow reviewers to understand the reasons for CNSC’s “satisfactory” ratings, and be assured that the Denison and Stanrock sites were indeed stable and not affecting the environment.</p> <p>A review of Denison (2018) that reported water quality at the three Denison TMAs (TMA-1, Lower Williams Lake and Stanrock) to CNSC for 2017, found that uranium concentrations at the TMA-1 outfall have exceeded PWQOs every year since 2013. This review found that receiver monitoring may not be accurately determining environmental impacts from the outfall. The review also found possible metals concerns in the outfall from Stanrock (indicated by toxicity testing results), that may not be captured in water quality monitoring.</p> <ul style="list-style-type: none"> - Did CNSC include the other Denison sites in the evaluation? If so, why were they not reported? If not, why are they not included in the evaluation? - Were these issues considered by CNSC when Denison and Stanrock were rated “satisfactory”? If so, why was the satisfactory rating granted? If not, why were they overlooked? <p>Further review comments specific to the Denison TMAs are included in the associated sub-sections below.</p>



2.3 AGNEW LAKE TAILINGS MANAGEMENT AREA

2.3.1 CNSC (2018b). *CNSC Compliance Inspection Report, Inspection No.: MNDM-ALTMA-2017-01, Type II Baseline Compliance Inspection of Agnew Tailings Management Area.*

The Inspection Report (CNSC, 2018b) described the actions taken by CNSC in 2017 to follow-up on radiological readings of 5uSv/hr at the Agnew Lake TMA measured in 2016, verify compliance with the Nuclear Safety and Control Act (NSCA) and associated Regulations, and with conditions from the facility's license (WNSL-W5-3102.3/2021). Compliance tables at the end of the report correlated Criteria, Compliance Expectations/Methods and identified if the Compliance Expectation had been met.

In general, the report was brief and provided limited substantiation for its findings. Outstanding issues included: not identifying and mitigating tailings cover degradation causes, potential eroded material fate and effect on receptors, why degraded cover was allowed to persist since 2016, how planned remediation using other tailings will ensure receptors are protected, how the current dose assessments will remain pertinent after the addition of Beaucage Mine tailings in 2018/ 2019, and if the uranium concentration above PWQO near the Agnew Lake TMA was a concern.

The report's evaluation summary is provided in Table 3. Specific review findings for the report are presented in Table 4.



Table 3. Evaluation summary of CNSC (2018b): CNSC Compliance Inspection Report, Inspection No.: MNDM-ALTMA-2017-01, Type II Baseline Compliance Inspection of Agnew Tailings Management Area.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The inspection report provided information to the public from CNSC. An overview of the Agnew Lake TMA degraded tailings cover concern and follow-up actions were provided, but the brief nature of the inspection report made it difficult to understand the potential risks and required follow-up actions.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	It was unclear from the report, if CNSC had sufficient information to understand site conditions and conduct appropriate follow-up oversight.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report indicated that the conditions on the Agnew Lake TMA had deteriorated, but the effects to the environment from the degraded situation were not clear.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 4. Agnew Lake TMA concerns from CNSC (2018b): CNSC Compliance Inspection Report, Inspection No.: MNDM-ALTMA-2017-01, Type II Baseline Compliance Inspection of Agnew Tailings Management Area, and review comments and questions.

CNSC-identified issue	CNSC-reported resolution	Comment or question
<p>There were a few areas on the TMA with gamma dose rate readings that were above 1 µSv/hr (background is 0.65 µSv/hr). These readings were similar to those recorded during the 2016 inspection.</p>	<p>Areas with radiological readings above 5uSv/hr should be added to the cover repair work planned at Agnew Lake mine in 2018/2019.</p> <ul style="list-style-type: none"> - Compliance Expectation NOT MET <p>New radiation warning signs were posted throughout the site advising the public of hazards on site.</p> <ul style="list-style-type: none"> - Compliance expectation MET 	<p>The Inspection Report did not address the questions or comments for CNSC, 2018a (presented above) including identifying and mitigating cover degradation causes, potential eroded material fate and effect on receptors, why degraded cover was allowed to persist since 2016, how planned remediation using other tailings will ensure receptors are protected, and how the current assessments will remain pertinent after the addition of Beaucage Mine tailings in 2018/2019.</p> <ul style="list-style-type: none"> - How will CNSC address the concerns identified?
<p>CNSC staff observed two hunting blinds that remained on the site near the TMA. Hunting blinds remain on the site since 2016 despite Ministry of Northern Development and Mines (MNDM) signs alerting the owners of the radiological risks - this continues to pose a public health and safety risk.</p>	<p>Action Notice WDD-ALTMA-2017-AN01 was issued to MNDM: MNDM shall ensure the removal of all hunting blinds erected on the Agnew Tailings Management Area and provide CNSC with notification on the timeline of this removal.</p> <ul style="list-style-type: none"> - Compliance expectation NOT MET 	<p>It appeared that the hunting blinds were removed in CNSC (2018a) whereas they were not in the Inspection Report.</p> <ul style="list-style-type: none"> - Were the hunting blinds removed?



CNSC-identified issue	CNSC-reported resolution	Comment or question
<p>CNSC collected water samples for heavy metals around the TMA.</p>	<p>CNSC reported concentrations were within the range of what was measured by MNDM in 2016 (results in Appendix D of the inspection report).</p> <ul style="list-style-type: none"> - Compliance expectation MET 	<p>The purpose of the water samples, their locations and evaluation criteria were not provided. The samples were collected for total dissolved solids (TDS), chloride, major ions and a general metals scan that included uranium as the only radiological parameter. The measured uranium concentration (9.57 µg/L) exceeded the PWQO (5 µg/L) and indicates a potential environmental concern.</p> <ul style="list-style-type: none"> - Where were the water samples collected and what was their purpose? - Were the analyses conducted sufficient to characterize the potential risk to receptors, and why? - Was the uranium concentration above PWQO a concern?



2.3.2 Ministry of Northern Development and Mines (2017). Memorandum: Re: 2016 Annual Report – Agnew Lake Tailings Area, License Number WNSL-W5-3102.3/2021.

The Annual Report (MNDM, 2017) was submitted to CNSC and discussed 2016 surface water sampling, radiation surveys, estimated doses to lens of the eye, dam inspections and recommendations to make radiation doses as low as reasonably achievable (ALARA). The report contained additional information not provided in CNSC (2018b), but still did not identify firm timelines for cover repair, discuss how possible tailings relocation from Beaucage could affect the TMA, or provide an indication of the environmental effects and mitigation/remediation for uranium exceedances in surface water near the TMA.

The report’s evaluation summary is provided in Table 5. Key findings and recommendations in the annual report relevant to this review are provided in Table 6.

Table 5. Evaluation summary of MNDM (2017): Memorandum: Re: 2016 Annual Report – Agnew Lake Tailings Area, License Number WNSL-W5-3102.3/2021.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report provided a reasonable level of information to CNSC to assess and respond, although it did not clearly identify possible environmental concerns from uranium exceedances in surface water (2016, and 2017 as identified under a separate cover by CNSC, 2018b) or the potential effects of tailings relocation to the TMA.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	See the comment above.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report indicated that the conditions on the Agnew Lake TMA had deteriorated, but the effects to the environment from the degraded situation were not clear.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 6. Findings from MNDM (2017), Memorandum: Re: 2016 Annual Report – Agnew Lake Tailings Area, License Number WNSL-W5-3102.3/2021, and review comments and questions.

MNDM finding	Comment or question
<p>Concentrations of uranium exceeded PWQO (5 µg/L) at the Agnew Lake TMA West Dam on June 6, 2016 (39.2 µg/L) and November 4, 2016 (49.2 µg/L). Water sampled at the West Dam contained radium-226 (0.056 Bq/L, June 6; 0.0084 Bq/L, Nov. 4); water sampled at the Middle Dam Pond also contained radium-226 (0.084 Bq/L, June 6; 0.0072 Bq/L, Nov. 4 at concentrations below PWQO (1 Bq/L).</p>	<p>CNSC (2018b) reported 2017 uranium concentrations in water (9.57 µg/L) as being within the range observed in 2016; the 2017 concentrations are lower, but still above PWQO.</p> <ul style="list-style-type: none"> - Were the 2017 CNSC samples collected in the same location(s) as MNDM? - What follow-up does MNDM recommend to remediate/mitigate the PWQO uranium exceedances, and when will it be implemented?
<p>Radiation dose rates in the southwest and middle portions of the TMA were measured as high as 6.4 and 8.1 uSv/h. Exposed locations in the TMA were associated with higher dose rate readings, and should therefore be repaired and covered during regular inspections. The site is not suited for permanent residency, thus signage and restricted access should be installed to warrant caution from the public.</p>	<p>The regular cover inspection and repair recommendation is reasonable and in keeping with continuous operation and maintenance of the TMA but was not included in CNSC (2018a, b). This recommendation seems pertinent to respond to cover degradation.</p> <ul style="list-style-type: none"> - Why was the recommendation for regular cover inspection and repair not included in CNSC (2018a,b)?
<p>Seepage from the West Dam and undesirable vegetation was noted. Vegetation should be removed within two years.</p>	<p>The seepage and undesirable vegetation were not included in the inspection done on the TMA by CNSC in 2017, which would have been the first opportunity to conduct the inspection, and the recommendation was not included in CNSC (2018a, b).</p> <ul style="list-style-type: none"> - Why were the dam findings and recommendation for repair not included in the CNSC (2018a,b) evaluations?



2.4 ELLIOT LAKE SITES

Serpent River Watershed Monitoring and Overviews

2.4.1 Rio Algom Limited and Denison Mines Inc. (2018). *Serpent River Watershed Monitoring Program, 2017 Annual Water Quality Report.*

The report described the results of the Serpent River Watershed Monitoring Program (SRWMP), which is integrated with three other monitoring programs (reported separately in Denison Mines, 2018 and Rio Algom, 2018): the Tailings Management Area (TMA), the Operational Monitoring Program (TOMP) and Source Area Monitoring Program (SAMP). The TMA, TOMP and SAMP are discussed in detail in separate reports by Rio Algom and Denison (discussed in subsequent sub-sections), and while important for the general context of the report, are somewhat redundant.

The SRWMP conducted monitoring at 21 locations in the Serpent River Watershed, between 1 and 4 times per year. Its results will be included in the next Serpent River Watershed State of the Environment Report (Cycle 5, 2015 – 2019), and it therefore appeared to be an interim document. It is however, an important annual update to CNSC, and a key issue that this review identified was an apparent lack of consideration of seasonality on water quality results, which may affect water quality findings.

The report's evaluation summary is provided in Table 7. Key findings and recommendations in the report relevant to this review, and review comments and questions, are provided in Table 8.



Table 7. Evaluation summary of Rio Algom Limited and Denison Mines Inc. (2018): Serpent River Watershed Monitoring Program, 2017 Annual Water Quality Report.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report provided a summary of water quality in the Serpent River watershed, but did not appear to consider seasonal fluctuations in water quality. The annual summaries presented can mask seasonal concerns and ,may not provide sufficient resolution to inform management actions to improve water quality in the watershed.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information is not adequate to understand the characteristics of the watershed and fully inform regulatory oversight.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report indicated that the conditions of the Serpent River watershed were improving over time, and presented summary supporting data in the report body to substantiate the claim.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 8. Summary of findings and recommendations from Rio Algom Limited and Denison Mines Inc. (2018): Serpent River Watershed Monitoring Program, 2017 Annual Water Quality Report.

Rio Algom and Denison finding	Comment or question
<p><i>Section 3.2 – Location Summary</i></p> <p>The results of the 2017 monitoring were summarized. The mean annual concentrations of all measured parameters were below PWQO or BC MOE guidelines where there was no PWQO. Minor trends in parameter concentrations over time were noted; sulphate concentrations were found to be gradually decreasing. The results for individual sampling events by location were not provided.</p>	<p>Averaging annual results may mask important seasonal variations. Water quality fluctuates seasonally – higher flows in the spring, fall and during storm events introduce suspended solids and organic carbon from erosion-runoff and wetland flushing, respectively. Radionuclides and metals adsorb to suspended solids and organics, and may be appreciably higher seasonally or during storm events. The risk of these higher concentrations may not be identified by examining average data only.</p> <ul style="list-style-type: none"> - Can data be presented in shorter sub-annual intervals (e.g., quarterly), to consider seasonal variation? - Are radiological materials sampled during the time(s) of year when their concentrations are likely to be highest (i.e., spring freshet, fall increasing flow and summer storm events)? <p>Denison (2018) identified decreasing sulphate concentrations as a contributing factor to increased radium in the Stanleigh effluent.</p> <ul style="list-style-type: none"> - Will the decreasing sulphate result in increased radium in the Serpent River watershed?



Rio Algom and Denison finding	Comment or question
<p data-bbox="256 269 674 298"><i>Section 4.1 – Response Monitoring</i></p> <p data-bbox="256 337 1052 516">Response monitoring was initiated in December, 2017 after the radium-226 compliance exceedance at the Stanleigh final discharge. Monitoring was conducted at McCabe Lake (SR-06), the first receiver station downstream of the effluent outfall, and near the mixing point of the Serpent River and Pecors Lake (SR-03).</p> <p data-bbox="256 555 1043 623">Response monitoring will continue into 2018, until radium control is achieved at the Stanleigh discharge.</p>	<p data-bbox="1079 269 1881 373">The Stanleigh Effluent exceedances and follow-up monitoring were described in detail in Rio Algom, 2018 (discussed in the subsections below). However, in the context of this report:</p> <ul data-bbox="1079 412 1881 480" style="list-style-type: none"> - What is the measure/ completion point for “radium control” at the Stanleigh discharge?



2.4.2 Minnow (2017): *Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report.*

The Minnow report was the fourth installment of a 4 year cyclical study of the uranium mining impacts on and recovery of the Serpent River watershed. The report included a detailed historical context, past data synthesis, identified existing contaminant sources, summarized effluent and water quality from existing tailings management facilities and former mine sites, described the watershed monitoring conducted in the current study cycle, and provided a receptor dose/risk assessment.

This review focussed on the study design and results of the current assessment. Other elements of the report are discussed in more detail, in other documents reviewed. The review identified potential areas of improvement in communication of the spatial-temporal trends in the watershed, sampling methods, and seasonal sampling and data analysis.

The report’s evaluation summary is provided in Table 9. The findings of the study, and review comments and questions are provided in Table 10.

Table 9. Evaluation summary Minnow (2017): Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report provided a good historical context and update with current water quality results. However, spatial-temporal trends in the watershed were not fully communicated, and sampling methods, timing and data compilation/analysis may not be capturing important seasonal variations in water quality.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information was not adequate to fully understand the characteristics of the watershed – especially seasonality – and fully inform regulatory oversight.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report indicated that the conditions of the Serpent River watershed were generally improving over time.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 10. Minnow (2017) Serpent River Watershed Cycle 4 (2010 to 2014) State of the Environment Report findings of the study, and review comments and questions.

Minnow (2017) finding	Comment or question
<p><i>General</i></p> <p>The report presented detailed water quality findings by area (e.g., by TMAs and receiving water) and integrated numerical results, but did not provide a comprehensive overview of the surface water program (e.g., watershed sample locations and what conditions each sample was intended to represent).</p>	<p>The context of sample location and purpose is important to understand the dynamics of water and contaminant movement through the Serpent River watershed. Without this context, it is difficult to understand the pertinence and meaning of the numerical results.</p> <ul style="list-style-type: none"> - Will future reports contain additional detail on sample location and purpose, so that the relationship between sample locations can be better understood?
<p><i>Section 2 – Methods</i></p> <p>The section presented a summary of methods used to collect, process and assess data. Specific collection methods, and sample seasonal timing were not specified.</p>	<p>Sample collection methods and water quality seasonality can strongly influence water quality results. For instance, lake stratification in the summer can result in drastically different water quality in each stratified layer – if it is not specified which layer water is sampled from, the most sensitive or impacted lake condition may not be represented in the results. Similarly, water quality can be degraded during spring, fall and storm runoff from suspended solids and adsorbed contaminants – if sampling is conducted during these periods it may over emphasize certain parameters, or under estimate impacts if sampling is conducted only during calm periods.</p> <ul style="list-style-type: none"> - How are water quality samples collected? Can specific methods be described? - When are samples collected, and do they consider the effects of seasonality?



Minnow (2017) finding	Comment or question
<p data-bbox="256 267 642 293"><i>Section 5.1 – Program Overview</i></p> <p data-bbox="256 337 978 402">The section discussed the historical data collection programs, and evolution to the current program.</p> <p data-bbox="256 446 1016 618">Sediment was found to accumulate in the lakes of the watershed at rates between 0.3 to 0.74 mm/yr meaning that it takes over 10 years for 1 cm of sediment to accumulate. The sediment program accordingly, now collects sediment every 10 years, with the next sampling to be conducted in 2019.</p>	<p data-bbox="1043 267 1879 516">Sediment deposition around TMA or water course outfalls may be more appreciable than the ambient lake settling rates identified the study resulting in more risk or sediment accumulation than that related to whole lake deposition . Sediment in these areas is also an early indicator of broader sediment change in a lake, and may more clearly track the movement of sediment-adsorbed radiological parameters and metals.</p> <ul data-bbox="1043 560 1864 699" style="list-style-type: none"> - Could sediment be accumulating more quickly around TMA or water course outfalls? If so, could a sediment sample program be conducted on a shorter interval to identify changes in sediment quality?
<p data-bbox="256 742 737 768"><i>Section 5.3 – Summary (of water quality)</i></p> <p data-bbox="256 812 1016 1133">Minnow found that overall, water quality improved in the Serpent River watershed over time. Only manganese at one location (D-6) and iron at three locations (D-6, DS-18 and M-01) occasionally ($\leq 20\%$) had concentrations above the water quality benchmark established in 1999. Generally, concentrations of manganese, radium-226, sulphate, and uranium decreased over time, except at the outlet of McCabe Lake (SR-06) where barium and radium-226 concentrations have been increasing, although concentrations remain well below the water quality benchmark.</p>	<p data-bbox="1043 742 1860 954">The observed parameter concentration trends over time (generally decreasing) are sensible given the incremental improvements in effluent management and quality at the TMAs (discussed for the various sites, below). Barium and radium concentration increases in McCabe Lake are likely related to the challenges of radium treatment at the Stanleigh ETP (also discussed in further detail, below).</p> <p data-bbox="1043 998 1879 1247">Results from the dataset were examined by summary statistics on an annual basis, which may mask important seasonal water quality trends, impacts and watershed sensitivities. If datasets were examined seasonally (providing data is adequate to do so), it might identify important water quality trends that could inform additional improvements in effluent management and further improve Serpent River watershed water quality.</p>



2.4.3 CNSC (2015): History of uranium mining in the Elliot Lake region of Ontario and associated effects on water quality and fish intended for human consumption.

The report provided an overview of the development and closure history of the uranium mines and mills around Elliot Lake, identified some of the important risks and monitoring programs, and discussed the overall effects of uranium mining on the Serpent River watershed. The report provided a good historical and near-past overview of uranium mining impacts and watershed recovery, that could provide important context for the findings published in the annual Regulatory Oversight reports, and review comments reflect this potential application. The report’s evaluation summary is provided in Table 11. The findings of the report, and review comments and questions are provided in Table 12.

Table 11. Evaluation summary of CNSC (2015). History of uranium mining in the Elliot Lake region of Ontario and associated effects on water quality and fish intended for human consumption

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report was completed by CNSC to provide the public with a history of the uranium mining impacts and recovery in the Serpent River watershed. It provided a good overview and context for the present data regulatory oversight.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information was adequate to describe historical actions and general changes over time, and would provide valuable context to CNSC annual Regulatory Oversight reports.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report indicated that the conditions of the Serpent River watershed were generally improving over time.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 12. Important findings from uranium mining environmental impacts in the Elliot Lake area (CNSC, 2015), and review comments.

CNSC (2015) finding	Comment or question
<p><i>Section 1.3 – Monitoring of tailings dikes and dams</i></p> <p>CNSC identified that the tailings dikes and dams are monitored annually under a geotechnical inspection program run by Denison Mines Inc. and Rio Algom Limited as part of their licence conditions.</p>	<p>The geotechnical fitness of dikes and dams (including water leakage/loss) is important for safe long term tailings management. This element of licensing and human and environmental risk was not discussed in CNSC (2018a), however. Geotechnical reports were not included in the documents for this review.</p> <ul style="list-style-type: none"> - Why were the geotechnical fitness evaluations not included in the Regulatory Oversight report (CNSC, 2018a)? - Were there any important geotechnical findings in 2017 that could have been included in the Regulatory Oversight report?
<p><i>Section 2.1 – Issues related to terrestrial fauna</i></p> <p>This section summarized the findings of risk assessments conducted by Laurentian University and CNSC, that identified little terrestrial risk from the decommissioned Elliot Lake sites, and guided the current environmental effects monitoring to focus on the aquatic environment.</p>	<ul style="list-style-type: none"> - This background is important for reviewers and readers, so that the environmental focus of CNSC (2018a) on surface water monitoring is understood, and could improve future annual Regulatory Oversight reports.



CNSC (2015) finding	Comment or question
<p data-bbox="256 267 800 298"><i>Section 3 – Water quality in the Serpent River</i></p> <p data-bbox="256 337 1035 625">This section summarized the temporal changes in surface water quality in the Serpent River watershed by sub-area. Improvement in mining practices since the 1950s, '60s, '70s and '80s (i.e., retention and treatment of mine and tailings effluent before release to the environment) resulted lower concentrations of uranium and radium in surface water over time, as well as metals associated with acid mine drainage (although these were only measured since 1999).</p>	<p data-bbox="1062 267 1839 375">The section discussed water quality, but did not discuss sediment quality which is identified in Section 4 of the report, as being historically contaminated with radionuclides and metals.</p> <ul data-bbox="1062 412 1845 625" style="list-style-type: none"> - The lack of sediment quality discussion was a noted absence in the report. - The overview however, is important for understanding watershed aquatic health, and could be included in future Regulatory Oversight reports.



CNSC (2015) finding	Comment or question
<p data-bbox="256 267 1018 295"><i>Section 4 – Flesh quality of fish in the Serpent River ecosystems</i></p> <p data-bbox="256 337 783 365"><i>Section 5 – Serpent River Ecosystem Health</i></p> <p data-bbox="256 407 1024 581">The report found that fish tissue quality should not be affected by surface water given that surface water quality was better than the applicable water quality guidelines, and radionuclides tend to accumulate in fish bone rather than tissue. Tissue is the primary concern because fish predators and human eat the tissue.</p> <p data-bbox="256 623 1033 836">Fish may still be affected by contaminated sediment, however, and were sampled in 1998, 1999, 2004 and 2011 – metal and radionuclide concentrations were all below fish consumption guidelines (Health Canada, World Health Organization and United States Environmental Protection Agency) and recommended radionuclide doses (CNSC).</p> <p data-bbox="256 878 1035 1091">Radium levels in Whiskey Lake fish increased from 1999 to 2011 and are above the background reference level but still below the CNSC recommended dose. Given the human health concern with Fish Consumption, CNSC reported that they ‘expected’ the license holder contributing radium to continue monitoring fish in subsequent years.</p>	<p data-bbox="1062 267 1827 370">The descriptions of fish tissue quality and Serpent River ecosystem health provided a good context for watershed aquatic health, and information pathways to human receptors.</p> <ul data-bbox="1062 412 1738 479" style="list-style-type: none"> - The overview could be included in future Regulatory Oversight reports as an improvement.



Denison Mines sites

2.4.4 Denison Mines (2018): 2017 Operating Care and Maintenance Annual Report.

The 2017 Operating Care and Maintenance report included details on Denison company operation, financial guarantees, license change details, health and safety, and water monitoring details. The water monitoring results were reviewed as part of this work. The report presented data back to 2013, and interpreted current data in this context. The report was generally thorough and allowed a good understanding of the monitoring and response actions at the sites in 2017. The review identified areas of improvement in clearly identifying potential environmental impacts from the Denison TMAs and more closely examining seasonal water quality, as well as concerns with ongoing uranium exceedances at the TMA-1 outfall.

The Denison licences (CNSC 2004b, CNSC 2010, CNSC 2012) were consulted to confirm compliance limits. The review of Denison 2018 intrinsically included the findings of Denison 2017a (the 2016 Operating Care and Maintenance Annual Report) because its information was included in the 2017 report.

The report's evaluation summary is provided in Table 13. The findings of the report, and review comments and questions are provided in Table 14.



Table 13. Evaluation summary of CNSC Denison (2018): 2017 Operating Care and Maintenance Annual Report.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report was generally thorough and provided a good description of monitoring and compliance. Potential environmental impacts could however, be identified more clearly.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information was generally adequate to describe compliance issues, but more closely examining seasonal water quality and providing a firm plan to respond to ongoing uranium exceedances at the TMA-1 outfall are key areas for improvement.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	<p>The report indicated:</p> <ul style="list-style-type: none"> - TMA-1: radium was increasing in the TMA and uranium consistently exceeded PWQOs in effluent; - Lower Williams Lake: effluent was consistently below PWQOs; - Stanrock: metals toxicity concern in effluent; and - Groundwater quality fluctuates moderately year to year.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 14. Findings of Denison (2018): 2017 Operating Care and Maintenance Annual Report, and review comments and questions.

Denison (2018) report finding	Comment or question
<p><i>Section 5.2.1.1 - Denison TMA-1</i></p> <p>The TOMP monitoring indicated gradually increasing annual average radium concentrations in the Denison Effluent Treatment Plant (ETP) influent, likely due to decreasing sulphate and hardness in the TMA. Increasing radium may be related to dissolution of barium or calcium sulphate compounds with which radium is associated.</p> <p>Annual average radium concentrations have exceeded PWQO every year since 2013 (Table 5.2.1.1a); average annual uranium concentrations have exceeded PWQO every year since 2013, except for 2016. The discharge has remained below the discharge criteria in the license. Radium has remained below PWQO at final discharge at the Stollery Settling Pond Outlet since 2013; uranium has exceeded PWQO at this location every year since 2013. However, all parameters were reported as remaining below licence discharge criteria.</p> <p>2017 toxicity testing of pond outlet water found 0% acute mortality for <i>Daphnia magna</i> and Rainbow Trout. > 100% IC₂₅ and >100% LC₅₀ results for <i>Ceriodaphnia dubia</i> was determined in 2017, signifying non-toxic effluent for reproduction and survival of the test organisms.</p>	<p>The practice of rolling results into an annual average may underestimate the seasonal concentrations of uranium and radium released. Monthly reports to CNSC report these concentrations, but interpretation of data on an integrated annual basis is conducted in the annual report; seasonally, there may be patterns that are important to understand for assessing receiver impacts and implementing mitigation for possible future exceedances.</p> <ul style="list-style-type: none"> - Will future annual reports consider important seasonal fluctuations in water quality? <p>The average annual uranium PWQO exceedance at the final outfall is concerning, and may indicate an environmental impact near the outfall that is not captured by water quality monitoring stations further downstream. The toxicity testing conducted to date does not consider tissue accumulation.</p> <ul style="list-style-type: none"> - Is there a plan or requirement to mitigate the uranium releases or assess the environmental impacts near outfall in more detail? If not, can CNSC provide rationale for why. - What is the cause of the uranium exceedance, and is there remedy to bring uranium concentrations to below PWQO? Note: the Ontario Ministry of Environmental, Conservation and Parks, does in some cases, permit mixing zones from effluent outfalls.



Denison (2018) report finding	Comment or question
	<p>Radium exceedances within the treatment system but not at the final outfall indicate treatment is effective, but that continued treatment is necessary.</p> <ul style="list-style-type: none"> - Have there been predictions made of radium concentrations in the future? If so, what are the predicted peak radium concentrations? If not, are predictions planned? <p>Is the existing treatment sufficient to mitigate increasing radium concentrations to maintain radium below PWQO?</p>
<p><i>Section 5.2.1.2 – Lower Williams Lake</i></p> <p>Average annual concentrations of metals and radionuclides at Lower Williams Lake Final Discharge were all well below PWQO and the compliance limit in 2017.</p>	<p>The practice of rolling results into an annual average may underestimate the seasonal concentrations of uranium and radium released. Monthly reports to CNSC report these concentrations, but interpretation of data on an integrated annual basis is conducted in the annual report; seasonally, there may be patterns that are important to understand for assessing receiver impacts and implementing mitigation for possible future exceedances.</p> <ul style="list-style-type: none"> - Will future annual reports consider important seasonal fluctuations in water quality?



Denison (2018) report finding	Comment or question
<p><i>Section 5.2.1.3 - Stanrock</i></p> <p>The average annual uranium and three metals concentrations (cobalt, iron and manganese), exceeded PWQO for Stanrock ETP influent every year since 2013. The parameters have all remained below PWQO and compliance discharge criteria at the final outfall and control point for the effluent at Orient Lake, but 2017 toxicity testing at the outlet found >100% IC₂₅ and 55% IC₂₅ for spring and fall sampling events respectively (average >77% IC₂₅), indicated that reproductive inhibition occurred when effluent concentration > 77%. Survival was >100% IC₅₀ for <i>Daphnia magna</i> and Rainbow Trout, indicating the effluent was non-toxic for survival.</p>	<p>The practice of rolling results into an annual average may underestimate the seasonal concentrations of uranium and radium released. Monthly reports to CNSC report these concentrations, but interpretation of data on an integrated annual basis is conducted in the annual report; seasonally, there may be patterns that are important to understand for assessing receiver impacts and implementing mitigation for possible future exceedances.</p> <ul style="list-style-type: none"> - Will future annual reports consider important seasonal fluctuations in water quality?
<p><i>Section 5.2.2 – Groundwater Quality</i></p> <p><i>Section 5.2.3 – Porewater Quality</i></p> <p>Groundwater quality monitoring data was presented for Denison TMA-1, Stanrock and Williams Lake facilities, and porewater quality for Stanrock. Generally, groundwater and porewater had depressed pH and elevated sulphate and iron, with minor fluctuations over past years but no concerns.</p>	<p>The groundwater and porewater characteristics indicate some effect by acid mine drainage, which is expected as the groundwater and porewater programs monitor TMAs. Evaluation criteria for acceptable groundwater quality was not presented.</p> <ul style="list-style-type: none"> - What are the criteria that groundwater and porewater is compared to, and why is it protective of receptors?



Rio Algom sites

2.4.5 Rio Algom Limited (2018): *Operating Care and Maintenance 2017 Annual Report*.

The 2017 Operating Care and Maintenance report included details on Rio Algom company operation, financial guarantees, license change details, health and safety, and water monitoring details. The water monitoring results were reviewed as part of this work. The report presented past data to 2013, and interpreted current data in this context.

The report was generally thorough and allowed a good understanding of the monitoring and response actions at the sites in 2017. The review identified areas of improvement in clearly identifying potential environmental impacts from the Denison TMAs and more closely examining seasonal water quality, as well as concerns with ongoing uranium exceedances at the TMA-1 outfall.

The Rio Algom licence (CNSC, 2007) was consulted to confirm compliance limits. The review of Rio Algom 2018 intrinsically included the findings Rio Algom (2017 - the 2016 Operating Care and Maintenance Annual Report) because its information was included in the 2017 report.

The report's evaluation summary is provided in Table 15. The findings of the report, and review comments and questions are provided in Table 16.



Table 15. Evaluation summary of CNSC Denison (2018): 2017 Operating Care and Maintenance Annual Report.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report was generally thorough and provided a good description of monitoring and compliance. Potential environmental impacts could however, be identified more clearly.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information was generally adequate to describe compliance issues, but more closely examining seasonal water quality, providing a firm plan to manage radium at the Stanleigh outfall and assess its potential effects in McCabe Lake (downstream) are areas for improvement.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	<p>The report indicated:</p> <ul style="list-style-type: none"> - Pronto TMA: effluent was below PWQO and metals fluctuated seasonally; - Nordic, Lacnor and Buckles TMA: effluent was consistently below PWQOs; - Panel TMA: effluent was consistently below PWQOs with seasonal fluctuations of radium and metals; - Quirke TMA: effluent was consistently below PWQOs; - Stanleigh TMA: radium exceedances occurred in 2017 and follow-up action was described; - Milliken TMA: effluent was consistently below PWQOs; and - Spanish American TMA: effluent was consistently below PWQOs.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 16. Findings of Rio Algom Limited (2018): Operating Care and Maintenance 2017 Annual Report , and review comments and questions.

Rio Algom (2018) report finding	Comment or question
<p><i>6.2.1 – TMA Maintenance (Pronto)</i></p> <p>The TMA maintenance conducted in 2017 was described in this section. Of interest to this review, re-grading (lowering) of the Pronto tailings pond dam overflow channels was conducted.</p>	<p>Tailings from Beaucage mine may be relocated to Pronto.</p> <ul style="list-style-type: none"> - How will the relocated tailings affect the water levels and associated water control infrastructure in the Pronto TMA? - Will adding tailings affect its operation and effluent quality?
<p><i>6.2.2.2 – Discharge Compliance (Pronto TMA)</i></p> <p><i>6.2.3 – Water Quality Monitoring (Pronto TMA)</i></p> <p>Rio Algom reported that Pronto effluent at the final point of control, PR-04, was in compliance with the discharge criteria. Monthly compliance with discharge limits were documented, and comment was provided on seasonal fluctuations of metals.</p>	<p>The water quality monitoring was reported clearly and thoroughly. The monthly average concentrations of all parameters were below PWQO.</p>



Rio Algom (2018) report finding	Comment or question
<p><i>6.3.2.2 – Discharge Compliance (Nordic, Lacnor and Buckles TMA)</i></p> <p><i>6.3.3 – Water Quality Monitoring (Nordic, Lacnor and Buckles TMA)</i></p> <p>Rio Algom reported that Nordic effluent at the final point of control, N-19, was in compliance with the discharge criteria. Monthly compliance with discharge limits were documented, and comment was provided on seasonal fluctuations of radon and metals.</p> <p>Porewater and groundwater quality was reported. Parameter concentration trends were discussed, but criteria for evaluating acceptable groundwater and porewater quality were not identified, and concerns (if any) were not determined.</p>	<p>The surface water quality monitoring was reported clearly and thoroughly. The monthly average concentrations of all parameters were below PWQO.</p> <p>Identifying concerns with porewater and groundwater quality (if any) is critical to identifying environmental concerns and implanting mitigation or remediation (if necessary).</p> <ul style="list-style-type: none"> - What are the criteria for porewater and groundwater quality? - Were there any concerns related to porewater or groundwater in 2017, and if so, how were/will they responded to?
<p><i>6.4.2.2 – Discharge Compliance (Panel TMA)</i></p> <p><i>6.4.3 – Water Quality Monitoring (Panel TMA)</i></p> <p>Rio Algom reported that Panel effluent at the final point of control, P-14, was in compliance with the discharge criteria. Monthly compliance with discharge limits were documented, and comment was provided on seasonal fluctuations of radon and metals. Seepage water quality was reported, and was also below environmental quality criteria.</p>	<p>The water quality monitoring was reported clearly and thoroughly. The monthly average concentrations of all parameters were below PWQO.</p>



Rio Algom (2018) report finding	Comment or question
<p data-bbox="254 266 999 331"><i>6.5.2.2 – Discharge Compliance (Quirke TMA and former mine site)</i></p> <p data-bbox="254 375 999 440"><i>6.5.3 – Water Quality Monitoring (Quirke TMA and former mine site)</i></p> <p data-bbox="254 483 1031 656">Rio Algom reported that water quality in Quirke TMA, final effluent and water draining from the former mine site was in compliance with the discharge criteria. Monthly compliance with discharge limits were documented, and comment was provided on long term stability of radon and changes in metals.</p> <p data-bbox="254 699 1031 872">Seepage, porewater and groundwater quality was reported for monitoring locations around the TMA; seepage water was also below environmental quality criteria. Criteria for evaluating acceptable porewater and groundwater quality were not identified, and concerns with groundwater quality were not determined.</p>	<p data-bbox="1060 266 1793 370">The surface water quality monitoring was reported clearly and thoroughly. The monthly average concentrations of all parameters were below PWQO.</p> <p data-bbox="1060 414 1793 518">Identifying concerns with porewater and groundwater quality (if any) is critical to identifying environmental concerns and implanting mitigation or remediation (if necessary).</p> <ul data-bbox="1060 561 1814 727" style="list-style-type: none"> - What are the criteria for porewater and groundwater quality? - Were there any concerns related to porewater or groundwater in 2017, and if so, how were/will they responded to?



6.6.2.1 – Operating Summary (Stanleigh)

6.5.2.2 – Discharge Compliance (Stanleigh)

6.5.3 – Water Quality Monitoring (Stanleigh)

Rio Algom reported that the Stanleigh ETP was shut down in April, May, June due to increased radium concentrations. Radium concentrations exceeded the plant compliance limit (0.37 Bq/L) in grab samples collected on May 02 (0.412 Bq/L); May 15 (0.381 Bq/L); June 19 (0.382 Bq/L); November 20 (0.378 Bq/L); and November 27 (0.385 Bq/L), but monthly means remained below criteria (0.37 Bq/L) in these months. Radium concentrations in all grab samples and the monthly mean exceeded the discharge criteria in December. The plant reportedly had to continue operation in November and December despite the compliance exceedances, to maintain TMA water levels within the specified operating range. The plant discharge remained below the PWQO (1 Bq/L) for the entirety of 2017. Rio Algom noted intermittent “spikes” in radium grab samples starting as early as 2015.

The following measures were implemented to improve radium management in the TMA:

- Additional real-time monitors were added to the plant influent stream to better manage radium, and a new operating plan to mitigate radium concerns was submitted to CNSC on November 20, 2017 for approval;

The report provided a substantially more thorough description of the Stanleigh radium exceedance incidents and responses than CNSC (2018a, c). CNSC (2018c) was written specifically to describe the incidents and responses, but did not include the details about early year exceedances, reporting and follow-up responses, that are important to understand the incident and Rio Algom as well as CNSC response.

- Why did the CNSC report (2018c) not include these important details? How does CNSC plan to improve its reporting?

Rio Algom identified intermittent radium “spikes” in effluent as early as 2015.

- Was CNSC aware of the radium “spikes”? If so, what follow-up action to investigate and remediate the spikes did CNSC undertake? If not, why was this information not included in monthly and annual effluent monitoring reports?

The actions taken by Rio Algom in response to the radium exceedances appeared to be reasonable overall, but:

- Given the radium concerns identified early in the year, why were the response actions not conducted earlier? Why did CNSC not require action after the incidents in April and May?

Downstream effects assessments were conducted further afield than the area immediately downstream of the outfall, where effects might have occurred.



- Recommissioning the Ferric Sulphate addition system as a coagulant to aid in the efficiency of the barium chloride addition to co-precipitate radium;
- Reactivating the automated polymer flocculent batching system (PolyRex) to potentially improve radium removal with Magnafloc 10; and,
- Extending the operating period at reduced flow rates to increase retention time in the Settling Pond.

To identify possible environmental effects from the exceedances, Rio Algom conducted the following assessments:

- Supplemental toxicity sampling, beginning December 2017, at CL-06 (the final discharge), downstream at the immediate receiving SRWMP station SR-06 (McCabe Lake Outlet) and at the Serpent River mixing station SRWMP SR-03 (Pecors Lake) to ensure there were no immediate environmental impacts as a result of the exceedances; and
- Semi-annual response monitoring continued at station SRWMP location SR-15 (May Lake Outlet) to monitor any long-term effects to the receiving environment.

To help determine the cause of elevated radium, improve treatment and develop a long term radium control strategy, Rio Algom conducted the following:

- Pilot testing with ferric sulphate (coagulant) to aid in the efficiency of barium chloride to co-precipitate radium;

- Why were effects not assessed in the receiver immediately downstream of the outfall? Will the receiver in this location be assessed in the future?

Lethal toxicity testing ignores the other effects to biological systems from radiation exposure (e.g., reproduction abnormalities).

- Have additional toxicological tests been considered to assess the effects of effluent more fully? If so, what are they, and if not, why are the existing tests sufficient to describe effects on receptors?

Identifying concerns with groundwater quality (if any) is critical to identifying environmental concerns and implanting mitigation or remediation (if necessary).

- What are the criteria for porewater and groundwater quality?
- Were there any concerns related to porewater or groundwater in 2017, and if so, how were/will they responded to?



- A dye test to determine the settling pond flow characteristics and improve retention time;
- Bench- and pilot-testing on treatment system design modifications;
- Re-evaluated the Stanleigh water balance and revised the operating strategy to allow for prolonged periods of treatment at reduced flow rates while maintaining basin elevations within the approved envelope and allowing for runoff storage capacity.

All other parameters in effluent at the final point of control, CL-04 were in compliance with the discharge criteria. Monthly compliance with discharge limits were documented. Sulphate was found to be decreasing, which may have contributed to the radium exceedances, and barium was increasing. Barium environmental effects were assessed by toxicity testing which found effluent to be non-lethal to Rainbow Trout and *Daphnia magna*, except for 20% mortality in *Daphnia* in May. A separate report by Minnow Environmental (2018) was included that described the Stanleigh effluent impact assessment.

Seepage water quality was reported, and was below environmental quality criteria.

Groundwater quality was reported, but criteria for evaluating acceptable groundwater were not identified, and concerns with groundwater quality were not determined.



Rio Algom (2018) report finding	Comment or question
<p data-bbox="254 267 816 297">6.7.3 – <i>Water Quality Monitoring (Milliken TMA)</i></p> <p data-bbox="254 337 1037 440">Rio Algom reported that water quality in Milliken TMA final effluent was in compliance with the discharge criteria. Monthly compliance with discharge limits were documented.</p>	<p data-bbox="1062 267 1793 370">The surface water quality monitoring was reported clearly and thoroughly. The monthly average concentrations of all parameters were below PWQO.</p>
<p data-bbox="254 483 945 513">6.8.3 – <i>Water Quality Monitoring (Spanish American TMA)</i></p> <p data-bbox="254 553 1037 724">Rio Algom reported that water quality in Milliken TMA final effluent was in compliance with the discharge criteria, and that radium was gradually decreasing. Monthly compliance with discharge limits were documented. The Spanish American TMA discharges into Denison’s TMA-1.</p>	<p data-bbox="1062 483 1793 586">The surface water quality monitoring was reported clearly and thoroughly. The monthly average concentrations of all parameters were below PWQO.</p>



2.4.6 Minnow (2018): Stanleigh Effluent Radium-226 Impact Assessment Report.

Minnow conducted special studies to assess the potential impacts of radium released from Stanleigh in 2017, to the receiving environment of McCabe Lake, where the effluent discharges. The studies included: a review of existing conditions in McCabe Lake to define conditions before the releases, a review of water quality monitoring and toxicity testing, a mixing study using the CORMIX model, and a dose and risk assessment.

Of particular interest to this review were the results of the CORMIX modelling, dose and risk assessment. The review found that radium may have had adverse effects within 250 m of the outfall, based on Minnow's modeling, that may warrant further investigation during the planned 2019 sediment and biota sampling.

The report's evaluation summary is provided in Table 17. The findings of the report, and review comments and questions are provided in Table 18.

Table 17. Evaluation summary of Minnow (2018): Stanleigh Effluent Radium-226 Impact Assessment Report.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report was thorough and provided a good description of the assessments completed.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information was generally adequate to describe risks, but additional sediment and biota sampling conducted within 250 m of the Stanleigh outfall may provide additional information on potential effects from the radium release, and provide a recent baseline from which to compare future conditions near the outfall.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report indicated that the Stanleigh effluent had not degraded the aquatic environment of McCabe Lake, but recommended further follow-up monitoring in 2019 to test the hypothesis.
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.



Table 18. Findings of Minnow (2018) special studies related to the Stanleigh ETP 2017 radium concentrations in effluent, and review comments and questions.

Minnow (2018) finding	Comment or question
<p><i>Section 4 – Mixing and CORMIX modelling</i></p> <p>Minnow presented the modelling inputs, assumptions, modeling scenarios, and results. They defined the near field (mixing) region as extending 500 m east into McCabe Lake from the outfall, identified in their most conservative mixing scenario. The predicted effluent concentration in the summer was taken as a representative concentration, as the effluent plume in the summer experiences slightly less dilution compared to spring and fall. In addition, the predicted effluent plume concentrations were multiplied by two, as the CORMIX predicted effluent dilution and corresponding concentration are considered to be accurate within +/- 50% based on extensive comparison with field and laboratory data. The radium-226 concentration at the edge of the NFR (i.e., in the >2.5 % mixing region, Figure 4.2) for the maximum effluent concentrations in open water and under-ice conditions was estimated at 0.257 Bq/L and 0.276 Bq/L respectively, less than the 0.37 Bq/L compliance limit.</p>	<p>The mixing area assumed by Minnow (i.e., extending up to 500 m from the point of discharge) was large, and their graphical modelling output (Figure 4.2) showed effluent at >25% of its initial strength ~10 m from the outfall, > 10% ~75 m from the outfall and > 5 % ~250 m from the outfall. Using the same assumptions as Minnow (summarized in the adjacent column), the modelling indicates:</p> <ul style="list-style-type: none"> - Radium concentrations above the compliance limit (0.37 Bq/L could) could have occurred up to 250 m from the outfall; and - Radium concentrations above the PWQO (1 Bq/L) could have occurred up to 75 m from the outfall. <p>Radium concentrations in effluent never exceeded the PWQO in 2017, however, and the conservative assumptions in the Minnow model likely over-predicted radium presence in McCabe Lake.</p> <p>Nevertheless, there is possibly an area in the lake within 250 m of the outfall where radium could exceed discharge criteria and be a concern. Physical sampling to identify impacts (if any) and further study were not conducted in this area. Given the transient nature of water and fish, impacts to these receivers are no longer measurable, but residual impacts to sediment and benthic invertebrates may be. This area could also be affected by future discharges, and defining its current condition could help to identify potential future impacts.</p>



Minnow (2018) finding	Comment or question
	<ul style="list-style-type: none"> - Is there reason to suspect environmental impacts within 250 m of the outfall, given the rationale provided above? <p>This review did not include a detailed technical assessment of the modelling inputs, assumptions, and modeling scenarios, and assumed that the modelling completed and results presented by Minnow were correct.</p>
<p><i>Section 5 – Dose and Risk Assessment Results</i></p> <p>A dose and risk assessment previously conducted for McCabe Lake by Ecometrix (2011), was repeated using the higher radium concentrations predicted for the near field and entire lake as modelled by Minnow (see above). None of the does estimates for wildlife of human receptors exceeded the applicable dose bench marks.</p>	<p>The dose assessment may not have considered the potentially higher radium concentrations within 250 m of the outfall.</p> <ul style="list-style-type: none"> - Could potentially higher radium concentrations occurring within 250 m of the outfall, have caused unacceptable doses? If so, what (if any) mitigation can be implemented?
<p><i>Section 7 – Recommendations</i></p> <p>Minnow recommended that biota and sediment samples be collected in McCabe Lake in 2019 as part of Cycle 5 of the Serpent River Watershed Monitoring Program, to follow-up on the 2017 radium releases.</p>	<p>Samples within 250 m of the outfall may show the most dramatic effects of the 2017 radium exceedances.</p> <ul style="list-style-type: none"> - Are benthic and sediment samples planned within 250 m of the outfall? If not, why will other samples sufficiently represent the potential risk from this area?



2.4.7 CNSC (2018c): Memorandum: Status Update on Exceedance of Monthly Average Discharge Limit for December 2017 for Radium-226 for the Elliot Lake Historic Sites.

The memorandum provided the same summary as presented in the CNSC (2018a) Regulatory Oversight Report for the Stanleigh ETP discharge exceedance in December, 2017. No additional information was provided, and the comments and questions regarding CNSC 2018a Sections 20.1 and 20.3 as well as Appendix K (above) also pertain to the memorandum. The report evaluation is provided in Table 19.

Table 19. Evaluation summary CNSC (2018c): Memorandum: Status Update on Exceedance of Monthly Average Discharge Limit for December 2017 for Radium-226 for the Elliot Lake Historic Sites.

Evaluation question:	Review comment:
How effectively does the regulatory oversight report convey the available information to the CNSC about nuclear facilities which the CNSC has licenced and for which the Commission has ultimate responsibility in evaluating the adequacy of the license conditions?	The report was prepared by CNSC internal use and for public information. The report was brief and did not include important information from Rio Algom (2018), and therefore did not convey sufficient information to inform action by CNSC.
Is the available information adequate to the task of understanding site conditions so that the CNSC can follow up as required?	The information presented in the report was not sufficient to follow-up as appropriate.
Are the chemical and physical conditions of the Agnew Lake, Rio Algom and Denison sites in Elliot Lake changing or stable, and if they are changing, are conditions improving or deteriorating?	The report did not contain sufficient information to fully evaluate the Stanleigh TMA or receiving waterbody (McCabe Lake).
How do current site conditions compare to earlier predictions of how the site conditions would evolve to this approximate point in time?	The report did not contain sufficient information to determine what conditions had been predicted, and compare those to what were observed.

