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In the matter of

NexGen Energy Ltd.

Licence application to prepare a site for and construct its Rook 1 uranium mine and mill project

**Commission Public Hearing
Part 1**

November 19, 2025

Référence de NexGen Energy Ltd.

À l’égard de

NexGen Energy Ltd.

Demande de permis concernant la préparation de l’emplacement et la construction de son projet de mine et d’usine de concentration d’uranium Rook I

**Audience publique de la Commission
Partie 1**

Le 19 novembre 2025

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Volume 2: Rook I Project Environmental Impact Statement

Rook I Project

Environmental Impact Statement

Section 14 Wildlife and Wildlife Habitat

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
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November 2024

Executive Summary

Section Purpose

Section 14 of the Environmental Impact Statement (EIS) provides a comprehensive assessment of potential effects of the Rook I Project (Project) on wildlife and wildlife habitat. This assessment included consideration of both potential effects from the Project and cumulative effects from the Project and other reasonably foreseeable developments (RFDs). The wildlife and wildlife habitat assessment used widely accepted scientific practices and incorporated Indigenous and Local Knowledge.

Eleven wildlife species represented valued components (VCs) in the Environmental Assessment (EA). These eleven wildlife and wildlife habitat VCs included:

- woodland caribou;
- moose;
- grey wolf;
- black bear;
- beaver;
- little brown myotis;
- olive-sided flycatcher;
- rusty blackbird;
- common goldeneye;
- mallard; and
- Canadian toad.

The selection of VCs was based on several factors including, but not limited to, the potential level of interaction between the Project and the VCs, the sensitivity of the VCs to potential effects from the Project, species conservation status or concern, and feedback from Indigenous Groups and local communities. Valued components initially identified for inclusion within the EA were modified after receiving feedback during community engagement and JWG meetings and was informed by Indigenous and Local Knowledge obtained during the Indigenous Knowledge and Traditional Land Use (IKTLU) Studies.

The assessment of potential effects on wildlife and wildlife habitat was informed by the assessments completed for vegetation, terrain, soils, hydrogeology, hydrology, surface water quality, sediment quality, air quality, and noise. Alterations in abundance and distribution of wildlife can affect ecological services (e.g., availability of wildlife) for people that use these resources. As such, the wildlife and wildlife habitat assessment provided information that was used to support other VC assessments such as human health, Indigenous land and resource use, and other land and resource use.

Setting

At a regional scale, the Project would be located within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system, approximately 40 km east of the Saskatchewan-Alberta border and 640 km northwest of the city of Saskatoon. The assessment of wildlife and wildlife habitat used the same spatial boundaries as vegetation, which consist of local study area (LSA) of 2,832 ha and regional study area (RSA) of 107,491 ha. The exception was for woodland caribou, which included additional spatial boundaries required for the assessment of Project-specific and cumulative effects: caribou home range of 43,521 ha and SK2 West Caribou Administration Unit (SK2 West) of 48,287 km^2.

Existing Conditions (Section 14.3)

Existing conditions for wildlife and wildlife habitat were characterized based on results from field studies carried out between 2018 and 2020, Indigenous and Local Knowledge, and other available data sources.

Woodland Caribou

The Project would be located in the north sub-unit of SK2 West, with the caribou home range and RSA overlapping both the SK1 and SK2 West. Under existing conditions (i.e., Base Case), caribou populations in the SK2 are ranked “as likely as not self-sustaining” (ECCC 2020) as the minimum 65% undisturbed critical habitat threshold necessary to support a self-sustaining population does not exist (ECCC 2020). In the SK1, Environment and Climate Change Canada’s critical habitat assessment found that the caribou population(s) were considered self-sustaining (McLoughlin et al. 2019; ECCC 2020).

In the Base Case, approximately 97% of the LSA, 66% of the caribou home range, 68% of the RSA, and 43% of the SK2 West is considered disturbed. Of the undisturbed habitat in each caribou study area, less than 2% of the LSA, 13% of the caribou home range, 18% of the RSA, and 46% of SK2 West are considered high, moderate, or low suitability for caribou. The remainder of the undisturbed habitat in each study area is water or unclassified/unknown.

Existing linear feature densities in SK2 West and the RSA are lower than the density threshold that has been suggested to reduce predation effects on caribou, while linear feature density in the LSA and the caribou home range is slightly greater than the predicted threshold density for reducing predation on caribou. Existing linear features likely partially impede local caribou movements and habitat connectivity between suitable patches. Restricted caribou movement might influence survival and reproduction if caribou experience reduced access to resources.

Under existing conditions, woodland caribou in the LSA and caribou home range may be experiencing some physiological stress from exploration activities and road and trail use; however, the level of stress is unknown. Existing noise levels in the LSA and RSA are low, but periodic exploration and recreational noise activities may be causing increased energy expenditures by caribou as they move away from the noise. There is limited risk of human-caused mortality to caribou from hunting in SK2 West and the RSA in the Base Case.

During baseline surveys in 2018 and 2019, woodland caribou or caribou sign (e.g., cratering, tracks, and scat [also referred to as pellets]) were observed in four locations, most frequently in open bog and black spruce/Labrador tea/feathermoss habitat. A herd of approximately 150 to 200 caribou was reported in March 2020 by the CRDN between Lloyd Lake and Preston Lake within SK1, immediately east of SK2 West (CRDN-JWG 2020b). Indigenous Groups indicated that caribou populations have decreased substantially, but still occur in the Project area (TSD V.2: CRDN; MN-S-JWG 2020a,b; TSD III BRDN; NexGen 2019a).

Moose

The proposed Project is located within Moose Management Unit 19, which is composed of Wildlife Management Zones 74, 75, and 76. Indigenous Groups identified moose as a key part of their culture and traditional diets, and hunting moose as important for community well-being and maintaining traditional ways of life. In the Base Case, suitable moose habitat is common and well distributed in the RSA. Moose habitat is relatively less abundant in the LSA largely due to the aggregation of existing anthropogenic disturbance. Under existing conditions, it is reasonable to assume that Highway 955 and the existing access road may be affecting moose, particularly during periods of higher exploration activity when there are more vehicles on the roads; however, the other linear features in the RSA are unlikely to be affecting moose movements. Collectively, high, moderate, and low suitability habitat represent 28.8% and 78.4% of the LSA and RSA, respectively.

The existing habitat conditions in the RSA are expected to support a healthy moose population. The low level of existing anthropogenic disturbance and low wolf density suggest that the moose population overlapping the RSA is likely self-sustaining and ecologically effective.

During baseline studies, moose were detected using a variety of habitat types during winter and summer, including along roads and other anthropogenic features.

Grey Wolf

Grey wolf is considered a habitat generalist species, capable of exploiting a variety of habitat types on the landscape as long as the animals are mostly free from trapping or hunting and ungulate densities are sufficient to support a population. Habitat suitability models developed for grey wolf identified that patches of high and moderate suitability habitat extend throughout the LSA, interspersed with low suitability habitat.

Wolves are highly mobile with strong dispersal ability and flexibility in habitat preferences; for these reasons, the species is likely resilient to moderate levels of fragmentation on the landscape (Serrouya et al. 2017). In the Base Case, disturbances created by forest fires and human development are unlikely to be negatively affecting habitat availability for wolves in the RSA.

Wolves are resilient and adaptable and able to accommodate many threats such as disease, parasites, injuries caused by prey, trapping, or hunting (Mech 1974). Therefore, under existing conditions, the wolf population overlapping the RSA is expected to be healthy, with survival and reproduction rates linked to available prey.

During baseline studies, grey wolves were detected using roads and trails in the RSA.

Black Bear

Black bears are considered habitat generalists and occupy coniferous, deciduous, and mixed wood forest habitat types throughout the year in response to the shifting availability of forage and prey items. Black bear habitat suitability varies seasonally; therefore, habitat suitability models were developed for spring and fall seasons. Overall, suitable black bear spring and fall habitat is common, well distributed, and connected across the LSA and RSA in the Base Case. In the Base Case, it was assumed that black bears use regenerating burn areas in the RSA in the fall for feeding on berries prior to denning, and areas near Highway 955 in the RSA in the spring. Dens may potentially be abandoned when disturbed by exploration activities in the winter during hibernation. However, anthropogenic disturbances represent only 0.4% of the RSA, and bears use of linear features (e.g., cutlines / seismic lines, roads, trails) may facilitate movement and habitat connectivity for black bears in and beyond the RSA.

Baseline surveys confirmed black bear use within the RSA, but black bear density was not measured. It was assumed that the black bear population overlapping the RSA is stable or increasing under existing conditions.

Beaver

Beavers are expected to have the capacity to adapt and be resilient to existing human-related disturbances and associated variations in habitat availability. A habitat suitability model was developed to predict suitable beaver lodge locations, forage, and cover. The majority of the LSA and RSA contains poor suitability beaver habitat, which is likely partially related to the extent of burned upland forest in the region; this is supported by observations made by members of the Birch Narrows Dene Nation (BNDN) about beavers not occupying burned habitat. The LSA and RSA contain large lakes that are also classified as poor habitat for beaver. Beavers are not considered sensitive to anthropogenic disturbance as dams are often created at human-made structures. In the Base Case, disturbances created by human development are unlikely to be negatively affecting habitat availability for beavers in the RSA.

The main limiting factors or threats affecting beaver survival, abundance, and distribution are likely harvest pressure and the availability of suitable habitat.

Baseline surveys for the Project detected beaver and beaver sign along shorelines of waterbodies in the LSA and RSA (Omnia 2020). Runs and feeding marks were the most often detected signs of beaver, followed by inactive lodges and active lodges. Beaver dams were observed at two waterbodies near the Project.

Little Brown Myotis

Little brown myotis is an endangered species under Schedule 1 of the federal *Species at Risk Act* (SARA; Government of Canada 2023) due to dramatic population declines caused by white nose syndrome (WNS). Because WNS results in substantial declines in bat survival once a colony is infected, the resiliency of little brown myotis populations in the RSA is expected to be very low once the disease has spread to the area. As of 15 September 2021, the fungus that causes WNS in bats had been detected in eastern Saskatchewan, suggesting that the disease could be soon affecting Saskatchewan populations (Global News 2021).

Critical habitat for little brown myotis has only been partially identified for hibernacula in some parts of Canada. Given the low potential for caves in the LSA, the likelihood of hibernacula near the Project was assumed to be low, though this likelihood is not certain since there is the potential for between-year variability in the use of hibernacula. Suitable roosting habitat was identified and mapped in the Base Case; the resulting model suggests that the LSA and RSA contain limited suitable roosting habitat. It is assumed that any suitable habitat is mostly connected in the RSA as little brown myotis are highly mobile and can fly through poor suitability burned habitat that is interspersed among patches of low suitability and high suitability habitats. Linear features in the LSA and RSA have little activity and likely do not function as dispersal barriers for this species because bats can travel long distances each night. The existing trails, seismic lines, and cutlines in the RSA may also provide commuting and foraging habitat for little brown myotis.

Baseline bat surveys for the Project were completed between late May and early October 2018, and between early May and late September 2020. Based on detection data, it was assumed that creek, bog, and coniferous forest habitat are used by little brown myotis for foraging in the RSA.

Olive-sided Flycatcher

Olive-sided flycatchers nest in forested stands but, because of their foraging behaviour, are associated with high contrast habitats including burned forests, logged areas, and natural forest openings such as gaps, meadows, rivers, and wetlands (Altman and Sallabanks 2012). Suitable olive-sided flycatcher nesting habitat was identified and mapped in the Base Case. Habitat types known to have the potential to support olive-sided flycatchers were fairly common and widespread in the LSA and areas surrounding Patterson Lake. Existing anthropogenic disturbance is low in the RSA, and it was assumed that most linear features in the RSA (i.e., trails, rough roads, and seismic / cutlines) do not functionally affect the movement and habitat connectivity of olive-sided flycatcher in the Base Case. Under existing conditions, low suitability habitat comprises 65% of suitable nesting habitat in the RSA; moderate and high suitability habitat represent 30% and 5% of nesting habitat, respectively.

Although there has been a reported decline in olive-sided flycatcher population size in Canada, the magnitude in the decrease has lessened in recent years (Government of Canada 2015a; Smith et al. 2020).

During baseline breeding bird surveys, olive-sided flycatcher was detected throughout the LSA and surrounding area around Patterson Lake with 13 observations at 12 survey sites. In the Base Case, it was assumed that olive-sided flycatcher survival and reproduction likely support a stable population given the current change in status from Threatened to Special Concern (COSEWIC 2018), the availability of suitable nesting habitat in the RSA, and the results of the baseline surveys.

Rusty Blackbird

In Saskatchewan, rusty blackbirds are a common summer resident in bogs and fens (Smith 1996).

In the Base Case, the majority of the LSA and RSA contain poor suitability habitat. Large patches of open land cover associated with recent burns and early-stage regenerating ecosites in the LSA and RSA may affect movements of rusty blackbirds. However, the magnitude of the effect is uncertain as adult rusty blackbirds often forage in multiple unconnected wetlands within their home range (Powell et al. 2010b).

Anthropogenic disturbance in the RSA may have decreased and altered potential rusty blackbird habitat under existing conditions; however, baseline surveys recorded rusty blackbird in low suitability and poor suitability habitats during the nesting period. Therefore, it was assumed that rusty blackbirds inhabiting the RSA have adapted to the existing fire regime and that low suitability habitats provide successful nesting habitat for the species in the Base Case. It is also assumed that existing anthropogenic disturbances in the LSA and RSA do not likely function as movement barriers for rusty blackbird given the high mobility and patchy distribution of the species.

During baseline surveys for the Project, four rusty blackbirds were detected among three locations.

Common Goldeneye

Common goldeneye is a species of duck that breeds in mature trees with suitable nest cavities along wetlands, lakes, and rivers. The assessment of habitat suitability for common goldeneye was focused on defining nesting habitat during the breeding period. The model predicted nesting habitat suitability to be highest at shoreline, but available up to 1.3 km from the edge of open water, and that common goldeneye primarily use waterbodies between 1.5 ha and 20 ha in size. In the Base Case, it was assumed that nesting territories in the RSA are at a density of 0.09 pairs/ha and that disturbance to nesting is negligible. Common goldeneye populations remain relatively stable despite threats from hunting, pesticides and contaminants, and degradation of habitat (Eadie et al. 2020).

Waterbirds in general are considered sensitive to disturbance and react negatively to anthropogenic noise or motion (Rodgers and Burger 1981; Bélanger and Bédard 1990; Dahlgren and Korschgen 1992). In the Base Case, it was assumed that existing activities in the RSA, which are largely low activity such as trails and seismic lines / cutlines, may occasionally disturb common goldeneye but have a negligible effect on habitat availability. Common goldeneye is predicted to fly over roads, trails, and cutlines, with little change to movement and distribution. Although likely not affecting the overall migration routes for the species, fire has resulted in a large amount of unsuitable habitat in the RSA, which likely influences the movement and distribution of birds in localized areas.

In the Base Case, it was assumed that the common goldeneye population overlapping the RSA is likely stable. During baseline surveys, eight pairs of common goldeneye were observed during the July waterfowl survey and 16 individuals were observed during the June migration survey.

Mallard

Mallard is the most abundant duck species in North America, and can be found on almost any waterbody, from lakes to ephemeral wetlands (Drilling et al. 2020). Suitable nesting habitat was identified and mapped in the Base Case. The moderate amount of suitable mallard habitat available in the Base Case suggests that habitat availability is not limiting for this species in the LSA and RSA. Suitable nesting habitat for mallard in the LSA is patchily distributed, with high suitability habitat associated with wetland habitat or areas within 150 m of open water.

Mallard is a highly successful species due to adaptability to varied habitats, hardiness in cold climates, and tolerance to human activities (Drilling et al. 2020). Breeding population estimates for mallard in the province of Saskatchewan increased between 2007 and 2016 (Government of Saskatchewan 2017). The Métis Nation of Saskatchewan (MN-S) and Buffalo River Dene Nation (BRDN) have noted that duck populations in general have declined (TSD III: BRDN; TSD IV: MN-S; MN-S-JWG 2019a; MN-S-JWG 2020b). Based on the available information, it was assumed that the population in the RSA may be decreasing in the Base Case. However, based on low level of disturbance, it was assumed that there are negligible threats to mallard survival and reproduction in the RSA in the Base Case. Mallards are predicted to fly over roads, trails, and cutlines with little change to movement and distribution. It was assumed that existing activities in the RSA may occasionally disturb mallard but have a negligible effect on habitat availability.

During baseline studies, 61 mallard individuals were detected.

Canadian Toad

The primary limiting factor affecting Canadian toad distribution is believed to be the availability of suitable overwintering habitat on the landscape (Hamilton et al. 1998). Suitable hibernation habitat is not expected to be limiting in the LSA in the Base Case because well-drained, upland habitat is common. Characterizing habitat suitability for Canadian toad focused on defining breeding habitat. In the Base Case, the LSA contains 4.8% of suitable breeding habitat for Canadian toad, most of which is surrounded by either large waterbodies or burned, pine-dominated upland habitat. The availability of suitable breeding habitat in the RSA is 14.3% but is limited by the amount of open wetland ecosites. Suitable breeding habitat is more common and connected in the western half of the RSA.

The amount of existing anthropogenic disturbance in the RSA is low (i.e., 0.4% of the RSA) and expected to have had little influence on Canadian toad populations. Highway 955 is likely a partial barrier to toad movement and dispersal, particularly during periods of high traffic volume, but the current density of linear features in the RSA is likely causing negligible adverse effects on Canadian toad. Disease and pathogens are a possible risk to Canadian toad populations in the RSA. Canadian toads were detected during baseline surveys carried out in May and June (i.e., breeding season). Canadian toad detections occurred in seven different ecosite / vegetation cover types in the LSA, including open water, late-stage regeneration upland, late-stage regeneration wetland, recent burn upland, jack pine/lichen, Labrador tea shrubby bog, and willow shrubby rich fen. Existing anthropogenic disturbance in wetland and pond habitat is limited and is likely having a negligible effect on Canadian toad breeding habitat.

Potential Effects and Proposed Mitigation (Section 14.4)

An analysis was completed to evaluate Project components and activities and associated effects pathways that could potentially affect wildlife and wildlife habitat. The evaluation also considered similar combined effects from the Fission Patterson Lake South Property, the identified RFD for the wildlife and wildlife habitat assessment. For woodland caribou, the RFD evaluation also included a qualitative analysis of anticipated effects from forestry in the southern unit of the SK2 West.

Project activities that would have the potential to affect wildlife and wildlife habitat during the Project lifespan include:

- land clearing;
- site preparation;
- construction of facilities and infrastructure;
- handling of ore and waste rock;
- changes to water and air quality; and
- other supporting mining construction, operation, and decommissioning and reclamation (i.e., closure) activities.

Similar activities that could affect wildlife and wildlife habitat would be expected to occur for the Fission Patterson Lake South Property.

As part of the pathways analysis, proposed environmental design features and mitigation measures were considered to determine whether effects on wildlife and wildlife habitat VCs could be avoided or reduced to negligible levels, thereby removing the pathway. A variety of environmental design features and mitigation measures were proposed, in part, to minimize the Project's effects on wildlife and wildlife habitat, including:

- limiting the Project footprint to the extent practicable, by optimizing the use of cleared areas and storing tailings underground;
- minimizing areas of vegetation clearing and soil disturbance;
- implementing progressive reclamation and revegetation;
- using and maintaining noise suppression, and enclosing or dampening equipment in the process plant buildings;
- treating contact water, if necessary, before discharge into receiving environment; and
- implementing wildlife policies and employee and contractor training programs.

These mitigations have been used extensively within the mining sector and have been proven effective. Similar mitigation and adaptive management practices would also be expected to be implemented by the Fission Patterson Lake South Property.

After mitigation measures were considered, the pathways screening analysis determined that many of the potential pathways from the Project to the environment could be removed. However, it was identified that the Project could still adversely affect wildlife and wildlife habitat from the following pathways:

- direct removal or alteration of soil and vegetation can cause loss of wildlife habitat and affect wildlife abundance and distribution;

- alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect wildlife habitat availability and distribution, and survival and reproduction; and
- sensory disturbance (e.g., presence of people, air traffic, lights, dust, smells, noise) can alter wildlife movement and behaviour and adversely affect wildlife habitat availability and wildlife abundance and distribution.

Therefore, these pathways were carried forward to the residual effects analysis.

Residual Effects Analysis (Section 14.5)

A residual effects analysis was conducted to determine the potential effects on wildlife and wildlife habitat under two assessment cases: effects of the Project (i.e., Application Case), and combined effects of the Project and the Fission Patterson Lake South Property (i.e., RFD Case). For wildlife and wildlife habitat, three measurement indicators were considered:

- habitat availability;
- habitat distribution; and
- survival and reproduction.

The residual effects analysis followed a precautionary approach by using an assessment area, referred to as the maximum disturbance area, that assumes disturbance of an area approximately four times larger than the currently anticipated Project footprint.

In the RFD Case, a precautionary approach was used by applying a maximum disturbance area to the Fission Patterson Lake South Property using the same assumptions made for the Project; this resulted in a maximum disturbance area approximately six times larger than the footprint presented in the Fission (2019) prefeasibility study.

Similar conservatism was incorporated into the overlapping temporal boundaries for the Project and RFD. The assessment assumed the period of residual effects from the Fission Patterson Lake South Property would completely overlap with similar effects associated with the Project, a maximum duration of 95 years.

Woodland Caribou

Under existing conditions, the provincial management threshold of limiting the amount of natural and anthropogenic disturbance within the caribou range to a maximum of 35% has already been exceeded; therefore, any amount of incremental habitat loss from any development, including residual losses of habitat associated with the proposed Project, is considered significant for woodland caribou. The Project is expected to affect caribou habitat availability in the LSA, caribou home range, RSA, and SK2 West by causing an incremental increase in the amount of disturbance. The changes would include both direct (i.e., physical footprint) and indirect (i.e., sensory disturbance / perceived predation risk) effects.

Overall, the proportion of disturbance in the caribou home range is expected to increase by 0.3% with development of the Project, resulting in a decrease of 0.6% of suitable caribou habitat. In SK2 West, the proportion of disturbance is expected to increase by less than 0.1%, resulting in a decrease of less than 0.1% of suitable caribou habitat. The distribution of high and moderate suitability habitat in the caribou home range would remain largely unchanged as a result of the Project as the caribou home range study area, which is centred on the proposed Project footprint, is already characterized by an existing aggregation of human development features and activities. The Project is not expected to increase the density of linear features in the LSA, caribou home range, RSA, and SK2 West. The Project may affect survival and reproduction of individual caribou that use the LSA, RSA, and caribou home range, but changes are expected to be non-measurable at the population level or in the SK2 West.

In the RFD Case, a loss of 1.3% of suitable caribou habitat is expected in the caribou home range as a result of the Project and the Fission Patterson Lake South Property; in SK2 West, a loss of less than 1% of suitable caribou habitat is expected to occur. The loss of suitable caribou habitat from forest harvest could not be quantified for the assessment because the projected amount and layout of future forest harvest is not publicly available. Forest licensees are required to mitigate negative effects on woodland caribou.

All other Wildlife VCs

The Project is expected to result in habitat loss, habitat alteration, and sensory disturbance for all VCs during all Project phases. The magnitude of loss from the proposed Project would be less than 1.5% of suitable habitats in the RSA for all VCs. Cumulative habitat loss in the RFD Case would be less than 3.5% of suitable habitat in the RSA for all VCs. During Operations and Closure, habitats would be progressively reclaimed to the extent possible. Habitat distribution for all VCs in both the Application Case and RFD Case is expected to remain well connected throughout the RSA. Although there is variability on effects for individual animals, overall, all VC populations are expected to remain self-sustaining and ecologically effective.

Climate Change

Climate change and associated effects (e.g., changes in forest fire pattern) on wildlife and wildlife habitat were considered. Climate change is projected to decrease the availability of wetlands and moister ecosystems and could exacerbate reductions in habitat for wildlife and wildlife habitat VCs. Upland ecosystems may become drier and more prone to forest fire, which would further exacerbate effects on wildlife VCs relying on mature forests. While the predictions of induced effects from climate change are uncertain, it is anticipated that all VCs except for woodland caribou would remain self-sustaining and ecologically effective.

Effects on Biodiversity

Wildlife biodiversity is inclusive of wildlife and the ecosystems that they occupy. Therefore, effects on biodiversity were assessed based on the changes to wildlife and wildlife habitat, which provided both finer (i.e., species level) and coarser (i.e., ecosystem level) elements of biodiversity. Effects of the Project on biodiversity are anticipated to be low in magnitude for both the Application Case and RFD Case.

The geographic extent of effects would be restricted to the maximum disturbance area in the Application Case and extend to the RSA in the RFD Case. The residual effects are predicted to be mostly reversible over the long term for all ecosystems and plant communities that would regenerate after reclamation. The loss of wetlands is conservatively assumed to be permanent and irreversible; however, projected wetland losses are minor relative to the availability of wetlands that occur elsewhere in in the RSA, and wetlands are expected to remain well connected in the RFD Case.

Overall, changes in the Application Case and RFD Case are expected to increase landscape fragmentation; however, biodiversity in the RSA is predicted to be maintained and similar to existing conditions.

Significance Determination (Section 14.5)

In the Application Case, the weight of evidence from the analysis predicts that changes to the availability, distribution, and survival and reproduction of wildlife and wildlife habitat that overlap the RSA, with the exception of woodland caribou, would be within the resilience and adaptability limits for these VCs. Therefore, the residual effects on wildlife and wildlife habitat VCs in the Application Case, with the exception of woodland caribou, are predicted to be **not significant**.

The incremental and cumulative effects resulting from the Project, previous and existing developments, and the Fission Patterson Lake South Property on wildlife and wildlife habitat are also predicted to be **not significant** for all VCs, with the exception of woodland caribou.

Woodland caribou is listed as vulnerable/rare to uncommon (S3) in Saskatchewan and is Threatened and on Schedule 1 of the SARA. Under existing conditions, the SK2 West does not meet the minimum 65% undisturbed habitat threshold necessary to support a self-sustaining population. Therefore, the amount of incremental habitat loss from any development, including residual losses of habitat associated with the proposed Project and the Project combined with the Fission Patterson Lake South Property, would further reduce the ability for woodland caribou to be self sustaining. As a result, residual adverse effects to woodland caribou for both the Application Case and RFD Case are predicted to be **significant** without further mitigation.

NexGen is committed to reclaiming habitat disturbed by the Project footprint and offsetting the incremental loss of caribou habitat to help achieve self-sustaining and ecologically effective caribou populations. Trial reclamation to restore caribou habitat along linear features has commenced, which demonstrates this commitment. NexGen is also committed to developing and implementing a Caribou Mitigation and Offsetting Plan through engagement with the ENV and Indigenous Groups. Implementation of the Caribou Mitigation and Offsetting Plan is expected to result in a net increase in functional caribou habitat. With the implementation of the Caribou Mitigation and Offsetting Plan, the contribution of Project-specific residual adverse effects to woodland caribou are predicted to be **not significant**. In keeping with the Province's SK2 range plan, it is also anticipated that other future developments, such as the Fission Patterson Lake South Property, would implement similar mitigation actions to support a trajectory towards conserving caribou.

Prediction Confidence and Uncertainty (Section 14.6)

Overall, there was a moderate to high degree of confidence in the predictions related to the wildlife and wildlife habitat assessment. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential effects (i.e., a precautionary assessment).

Monitoring and Follow-Up (Section 14.7)

Surveillance monitoring completed as part of the Environmental Protection Program, and associated environmental monitoring, would be implemented to verify effects predictions and effectiveness of mitigation measures for wildlife and wildlife habitat, identify unanticipated effects (i.e., manage the residual uncertainty in the effects prediction), and apply adaptive management, if required.

The Decommissioning and Reclamation Plan would be implemented for long-term reclamation and establishment of vegetation communities that contribute to the maintenance of self-sustaining and ecologically effective wildlife populations and biodiversity. Monitoring and follow-up would be implemented to verify that reclamation was trending towards the successful regeneration and succession of vegetation communities that are functionally similar to natural wildlife habitat in the region. Results from monitoring would be used to modify or apply different reclamation procedures through the process of adaptive management.

Abbreviations and Units of Measure

Abbreviation	Definition
BNDN	Birch Narrows Dene Nation
BRDN	Buffalo River Dene Nation
CRDN	Clearwater River Dene Nation
CNSC	Canadian Nuclear Safety Commission
COPC	constituent of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWD	chronic wasting disease
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
ELC	Ecological Land Classification
ENV	Saskatchewan Ministry of Environment
ETP	effluent treatment plant
FMP	Forest Management Plan
IKTLU	Indigenous Knowledge and Traditional Land Use
JWG	Joint Working Group
LPA	local priority area
LSA	local study area
MN-S	Métis Nation – Saskatchewan
NexGen	NexGen Energy Ltd.
NPAG	non-potentially acid generating
NWT	Northwest Territories
PAG	potentially acid generating
PM	particulate matter
$PM_{2.5}$	particulate matter with a diameter of 2.5 microns or less
PM_{10}	particulate matter with a diameter of 10 microns or less
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
SARA	*Species at Risk Act*
SK	Saskatchewan
TSD	Technical Support Document
TSL	Term Supply Licence
UGTMF	underground tailings management facility
VC	valued component
WMZ	Wildlife Management Zone
WNS	white nose syndrome
WRSA	waste rock storage area
ZOI	zone of influence

Unit	Definition
%	percent
°C	degrees Celsius
±	plus or minus
µm	micron
cm	centimetre
dB	decibel
dBA	A-weighted decibel
ha	hectare
kHz	kilohertz
kg	kilogram
km	kilometre
km/km^2	kilometres per square kilometre
km/h	kilometres per hour
km^2	square kilometre
kV	kilovolt
m	metre
mg/cm^2/30 d	milligrams per square centimetre per 30 days
mg/L	milligrams per litre

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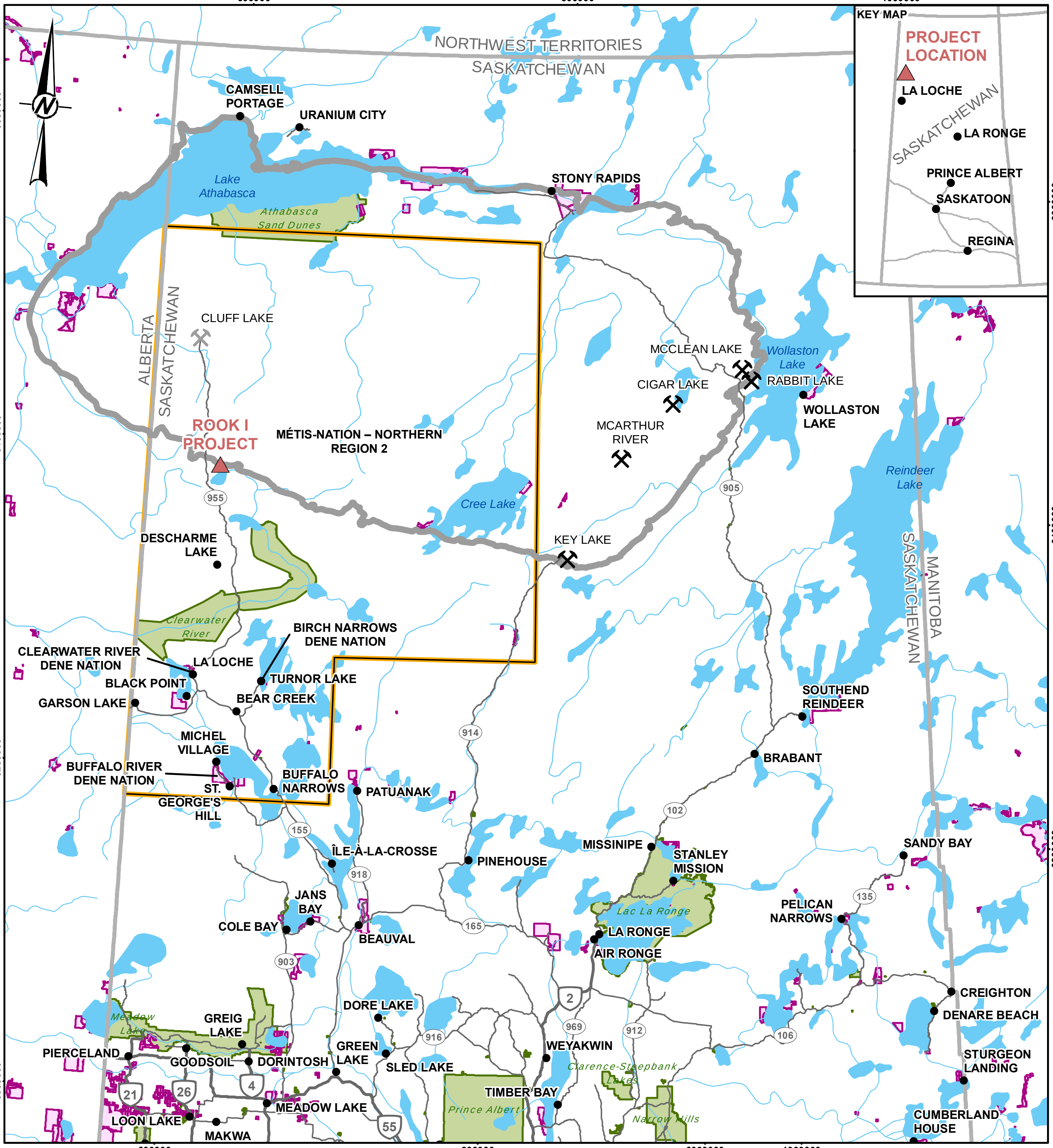
14 WILDLIFE AND WILDLIFE HABITAT

14.1 Introduction

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, called the Rook I Project (Project). The Project would be located approximately 40 km east of the Saskatchewan-Alberta border, 130 km north of the Northern Village of La Loche, and 640 km northwest of the city of Saskatoon (Figure 14.1-1). The Project would reside within Treaty 8 territory and the Métis Homeland. At a regional scale, the Project would be situated within the southern Athabasca Basin adjacent to Patterson Lake, along the upper Clearwater River system. Patterson Lake is at the interface of the Boreal Shield and Boreal Plain ecozones. Access to the Project would be from an existing road off Highway 955 (Figure 14.1-2), with on-site worker accommodation serviced by fly-in/fly-out access.

Section 14, Wildlife and Wildlife Habitat, of the Environmental Impact Statement (EIS) characterizes the potential residual effects of the Project on wildlife and wildlife habitat, which are attributes or components of the biophysical environment. Wildlife and wildlife habitat represent valued components (VCs) for the Environmental Assessment (EA). The Project has the potential to cause adverse effects on wildlife and wildlife habitat primarily by removing existing natural vegetation or altering final terrain and soil conditions (Section 12, Terrain and Soils) and/or plant species composition during Construction; the effects of which would continue through Operations and Decommissioning and Reclamation (i.e., Closure) until habitat is restored (Section 13, Vegetation). Deposition of dust and fossil fuel emissions (Section 7.2, Air Quality) may also influence vegetation and wildlife habitat.

Changes in groundwater (Section 8, Hydrogeology), hydrology (Section 9, Hydrology), and surface water quality and sediment quality (Section 10, Surface Water Quality and Sediment Quality) could affect wildlife habitat. Sensory disturbance from noise (Section 7.3, Noise), dust (Section 7.2), and lights (TSD XI, Light Effects Analysis Report) can also influence the movement, distribution, and survival and reproduction of wildlife. Alterations in abundance and distribution of wildlife can affect ecological services (e.g., availability of wildlife) for people that use these resources. For these reasons, the wildlife assessment provides information that is used to support the assessments of other VCs such as human health (Section 15, Human Health), Indigenous land and resource use (Section 16, Cultural and Heritage Resources and Indigenous Land and Resource Use) and other land and resource use (Section 17, Other Land and Resource Use). A simplified linkage diagram, Figure 14.1-3, illustrates how proposed Project activities could result in a direct or indirect effect on wildlife and wildlife habitat, and the VCs that could be influenced through changes to wildlife and wildlife habitat.



LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- URANIUM MINING FACILITY (DECOMMISSIONED)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- MÉTIS NATION-SASKATCHEWAN NORTHERN REGION 2

0 100 200
1:3,500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

LOCATION OF THE ROOK I PROJECT

CONSULTANT

wsp

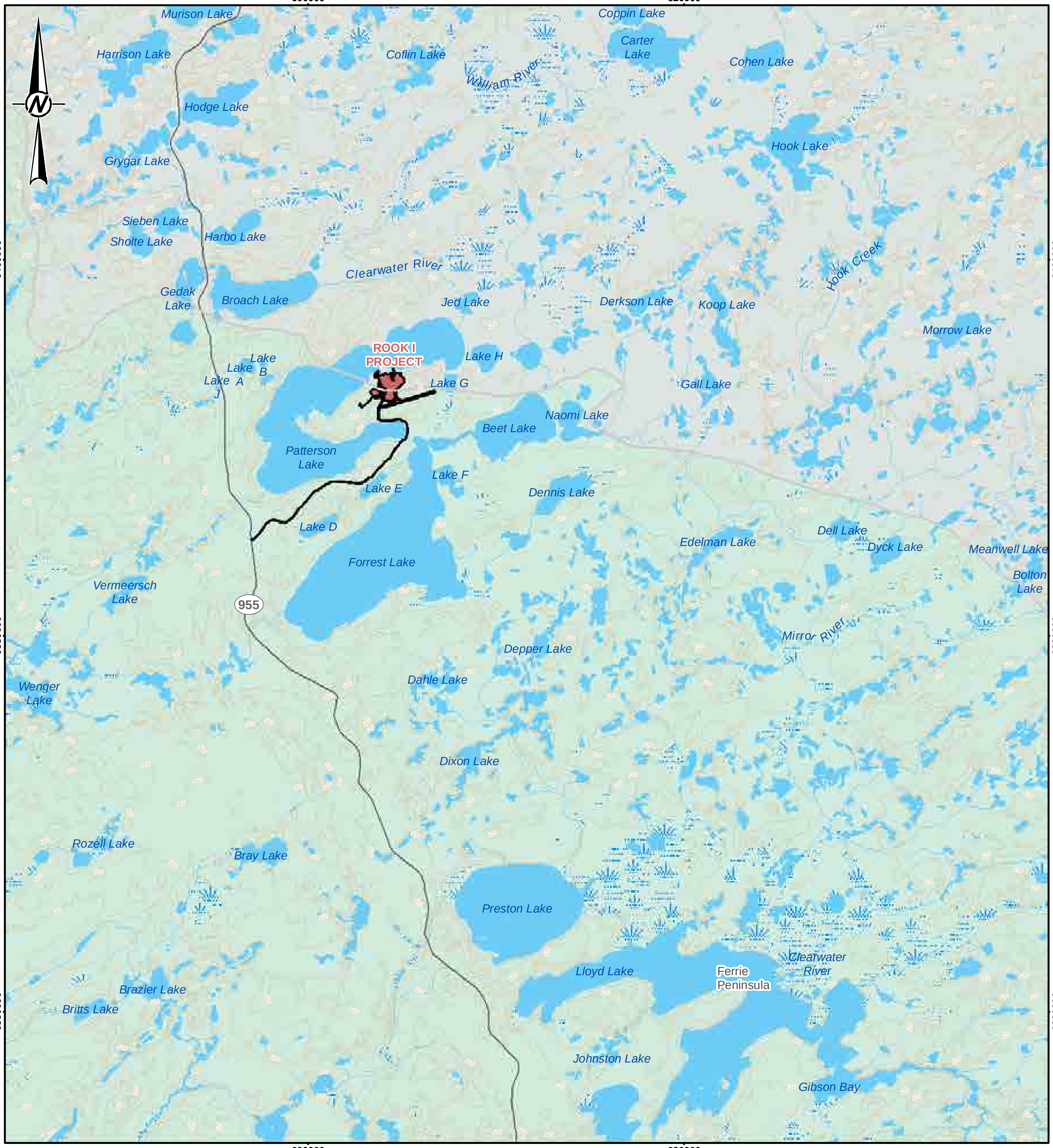
PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 14.1-1

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\14_Wildlife_and_Wildlife_Habitat\8_5x11\20144150_001_Fig14_1-1_Location-of-the-RookI-Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-10 AT: 10:48:58 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT

0 5 10
1:300,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
REGIONAL AREA OF THE ROOK I PROJECT

CONSULTANT
wsp

PROJECT	20144150	SCALE AS SHOWN	REV. 0

FIGURE 14.1-2

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\14_Wildlife_and_Wildlife_Habitat\8_5x11\20144150_002_Fig14_1-2_Regional-Area_Rook_I_Project_NoTitleblock_Rev0.mxd PRINTED ON: 2023-02-08 AT: 1:56:04 PM

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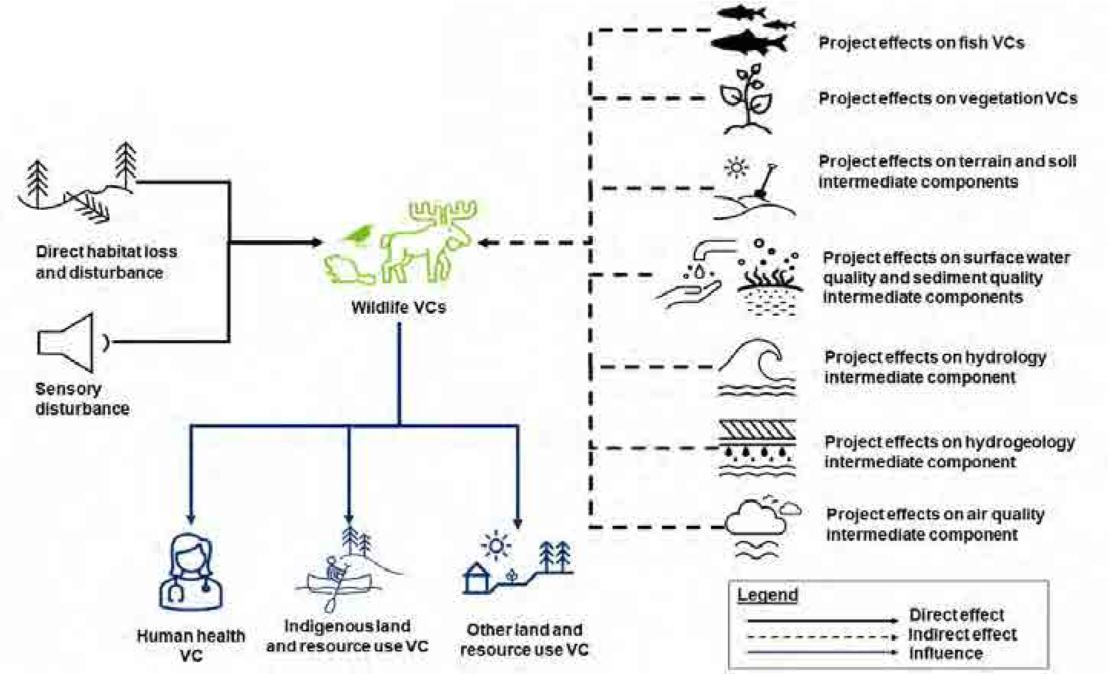
25mm

Figure 14.1-3: Linkage Diagram of Project Effects on Wildlife and Wildlife Habitat and Influenced Valued Components



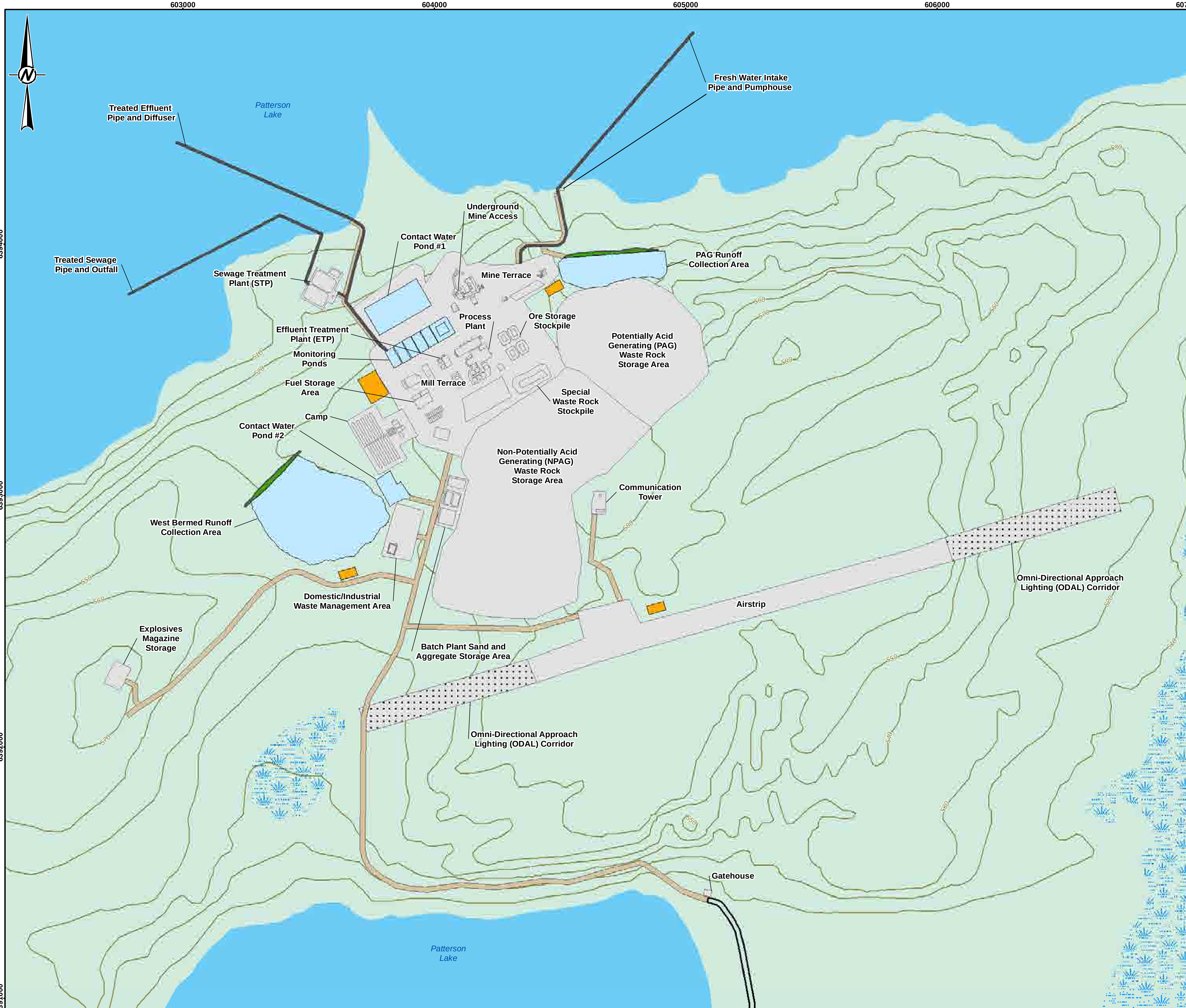
VC = valued component.

14.1.1 Project Summary

The Project would include the following key facilities to support the extraction and processing of uranium from the Arrow deposit for transportation off site (Figure 14.1-4):

- underground mine development;
- process plant buildings, including uranium concentrate packaging facilities;
- paste tailings distribution system;
- underground tailings management facility (UGTMF);
- potentially acid generating (PAG) waste rock storage area (WRSA);
- non-potentially acid generating (NPAG) WRSA;
- special waste rock[1] and ore storage stockpiles;
- surface and underground water management infrastructure, including water management ponds, effluent treatment plant (ETP), and sewage treatment plant;
- conventional waste management facilities and fuel storage facilities;
- ancillary infrastructure, including maintenance shop, warehouse, administration building, and camp;
- airstrip and associated infrastructure; and
- access road to Project and site roads.

[1] Special waste rock is mine rock that is mineralized with insufficient grade to be considered ore (i.e., greater than 0.03% of triuranium octoxide [U_3O_8] and less than 0.26% U_3O_8). All special waste would be temporarily stored in the special waste rock stockpile.



LEGEND

- ELEVATION CONTOUR (10 m INTERVAL)
- WATERBODY
- WETLAND
- WOODED AREA
- INTAKE OR DISCHARGE PIPE
- ACCESS ROAD
- CONTACT WATER CONTAINMENT BERM
- OMNI-DIRECTIONAL APPROACH LIGHTING (ODAL) CORRIDOR
- PROJECT INFRASTRUCTURE
- SITE ROAD
- TOPSOIL STORAGE AREA
- WATER MANAGEMENT POND

0 0.5 1

1:15,500 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021 AND UPDATED JUNE 8, 2021 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

LAYOUT OF INFRASTRUCTURE AND FACILITIES FOR THE ROOK I PROJECT

CONSULTANT	PROJECT	20144150	SCALE AS SHOWN	REV. 0
wsp	**FIGURE 14.1-4**			

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14.1.2 Purpose and Approach to the Assessment

The purpose of Section 14 is to provide a detailed and comprehensive assessment of all potential Project-specific effects and cumulative effects from the Project and other previous, existing, and reasonably foreseeable developments (RFDs), if applicable, on wildlife and wildlife habitat. This section meets the Terms of Reference for the Project submitted to the Saskatchewan Ministry of Environment (ENV) and Canadian Nuclear Safety Commission (CNSC) *Generic Guidelines for the Preparation of an Environmental Impact Statement – Pursuant to the Canadian Environmental Assessment Act, 2012* (Appendix 1A, Concordance Tables). The assessment of wildlife and wildlife habitat followed the overall EA approach and methods (Section 6, Environmental Assessment Approach and Methods) and included the following primary steps:

Step 1 – Define component-specific methods (Section 14.2): presents the specific approaches and methods used to measure and assess the effects of the Project on wildlife and wildlife habitat as well as cumulative effects from the Project, other previous and existing projects and activities, and RFDs, if applicable.

Step 2 – Characterize existing conditions (Section 14.3): describes and characterizes existing conditions to provide context and a basis for evaluating potential changes to wildlife and wildlife habitat caused by the Project.

Step 3 – Evaluate Project interactions and mitigations (Section 14.4): identifies Project components and/or activities with the potential to affect wildlife and wildlife habitat and provides environmental design features and mitigation policies and actions committed to by NexGen to avoid or minimize potential adverse effects. A pathways analysis was used to focus further assessment on key interactions between the Project and wildlife and wildlife habitat by evaluating the different effects pathways to determine if, after incorporation of mitigation, there is still potential to cause residual adverse effects. Primary pathways anticipated to result in residual adverse effects after incorporation of mitigation are carried forward to Step 4 for further analysis. Where potential adverse effects are adequately mitigated and thus not forwarded for further analysis (i.e., where mitigation results in negligible effects or avoids the pathway altogether), the reasons for concluding the assessment at this stage are provided.

Step 4 – Analyze residual effects (Section 14.5): evaluates and describes the potential Project effects on wildlife and wildlife habitat that are anticipated to occur through the primary pathways. The residual effects analysis is presented as an integrated narrative that describes the effects of the Project over time and highlights predicted effects at the point when adverse effects of the Project are expected to be greatest. This step also includes an analysis of residual cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 5 – Classify residual effects and determine significance (Section 14.5): summarizes the results of the residual effects analysis using effects criteria (i.e., direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence). Significance is determined using the results of the residual effects analysis and classification. Significance is determined for adverse effects only and for the maximum adverse effects of the Project and the cumulative effects from the Project, other previous and existing projects and activities, and RFDs.

Step 6 – Describe uncertainty and define prediction confidence (Section 14.6): identifies key uncertainties and explains how these uncertainties have been addressed to achieve a conservative, precautionary assessment. The implications of the approaches used to address uncertainties and the level of confidence in the residual effects analysis are discussed.

Step 7 – Identify monitoring and follow-up (Section 14.7): outlines the proposed actions to verify predicted residual effects. The purpose of these actions is to evaluate effectiveness of planned mitigation designs, policies, and practices, and address key sources of uncertainty.

14.2 Component Methods

14.2.1 Incorporation of Indigenous and Local Knowledge

Indigenous and Local Knowledge included in the assessment of wildlife and wildlife habitat was shared by potentially affected First Nations and Métis Groups (collectively referred to as Indigenous Groups) and local priority area (LPA)[2] community members through the Project engagement process. The overall approach and methods for the incorporation of Indigenous and Local Knowledge into the EA is discussed in detail in Section 3, Indigenous and Local Knowledge. Issues and concerns related to wildlife and wildlife habitat raised by Indigenous Groups and LPA community members, and how these comments were addressed, are summarized in Appendix 2B, Summary of Issues and Concerns Identified by Indigenous Groups, and identified and addressed in this assessment, where applicable.

A key source of Indigenous and Local Knowledge is the Project-specific studies completed by Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies (henceforth referred to collectively as Indigenous Knowledge and Traditional Land Use [IKTLU] Studies). The IKTLU Studies that were reviewed and referenced in the EIS as technical support documents (TSDs) are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Another key source of Indigenous and Local Knowledge was information shared by Indigenous Group representatives during Joint Working Group (JWG) meetings. The JWGs represent an agreed-upon primary engagement mechanism as outlined in the Study Agreements signed by each Indigenous Group and NexGen.

[2] The LPA consists of the local communities closest to the Project that would experience most of the Project effects and for which NexGen would prioritize local training, employment, and business opportunities for the Project. These communities are located along, or accessed via, Highways 155 and 955 north of the intersection of Highways 155 and 925.

More details regarding the JWGs can be found in Section 2, Indigenous, Regulatory, and Public Engagement and Section 3. There are four JWGs with the Project's primary Indigenous Groups (Section 2.4.1, Identification of Indigenous Groups for Engagement):

- Clearwater River Dene Nation (CRDN) JWG;
- Métis Nation – Saskatchewan (MN-S) JWG representing MN-S Northern Region 2;
- Birch Narrows Dene Nation (BNDN) JWG; and
- Buffalo River Dene Nation (BRDN) JWG.

The leadership of each Indigenous Group selected their JWG participants with consideration of group diversity; where possible, members included Elders, youth, different genders, a range of ages, and land users around Patterson Lake.

In addition to the IKTLU Studies and JWGs, Indigenous and Local Knowledge shared during specific engagement activities undertaken through the EA development process was incorporated into the assessment, where appropriate. These engagement activities included, but were not limited to:

- community information sessions held in four locations in 2019 (NexGen 2019a);
- site tours;
- comments from the CRDN (2019a) on the Cluff Lake Mine licence renewal;
- other formal and informal meetings;
- workshops with specific groups (e.g., Fur Block N-19 trapper's workshop); and
- environmental and socio-economic baseline data collection.

Comments submitted by Indigenous Groups on the Project Description (CRDN 2019b; MN-S 2019; YNLRO 2019; ACFN 2019; CNSC 2019) were also reviewed for applicable Indigenous and Local Knowledge.

Indigenous and Local Knowledge related to wildlife and wildlife habitat was incorporated into the assessment by considering and viewing the information as complementary and influential alongside scientific information. Where possible, knowledge from each potentially affected Indigenous Group or LPA community member was described separately and cited accordingly. Where information is described for multiple potentially affected Indigenous Groups, they are collectively referred to as "Indigenous Groups" throughout the assessment.

Indigenous and Local Knowledge was included in the wildlife and wildlife habitat assessment in the following ways:

- **Component Methods – Valued Components:** Indigenous and Local Knowledge helped to inform the selection of wildlife VCs and reflects species that were identified by Indigenous Groups and LPA communities as important for cultural and economic purposes. Wildlife resources contribute to traditional diets and health, food security, and are a source of fur and other resources. Hunting and trapping activities are practiced for subsistence and livelihood, are a foundation of culture and way of life, contribute to community wellbeing, and play a critical role in the transmission of knowledge and maintenance of culture. Hunting and trapping activities, and their locations also contribute to sense of place and identity and require access to a healthy land base and abundant wildlife resources (Section 14.2.2.1.1.4, Indigenous Considerations).

- **Existing Conditions:** Indigenous and Local Knowledge informed the existing conditions for wildlife and wildlife habitat, and was shared regarding wildlife population trends, wildlife habitat and distribution in the regional study area (RSA), including hunting and trapping locations in the RSA, and observations of some of the factors contributing to changes in wildlife abundance and distribution in the RSA and larger region (e.g., forest fires, industrial disturbance; Sections 14.3.1, Woodland Caribou, 14.3.2, Moose, 14.3.3, Grey Wolf, 14.3.4, Black Bear, 14.3.5, Beaver, 14.3.9, Common Goldeneye, 14.3.10, Mallard). Indigenous Knowledge also informed the existing conditions regarding the movement of caribou, moose, and black bear across the north arm of Patterson Lake at the narrows[3] (BNDN-JWG 2019b; Figure 14.2-1).
- **Project Interactions and Mitigations:** Indigenous and Local Knowledge helped to inform the scoping of Project interactions and pathway analysis and consideration of mitigation measures (Section 14.4, Project Interactions and Mitigations). This includes observations and experiences of Indigenous Groups related to the cumulative effects of natural and anthropogenic disturbances (e.g., forest fires, mining and exploration activities, noise and linear disturbances) on wildlife habitat, abundance and distribution, as well as the cumulative effects on air, water, and vegetation from previous or existing industrial activities on wildlife health and the safety of wild foods (e.g., Section 14.4, and Section 14.5, Residual Effects Analysis: Sections 14.5.1, Woodland Caribou, 14.5.2, Moose, 14.5.3, Grey Wolf, 14.5.4, Black Bear, 14.5.5, Beaver, 14.5.9, Common Goldeneye, and 14.5.10, Mallard).
- **Monitoring, Follow-Up, and Adaptive Management:** Feedback provided by Indigenous Groups during engagement, including recommendations, was considered in the development of monitoring and follow-up activities (Section 14.7, Monitoring, Follow-Up, and Adaptive Management). In addition, it is planned that ongoing feedback from Indigenous Groups on the effectiveness of mitigations would be considered when updating monitoring and management plans. Independent Indigenous monitors chosen by each primary Indigenous Group would have opportunities to participate in environmental monitoring programs for the proposed Project. Specific references to Indigenous and Local Knowledge, and Project comments and concerns related to wildlife and wildlife habitat raised by Indigenous Groups and LPA community members, are included in the applicable subsections of this assessment.

14.2.2 Valued Components, Measurement Indicators, and Assessment Endpoints

14.2.2.1 Valued Components

14.2.2.1.1 Selection and Screening Method

Valued components are aspects of the biophysical, cultural, and socio-economic environments that are considered to have scientific, social, cultural, economic, historical, archaeological, or aesthetic importance (Beanlands and Duinker 1983; CNSC 2021). The BNDN and BRDN define VCs as tangible biophysical resources (e.g., particular places and species) and less tangible social, economic, cultural, health, and knowledge-based values (e.g., social cohesion, place names, Indigenous language) (TSD II: BNDN; TSD III: BRDN).

[3] The narrows provides a location for wildlife to cross Patterson Lake as they move through the RSA. The narrows was described as a "migration route" during community engagement (BNDN-JWG 2019b), which was interpreted to mean a crossing point for wildlife rather than the formal scientific definition of seasonal round-trip long-distance movements (e.g., barren-ground caribou, songbirds, ducks, geese). The narrows in Patterson Lake is referred to as a movement route throughout Section 14 and it is acknowledged that this is a different term than what was provided during engagement.

Valued components were selected based on multiple considerations (Section 6.3.1, Valued Components) such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- species conservation status or concern (e.g., rarity, sensitivity, uniqueness);
- ecological and socio-economic/cultural value to Indigenous Groups and local communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and
- avoidance of redundancy with other VCs; for example, if two potential VCs represent the same issues, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Selection of wildlife VCs was also informed by Indigenous and Local Knowledge shared during community engagement sessions in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (Section 2 and Section 3), in JWG meetings, and in IKTLU Studies (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).

Once all potential wildlife VCs were identified, a screening process was completed using a series of criteria. Wildlife species were not selected as VCs if:

- there is little likelihood of interacting with the proposed Project (e.g., presence migratory birds in the area is limited to stopovers during spring and/or fall migration);
- the species was not detected in the RSA, which includes the local study area (LSA), during baseline surveys (Section 14.2.3, Spatial Boundaries; for delineation and rationale of spatial boundaries used in the assessment); or
- species were represented by other species using similar habitats and predicted to be similarly or less influenced by the Project.

All identified species, their conservation status, their importance, and the rationale for whether they were selected or not are presented in Table 14.2-1. The following subsections describe key considerations in identifying and selecting wildlife VCs.

14.2.2.1.1.1 Indicator, Umbrella, or Keystone Species Considerations

Some of the wildlife VCs selected for assessment represent conservation values that extend beyond the species itself (i.e., indicator, umbrella, or keystone species[4]; Caro and O'Doherty 1999, Sergio et al. 2006; Estes et al. 2011), or are highly interactive and have a large influence on the ecosystem (Soulé et al. 2005). For example, woodland caribou (*Rangifer tarandus caribou*) may act as an umbrella species (Hebblewhite 2017) and improve conservation prospects for other wildlife inhabiting the boreal forest (e.g., insects, birds, small mammals) that may not be adequately protected (Callaghan et al. 2011; Bichet et al. 2016; Li and Pimm 2016). Similarly,

[4] An indicator species is, in this case, intended to define a species thought to be sensitive to and therefore serve as early warning of environmental changes (Spellerberg 1994). An umbrella species is a species with large home ranges and specific habitat requirements that can serve as surrogates for the conservation of co-occurring species (Fleishman et al. 2000). A keystone species is a species whose addition to or loss from an ecosystem leads to major changes in at least one other species (Mills et al 1993).

conservation of predators, such as grey wolf (*Canis lupus*), can have substantial benefits to other biodiversity elements where predators act as keystone species (Sergio et al. 2006; Estes et al. 2011). Highly interactive species such as moose represent key sources of protein and energy for humans, predators, and scavengers in the boreal ecosystem, and can have strong influences on the dynamics and persistence of caribou populations (Wittmer et al. 2005; Festa-Bianchet et al. 2011).

Using indicator, umbrella, and keystone species as VCs has a number of advantages (Caro and O'Doherty 1999), but also has the potential to miss habitat conditions or ecological processes that are important for some wildlife but not associated with an indicator species (Simberloff 1998). This potential concern is addressed in the wildlife and wildlife habitat assessment by selecting multiple species with a variety of habitat requirements and different ecological roles, including habitat specialists (i.e., species with specific diets and stricter habitat requirements), predator species, prey species, wide-ranging species, and seasonal migrants.

14.2.2.1.1.2 Conservation Status Considerations

Identification of wildlife VCs included federally and provincially listed species at risk that have the potential to interact with the Project (Table 14.2-1). Four federally listed species at risk were selected as VCs for the assessment: woodland caribou, little brown myotis (*Myotis lucifugus*), olive-sided flycatcher (*Contopus cooperi*), and rusty blackbird (*Euphagus carolinus*). Seven other federally listed species, northern myotis (*Myotis septentrionalis*), common nighthawk (*Chordeiles minor*), barn swallow (*Hirundo rustica*), Ashton (formerly gypsy) cuckoo bumble bee (*Bombus bohemicus*), yellow-banded bumble bee (*Bombus terricola*), transverse lady beetle (*Coccinella transversalis*), and nine-spotted lady beetle (*Coccinella novemnotata*) were not selected as VCs because they are appropriately represented by other species or ecosystems. A screening level assessment (Appendix 14A, Species at Risk Screening Assessment) was completed for conformance with the *Species at Risk Act* (SARA; Section 14.5.12, Additional Species at Risk Screening Assessments). Not all provincially listed species were represented as VCs because not all listed species were deemed to be affected by the Project to the same degree, or were represented by other species. Rationale for inclusion or exclusion of select species at risk as a VC is provided in Table 14.2-1.

Unlisted species of high social and ecological importance (e.g., moose, black bear [*Ursus americanus*]) were selected as VCs because understanding the effects of the Project on listed species alone is insufficient to preserve overall species biodiversity in a landscape (Bonn et al. 2002).

14.2.2.1.1.3 Ecosystem and Species Life History Considerations

To determine effects on wildlife habitat availability and distribution influenced by the Project, a coarse- and fine-filter approach[5] was used. At the broadest level, upland, wetland, and riparian ecosystems were selected to assess effects on vegetation and wetlands, and overall biodiversity (Section 13.5, Residual Effects Analysis). Assessing and managing biodiversity at the vegetation and wetlands ecosystems level means that many biodiversity elements were addressed together (i.e., coarse-filter approach). Wildlife guilds (i.e., groups of species that use the same ecological resources in similar ways, independent of taxonomy) were partially captured by these ecosystem-level assessments. For example, little brown myotis and cavity nesting birds are dependent on mature forests, which may contain very old live trees, standing dead trees, coarse woody debris, and natural disturbance processes (e.g., fire, insects, and disease) that create wildlife trees (e.g., dead or decaying trees that provide opportunities for refuge and roosting cavities). Similarly, analysis of the availability,

[5] A coarse-filter approach focuses on protecting the structure of an ecosystem as a whole. A fine-filter approach focuses on protecting particular components within an ecosystem.

distribution, and function of wetland and riparian ecosystems provides an indication of potential effects on amphibians and semi-aquatic birds and mammals and helps identify potential movement corridors connecting habitats across the landscape.

To complement the coarse-filter assessment of vegetation and wetland ecosystems, a fine-filter approach was applied by assessing effects on a selected number of mammal, bird, and amphibian species (Jenkins 1976; Noss 1987; Table 14.2-1). Applying a fine-filter level of assessment is important for understanding effects on biodiversity that sometimes are distinct from effects on ecosystems and for which targeted mitigation at the species level may be required (e.g., listed species). The coarse- and fine-filter assessments complement and interact with one another; each assessment provides context for the other. Combined, the coarse- and fine-filter assessments provide a holistic assessment of the potential effects of the Project on biodiversity. Effects on biodiversity were then assessed for an overarching review of landscape-level effects with respect to all plants and animals.

Wildlife VCs were selected to focus the assessment on the primary areas of concern with respect to the Project. In cases where effects would be similar for multiple wildlife species that use similar habitats, only one species was selected as a VC to reduce ecological and assessment redundancy (Table 14.2-1). For example, olive-sided flycatcher is a member of a guild of species that forage on insects while flying (e.g., bank swallow [*Riparia riparia*] and require edge habitat (i.e., where one habitat type meets another) and forest openings. Beaver (*Castor canadensis*) is a member of a guild of semi-aquatic mammals that use wetlands, ponds, lakes, and streams, including muskrat (*Ondata zibethicus*) and river otter (*Lontra canadensis*). Understanding the potential effects of the Project on the selected VCs provides inferences about effects on other wildlife species or guilds with similar life history traits and habitat requirements.

14.2.2.1.1.4 Indigenous Considerations

Indigenous Groups spoke of the importance of hunting and trapping for subsistence, survival, and livelihood, and hunting and trapping are an important aspect of community well-being and cultural life (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD: V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BRDN-JWG 2020b; CRDN-JWG 2020a; MN-S-JWG 2019a). In addition to the provision of food and livelihoods, animals obtained through hunting and trapping can be used for their hides and furs in bedding, shelter, and clothing, as well as their bones, which are used for tools (TSD III: BRDN). Commercial trapping for fur remains an important activity, which some community members actively pursue (TSD II: BNDN; TSD III: BRDN; TSD V.2: CRDN) During community information sessions, LPA community members also identified wildlife and their protection as an important VC of the environment (NexGen 2019a).

The CRDN noted that “the enduring and intrinsic values of harvesting activities are central to Denesųłiné community life and continue to physically, emotionally, and spiritually sustain CRDN individuals and families” (TSD V.2: CRDN). Demonstrating respectful harvesting practices by taking only what is needed and not wasting the harvest are important aspects of traditional hunting and trapping to the BRDN and CRDN (TSD V.2; CRDN; BRDN-JWG 2020b):

> So, like we’re connected- not just by the food we eat. It’s a sacred connection, you know. We have respect for the animals that give us the food. (TSD V.2: CRDN)
>
> Living on the land - they say living off the land. The respect for the land – not to take too much – more than you need, you know. You have to give thanks. (TSD V.2: CRDN)

The MN-S consider the Region 2 territory as a vital source of food that provides members “a shared identity, sense of community, and permanence” (TSD IV: MN-S). Community members still rely on the land and its resources, and it is estimated that approximately 70% of their food comes from hunting, trapping, fishing, and gathering (TSD IV: MN-S). The BNDN reported that hunting and trapping “have long been at the heart of Dene culture, and they remain central to the subsistence lifeways of members of the BNDN” (TSD II: BNDN). For the BRDN, “hunting and trapping are important cultural activities and “meat obtained through hunting and trapping support community and household food security and nutrition, while trapping is important both culturally and as a livelihood” (TSD III: BRDN). The Ya’thi Néné Lands and Resources reported that large game harvesting “is very important to the Athabasca Denesųłiné. Not only as a source of food and materials, but as foundation of a culture and way of life that is passed down through generations” (TSD VI: YNLR).

Indigenous Groups have noted the inter-relationships between different biophysical components of the environment, and the role that air and water quality plays in contributing to a healthy terrestrial environment, including to vegetation and wildlife (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). Hunting and trapping activities, and the intergenerational transmission of knowledge requires access to large tracts of land based on the seasonal round of activities and changing availability of resources, as well as healthy and abundant resources (TSD II: BNDN; TSD III: BRDN; TSD V.2: CRDN).

Emphasis was placed on selecting wildlife VCs that were identified as important by Indigenous Groups and LPA communities through engagement activities, including in community information sessions, JWG meetings and in IKTLU Studies (Table 14.2-1). Indigenous Knowledge and Traditional Land Use Studies indicated that trapping and hunting of a variety of mammals is conducted around Patterson Lake (TSD III: BRDN; TSD IV: MN-S) and that the area is recognized as being “good for everything” (TSD V.1: CRDN). The BNDN identified that they use the area to harvest grouse and rabbits, for temporary resting and camping locations during moose hunts, for moose processing locations, and as water routes and terrestrial trails for accessing hunting and trapping locations for American marten (*Martes americana*), beaver, red fox (*Vulpes vulpes*), mink (*Neovison vison*), and Canada lynx (*Lynx canadensis*; TSD II: BNDN). Buffalo River Dene Nation members use the area for travel routes for hunting and trapping; teaching areas for trapping; trapping sites for lynx, marten, beaver, fisher (*Pekania pennanti*), muskrat, squirrel (*Sciurus* spp.), weasel (*Mustela* spp.), and otter; and hunting for moose, caribou (*Rangifer tarandus*), deer (*Odocoileus* spp.), rabbits (*Leporidae* spp.), and bear (TSD III: BRDN).

Barren-ground caribou (*Rangifer tarandus groenlandicus*) was initially considered for inclusion as a VC because in the past, the Patterson Lake area was known to be a hunting area for barren-ground caribou (TSD II: BNDN); the area was considered to be ecologically favourable for caribou (TSD III: BRDN) and within the range of the Beverly and Qamanirjuaq caribou herds (TSD VI: YNLR). Most migratory barren-ground caribou populations have been in decline during the past 20 to 30 years, including the Bathurst, Beverly, Ahiak, and Qamanirjuak herds (COSEWIC 2016). Seasonal and annual ranges often contract with decreasing population size and expand with increasing abundance (Messier et al. 1988; Bergerud 1996; Gunn et al. 2011; Klaczek et al. 2015; Virgl et al. 2017). Collar data suggest that the winter ranges of the Bathurst and Qamanirjuak herds of barren-ground caribou do not currently overlap with the Patterson Lake area (Golder 2014; Virgl et al. 2017; Government of Northwest Territories 2019). In addition, over 50% of the forest in the Patterson Lake area has been burned by wildfire in the last 40 years (1982 to 2020; Section 13.3.1.1, Ecosystem Availability), and barren-ground caribou would be expected to avoid the area (Thomas et al. 1996; Joly et al. 2009; Barrier and Johnson 2012), resulting in little to no interaction with the Project. The assessment of effects from the Project on woodland caribou is expected to overestimate effects on barren-ground caribou due to higher frequency and longer duration of interaction with the Project as woodland caribou are annual residents of the area; thus, barren-ground caribou was not selected as a VC.

Valued components initially identified for inclusion within the EA were modified after receiving feedback during community engagement and JWG meetings and from information provided in IKTLU Studies. The VC screening was then completed and validated that all identified species were either included or represented by a similar species in the final VC list. For example, it was noted that mallard is not preferred, and that common goldeneye (*Bucephala clangula*) would be more suitable VC because was it harvested more, was tastier and had a better diet (BNDN-JWG 2019b; MN-S-JWG 2019a). Members of the BNDN and BRDN also indicated that they were not familiar with common goldeneye but eat mallards (BNDN-JWG 2019b; BRDN-JWG 2019a). As a result, mallard was kept as a VC and common goldeneye was added. Common loon (*Gavia immer*), which is important to the MN-S (MN-S-JWG 2019b), was represented by common goldeneye in the final VC list to avoid assessment redundancy (Table 14.2-1). During JWG meetings, it was noted that beaver and muskrat are consumed equally but at different times of the year (BNDN-JWG 2019b), and that beaver was observed more often than muskrat and would be a more suitable VC because of their use of both aquatic and terrestrial habitats (MN-S-JWG 2019a). Based on this feedback, beaver was chosen as a more applicable wildlife VC. While black bear was not originally chosen given that grey wolf is representative of large predators in the ecosystem with a large home range size, black bear was added after Indigenous Groups identified it as a species of importance for hunting and trapping and requested that it be included as a VC (BNDN-JWG 2019a; TSD III: BRDN; TSD V.1: CRDN; TSD VI: YNLR).

The species considered for selection of VCs, and their rationale, are included in Table 14.2-1. Some wildlife species noted by Indigenous Groups or LPA communities during engagement activities were excluded from the final list of VCs selected (e.g., coyote, fox, fisher, otter, grouse, ptarmigan). These species were excluded, in part, because they were mentioned less frequently by Indigenous Groups or LPA communities during engagement compared to species retained as VCs. They are also represented by other wildlife species and vegetation ecosystems and not included to minimize redundancy in the assessment. For example, coyote, fox and fisher are represented by grey wolf and black bear, which are considered representative species for effects on other generalist carnivores that use a wide range of habitats. Beaver is a member of a guild of semi-aquatic mammals that use wetlands, ponds, lakes, and streams, including muskrat and river otter. The assessment of upland and wetland ecosystems are representative of effects on spruce grouse and ptarmigan.

Overall, Indigenous and Local Knowledge shared by Indigenous Groups influenced the selection of seven of the 11 wildlife VCs assessed in the EIS (Table 14.2-1). The four remaining VCs assessed also have traditional/cultural importance for Indigenous Groups as indicators of overall ecological health, within a holistic approach to understanding the environment and relationship with the land.

Table 14.2-1: Species Considered for Selection as Valued Components

Species	Presence in the RSA Confirmed by Baseline Surveys[(a)]	Provincially Tracked[(b)]	Federally Listed (Schedule 1, SARA)[(c)]	Comments from Indigenous Groups	Included as VC	Habitat Used and Rationale for Selection
Woodland caribou (*Rangifer tarandus caribou*)	Confirmed	S3	Threatened	▪ Hunted by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2020b; BNDN-JWG 2021b; CRDN-JWG 2020a; CRDN-JWG 2020b) ▪ Hunted and valued by LPA communities (NexGen 2019a) ▪ Decrease in the population of caribou observed (TSD II: BNDN; TSD V.2: CRDN; BNDN-JWG 2020b; BRDN-JWG 2019a; CRDN-JWG 2020c; MN-S-JWG 2020b)	Yes	▪ Identified by Indigenous Groups and LPA community members as a species of interest, particularly related to hunting ▪ Ecological, cultural, and socio-economic importance ▪ Umbrella species for other large, wide-ranging wildlife and regional biodiversity ▪ Relies on large areas of well-connected mature coniferous forests and bog-fen habitats ▪ Receptor for the ecological risk assessment
Barren-ground caribou (*Rangifer tarandus groenlandicus*)	Potential (winter)	S3N	n/a	▪ Barren-ground caribou of the Beverly, Ahiak, Bathurst, and Qamanirjuaq herds are important to the culture, history, and way of life of the Athabasca Denesųłiné (TSD VI: YNLR) ▪ Hunted by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Populations have not come back again or are shifting north (TSD II: BNDN; MN-S-JWG 2020a; BRDN-JWG 2020a)	No	▪ Indigenous Knowledge indicates historical range of barren-ground caribou may overlap with the Patterson Lake area ▪ Scientific data indicate a decline in most populations and annual range contractions during past 20-30 years ▪ Not likely to interact with the Project, particularly during low abundance phase of the population cycle, and due to avoidance of burned areas ▪ Woodland caribou VC acts as representative for barren-ground caribou during winter ▪ Predicted effects on woodland caribou are expected to overestimate effects on barren-ground caribou due to higher frequency and duration of interaction with the Project as woodland caribou are annual residents of the area
Moose (*Alces alces*)	Confirmed	n/a	n/a	▪ Should be included as a VC (BNDN-JWG 2019b; TSD II: BNDN) ▪ Harvested for food (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2020b; CRDN-JWG 2020b; MN-S-JWG 2020b) ▪ Hunted and valued by LPA communities (NexGen 2019a) ▪ Decrease in the population of moose observed (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; NexGen 2019a)	Yes	▪ Identified by Indigenous Groups and LPA community members as a species of interest, particularly related to hunting ▪ Ecological, cultural, and socio-economic importance ▪ Large source of protein and energy for large carnivores and scavengers in boreal forest environments (highly interactive species) ▪ Increase in moose density could negatively affect woodland caribou populations by increasing carnivore density ▪ Representative species for effects on smaller herbivores (e.g., snowshoe hare [*Lepus americanus*]) and ungulates such as white-tailed deer) that use similar seral stage habitats (i.e., early to mid-succession deciduous and mixed forest stands, wetlands, and riparian areas) ▪ Receptor for the ecological risk assessment
White-tailed deer (*Odocoileus virginianus*)	Confirmed	n/a	n/a	▪ Harvested for food (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Decrease in the population of deer observed (TSD II: BNDN; MN-S-JWG 2020b)	No	▪ Experience similar ecological pressures on survival (hunting pressure from humans and grey wolves) as moose ▪ Maintain home ranges of similar size to moose ▪ Habitat preferences overlap with moose ▪ Assessments of moose and the upland ecosystem VCs are representative of effects on white-tailed deer
Grey wolf (*Canis lupus*)	Confirmed	n/a	n/a	▪ Harvested for furs (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR)	Yes	▪ Identified by Indigenous Groups as a species of interest, particularly related to trapping ▪ Ecological, cultural, and socio-economic importance ▪ Large home range size ▪ A top predator in ecosystem (highly interactive species) ▪ Can be attracted to human developments ▪ Representative species for effects on other generalist carnivores that use a wide range of habitats, such as wolverine (*Gulo gulo*), red fox (*Vulpes vulpes*), and coyote (*Canis latrans*) ▪ Receptor for the ecological risk assessment
Black bear (*Ursus americanus*)	Confirmed	n/a	n/a	▪ Should be included as a VC (BNDN-JWG 2019a,b) ▪ Harvested for food and furs (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN-JWG 2020c) ▪ Valued by LPA communities (NexGen 2019a)	Yes	▪ Identified by Indigenous Groups and LPA community members as a species of interest ▪ Ecological, cultural, and socio-economic importance ▪ Large home range size ▪ A top predator in ecosystem (highly interactive species) ▪ Can be attracted to human developments ▪ Representative species for effects on other generalist carnivores that use a wide range of habitats, such as wolverine and coyote ▪ Receptor for the ecological risk assessment
Canada lynx (*Lynx canadensis*)	Confirmed	n/a	n/a	▪ Consider inclusion as a VC (BNDN-JWG 2019b) ▪ Harvested for furs (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN) ▪ Valued by LPA communities (NexGen 2019a) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Abundance and habitat selection are strongly linked to the abundance and habitat use of snowshoe hare, the key prey species that occupies early successional habitats with grasses and deciduous shrubs and trees for food and cover ▪ Mature forests provide shelter and den sites for lynx ▪ Assessments of upland, wetland, and riparian ecosystems VCs are representative of effects on lynx

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Species	Presence in the RSA Confirmed by Baseline Surveys[(a)]	Provincially Tracked[(b)]	Federally Listed (Schedule 1, SARA)[(c)]	Comments from Indigenous Groups	Included as VC	Habitat Used and Rationale for Selection
Coyote (*Canis latrans*)	Confirmed	n/a	n/a	▪ Consider inclusion as a VC (BNDN-JWG 2019b) ▪ Harvested for furs (TSD III: BRDN; TSD V.1: CRDN) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Abundance and habitat selection are strongly linked to the abundance and habitat use of prey species such as ungulates, snowshoe hare, and rodents ▪ Primarily occupy upland habitats and can be attracted to human developments ▪ Assessments of grey wolf and the upland ecosystem VC are representative of effects on coyote
Wolverine (*Gulo gulo*)	Potential	S2	Special Concern	▪ Wolverines are scarce (BRDN-JWG 2020a) ▪ Harvested for furs (TSD II: BNDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Species not detected during wildlife baseline surveys ▪ Wolverines use a wide range of habitat types that are assessed as upland, wetland, and riparian ecosystems VCs ▪ Critical habitat has not been identified for this species ▪ Assessments of caribou, grey wolf, and black bear VCs, which move over large areas and use a range of habitats, are representative of effects on wolverine
Fisher (*Pekania pennanti*)	Confirmed	n/a	n/a	▪ Consider inclusion as a VC (BNDN-JWG 2019b) ▪ Harvested for furs (TSD II: BNDN; TSD III: BRDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Frequently use late-successional coniferous and mixed forest stands with diverse structure (e.g., standing dead and live trees, fallen dead trees, and coarse woody debris) ▪ Species detected in LSA during wildlife baseline surveys; however, assessments of caribou, little brown myotis, and upland and riparian ecosystems VCs are representative of effects on fisher
American marten (*Martes americana*)	Confirmed	n/a	n/a	▪ Consider inclusion as a VC (BNDN-JWG 2019b) ▪ Harvested for furs (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Frequently use late-successional coniferous and mixed forest stands with diverse structure (e.g., standing dead and live trees, fallen dead trees, and coarse woody debris) ▪ Assessments of caribou, little brown myotis, and upland ecosystems VCs are representative of effects on American marten
River otter (*Lontra canadensis*)	Confirmed	S3	n/a	▪ Consider inclusion as a VC (BNDN-JWG 2019b) ▪ Harvested for furs (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Occupy similar habitats as beaver ▪ Assessments of beaver and wetland and riparian ecosystem VCs are representative of effects on river otter
Snowshoe hare (*Lepus americanus*)	Confirmed	n/a	n/a	▪ Consider inclusion as a VC (BNDN-JWG 2019b) ▪ Hunted and/or trapped by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Valued by LPA communities (NexGen 2019a)	No	▪ Occupy early successional habitats with grasses and deciduous shrubs and trees for food and cover ▪ Assessments of moose and upland and riparian ecosystems VCs are representative of effects on snowshoe hare for effects on habitat availability and habitat distribution even though their range size differs from moose ▪ Receptor for the ecological risk assessment
Beaver (*Castor canadensis*)	Confirmed	n/a	n/a	▪ Consider beaver instead of muskrat as a VC (MN-S-JWG 2019a) ▪ Harvested by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2019b; BRDN-JWG 2021b; CRDN-JWG 2020b,c) ▪ Species of interest to LPA communities (NexGen 2019a) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	Yes	▪ Identified by Indigenous Groups and LPA community members as a species of interest, particularly related to trapping ▪ Ecological, cultural, and socio-economic importance ▪ Representative species for effects on other semi-aquatic mammals such as muskrat and river otter that use wetlands, ponds, lakes, and streams ▪ Receptor for the ecological risk assessment
Muskrat (*Ondatra zibethicus*)	Confirmed	n/a	n/a	▪ Harvested for furs (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Decrease in the populations of furbearers observed (TSD II: BNDN; TSD V.2: CRDN)	No	▪ Occupy similar habitats as beaver ▪ Assessments of beaver and wetland and riparian ecosystem VCs are representative of effects on muskrat ▪ Receptor for the ecological risk assessment
Little brown myotis (*Myotis lucifugus*)	Confirmed	S4B, S4N	Endangered	▪ All wildlife is important	Yes	▪ Hibernacula may be limited ▪ Dependent on standing dead and live trees for maternity roosts in mature deciduous and mixed forest stands ▪ Requires open forest/edge habitat in wetter areas for foraging on insects ▪ Representative species for effects on northern myotis (*Myotis septentrionalis*) and late successional stage forests ▪ Receptor for the ecological risk assessment
Northern myotis (*Myotis septentrionalis*)	Confirmed[(d)]	S3	Endangered	▪ All wildlife is important	No	▪ Occupy and forage in similar habitats as little brown myotis ▪ Assessments of little brown myotis and upland and wetland ecosystems VCs are representative of effects on northern myotis

Table 14.2-1: Species Considered for Selection as Valued Components

Species	Presence in the RSA Confirmed by Baseline Surveys[a]	Provincially Tracked[b]	Federally Listed (Schedule 1, SARA)[c]	Comments from Indigenous Groups	Included as VC	Habitat Used and Rationale for Selection
Spruce grouse (*Falcipennis canadensis*)	Confirmed	n/a	n/a	▪ Consider inclusion as a VC (CRDN-JWG 2020b) ▪ Harvested for food (TSD II: BNDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR) ▪ Valued by LPA communities (NexGen 2019a) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Spruce grouse occupy lowland bogs and forest edges ▪ Assessments of olive-sided flycatcher and upland, wetland, and riparian ecosystems VCs are representative of effects on spruce grouse ▪ Receptor for the ecological risk assessment
Common nighthawk (*Chordeiles minor*)	Confirmed[d]	S4B, S4M	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Common nighthawk is an aerial insectivore ▪ Critical habitat has not been identified for this species ▪ Assessments of olive-sided flycatcher and upland, wetland, and riparian ecosystems VCs are representative of effects on common nighthawk
Olive-sided flycatcher (*Contopus cooperi*)	Confirmed	S4B, S4M	Special Concern	▪ Small songbirds are dying (MN-S-JWG 2020a) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	Yes	▪ Representative of coniferous forest, edges and openings near meadows and ponds ▪ Representative species for effects on listed bird species and aerial insectivores (e.g., bank swallow [*Riparia riparia*], barn swallow [*Hirundo rustica*], common nighthawk) ▪ Critical habitat has not been identified for this species
Bank swallow (*Riparia riparia*)	Potential	S4B, S5M	Threatened	▪ Small songbirds are dying (MN-S-JWG 2020a) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Bank swallow is an aerial insectivore ▪ Species not detected during wildlife baseline surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of olive-sided flycatcher and upland, wetland, and riparian ecosystems VCs are representative of effects on bank swallow
Barn swallow (*Hirundo rustica*)	Confirmed[d]	S4B, S4M	Threatened	▪ Small songbirds are dying (MN-S-JWG 2020a) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Barn swallow is an aerial insectivore ▪ Assessments of olive-sided flycatcher and upland, wetland, and riparian ecosystems VCs are representative of effects on barn swallow ▪ Critical habitat has not been identified for this species ▪ Any removal of occupied buildings (i.e., nests) would be mitigated in consultation with ECCC and ENV
Rusty blackbird (*Euphagus carolinus*)	Confirmed	S3B, SUN, S3M	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	Yes	▪ Rusty blackbird is an insectivore ▪ Representative species for effects on bank swallow, barn swallow, and common nighthawk, which are aerial insectivores ▪ Representative species for horned grebe (*Podiceps auritus*) and yellow rail (*Coturnicops noveboracensis*), which use similar small waterbodies ▪ Critical habitat has not been identified for this species ▪ Receptor for the ecological risk assessment
Common goldeneye (*Bucephala clangula*)	Confirmed	S5B, S3N, S3M	n/a	▪ Harvested for food (MN-S-JWG 2019b) ▪ Ducks are harvested (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2021b; CRDN-JWG 2020b,c; NexGen 2019a) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN) ▪ Decrease in the population of ducks observed (TSD III: BRDN; TSD IV: MN-S)	Yes	▪ Identified by Indigenous Groups as a species of interest, particularly related to hunting ▪ Dependence on water quality for successful breeding and foraging makes common goldeneye a valuable indicator for water quality ▪ Representative species for effects on fish-eating birds such as common loon and osprey (*Pandion haliaetus*), which have a larger foraging area
Common loon (*Gavia immer*)	Confirmed	n/a	n/a	▪ Important to Indigenous Groups (MN-S-JWG 2019b) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN) ▪ Decrease in the population of ducks observed (TSD III: BRDN; TSD IV: MN-S)	No	▪ Depend on water quality for successful breeding and foraging ▪ Assessments of common goldeneye and riparian and wetland ecosystems VCs are representative of effects on common loon ▪ Receptor for the ecological risk assessment
Red-throated loon (*Gavia stellata*)	Confirmed	S1B, S1M	n/a	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN) ▪ Decrease in the population of ducks observed (TSD III: BRDN; TSD IV: MN-S)	No	▪ Depend on water quality for successful breeding and foraging ▪ Assessments of common goldeneye and riparian and wetland ecosystems VCs are representative of effects on red-throated loon ▪ Receptor for the ecological risk assessment
Mallard (*Anas patyrhynchos*)	Confirmed	n/a	n/a	▪ Harvested for food (BRDN-JWG 2019a) ▪ Ducks are harvested (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2021b; CRDN-JWG 2020b,c; NexGen 2019a) ▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN) ▪ Decrease in the population of ducks observed (TSD III: BRDN; TSD IV: MN-S)	Yes	▪ Identified by Indigenous Groups as a species of interest ▪ Ecological, cultural, and socio-economic importance ▪ Representative species for effects on other waterfowl that use wetlands and adjacent uplands for breeding ▪ Receptor for the ecological risk assessment

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Species	Presence in the RSA Confirmed by Baseline Surveys[a]	Provincially Tracked[b]	Federally Listed (Schedule 1, SARA)[c]	Comments from Indigenous Groups	Included as VC	Habitat Used and Rationale for Selection
Horned grebe (*Podiceps auritus*)	Potential	S5B, S5M	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN) ▪ Decrease in the population of ducks observed (TSD IV: MN-S)	No	▪ Occupy similar habitats as rusty blackbird and mallard ▪ Horned grebe is a fish-eating bird ▪ Species not detected during baseline wildlife surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of rusty blackbird, mallard, common goldeneye, and riparian and wetland ecosystems VCs are representative of effects on horned grebe
Red-necked phalarope (*Phalaropus lobatus*)	Potential (migration)	S4B, S3M	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Potential presence in the RSA is primarily limited to spring and fall migration ▪ Not likely to interact with the Project ▪ Species not detected during baseline wildlife surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of riparian and wetland ecosystems VCs are representative of effects on red-necked phalarope
Yellow rail (*Coturnicops noveboracensis*)	Potential	S3B, S3M	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Occupies and breeds in small waterbodies ▪ Species not detected during baseline wildlife surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of mallard, rusty blackbird, and riparian and wetland ecosystems VCs are representative of effects on yellow rail
Whooping crane (*Grus americana*)	Potential (migration)	SXB, S1M	Endangered[e]	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Potential presence in the RSA is primarily limited to potential presence during spring and fall migration ▪ Not likely to interact with the Project ▪ Species not detected during wildlife baseline surveys ▪ Within Canada, critical habitat has been identified within Wood Buffalo National Park, but ongoing studies and consultation to identify additional critical habitat are being conducted (Environment Canada 2007) ▪ Assessments of upland, wetland, and riparian ecosystems VCs are representative of effects on whooping crane
Osprey (*Pandion haliaetus*)	Confirmed	S2B, S2M	n/a	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Fish-eating bird that occupies areas near large bodies of water where they forage ▪ Assessments of common goldeneye, and upland, wetland, and riparian ecosystems VCs are representative of effects on osprey
Peregrine falcon (*Falco peregrinus anatum*)	Potential (migration)	S1B, SNRM	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Potential presence in the RSA is primarily limited to spring and fall migration ▪ Not likely to interact with the Project ▪ Species not detected during baseline wildlife surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of upland, wetland, and riparian ecosystems VCs are representative of effects on peregrine falcon
Short-eared owl (*Asio flammeus*)	Potential	S3B, S2N, S3M	Special Concern	▪ Decrease in the population of birds observed (TSD II: BNDN; TSD III: BRDN)	No	▪ Breed in open landscapes including wetland areas ▪ Species not detected during baseline wildlife surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of wetland and riparian ecosystems VCs are representative of short-eared owl
Great grey owl (*Strix nebulosa*)	Confirmed	S3	n/a	▪ Decrease in the population of birds (TSD II: BNDN; TSD III: BRDN)	No	▪ Frequently use late-successional coniferous and mixed forest stands with diverse structure ▪ Assessments of caribou, little brown myotis, and upland ecosystems VCs are representative of effects on great grey owl
Canadian toad (*Anaxyrus hemiophrys*)	Confirmed	n/a	n/a	▪ Decrease in the numbers of frogs observed (TSD V.2: CRDN; BRDN-JWG 2019b)	Yes	▪ Breed in aquatic habitats and their dependence on these habitats makes them valuable environmental indicators for wetland and riparian areas and water quality ▪ Representative species for northern leopard frog
Northern leopard frog (*Lithobates pipiens*)	Potential	S3	Special Concern	▪ Decrease in the numbers of frogs observed (TSD V.2: CRDN; BRDN-JWG 2019b)	No	▪ Breed in and depend on aquatic habitats ▪ Species not detected during baseline wildlife surveys ▪ Critical habitat has not been identified for this species ▪ Assessments of Canadian toad and wetland and riparian ecosystems VCs are representative of effects on northern leopard frog
Ashton cuckoo bumble bee (*Bombus bohemicus*)	Potential	S1	Endangered	▪ All wildlife is important	No	▪ Habitat generalist that uses a variety of open and forested habitats with flowering plants; may also forage in disturbed areas along roadside ditches, cutlines, and seismic lines ▪ Preferred foraging habitat is at interface between open and forested/treed habitat that support rapid growth of flowering plants ▪ Critical habitat has not been identified for this species ▪ Assessment of upland ecosystems are representative of effects on Ashton cuckoo bumble bee
Yellow-banded bumble bee (*Bombus terricola*)	Potential	S4	Special Concern	▪ All wildlife is important	No	▪ Habitat generalist that uses a variety of open and forested habitats with flowering plants; may also forage in disturbed areas along roadside ditches, cutlines, and seismic lines. ▪ Preferred foraging habitat is at interface between open and forested/treed habitat that support rapid growth of flowering plants. ▪ Critical habitat has not been identified for this species ▪ Assessment of upland ecosystems are representative of effects on yellow-banded bumble bee

Table 14.2-1: Species Considered for Selection as Valued Components

Species	Presence in the RSA Confirmed by Baseline Surveys[a]	Provincially Tracked[b]	Federally Listed (Schedule 1, SARA)[c]	Comments from Indigenous Groups	Included as VC	Habitat Used and Rationale for Selection
Transverse lady beetle (*Coccinella transversoguttata*)	Potential	S4	Special Concern	▪ All wildlife is important	No	▪ Habitat generalist that uses a variety of forested habitats with plants that support prey species such as aphids, and coarse woody debris and leaf litter for overwintering ▪ Critical habitat has not been identified for this species ▪ Assessment of upland ecosystems are representative of effects on transverse lady beetle
Nine-spotted lady beetle (*Coccinella novemnotata*)	Potential	S4	Endangered	▪ All wildlife is important	No	▪ Habitat generalist that uses a variety of forested habitats with plants that support prey species such as aphids, and coarse woody debris and leaf litter for overwintering ▪ Critical habitat has not been identified for this species ▪ Assessment of upland ecosystems are representative of effects on nine-spotted lady beetle

a) Based on Annex VIII.1 (Wildlife Baseline Report [Mammals, Waterfowl, and Raptors]), Annex V.1 (Aquatic Environment Baseline Report), Annex VIII.2 (Wildlife Baseline Report 2 [Amphibians, Birds, and Bats]), and Annex VIII.3 (Wildlife Baseline Report [Bird Migration and Bats]).
b) Provincial rank definitions (SKCDC 2020; 2021): S1 = Critically Imperilled / extremely rare; S2 = Imperilled / very rare; S3 = Vulnerable / rare to uncommon; S4 = Apparently secure; S5 = Secure / Common; B = for a migratory species, rank applies to the breeding population in the province; M = for a migratory species, rank applies to the transient population in the province; N = for a migratory species, rank applies to the non-breeding population in the province; X = believed to be extinct or extirpated from the province; U = status is uncertain in Saskatchewan because of limited or conflicting information (unrankable); NR = rank is not yet assigned or species has not yet been assessed (not ranked).
c) Government of Canada 2023.
d) Species confirmed in LSA (Annex VIII.1; Annex V.1; Annex VIII.2; Annex VIII.3).
e) Whooping crane is also listed as endangered under Saskatchewan's *The Wildlife Act.*
IKTLU = Indigenous Knowledge and Traditional Land Use; LPA = local priority area; LSA = local study area; RSA = regional study area; SARA = *Species at Risk Act*; VC = valued component; ECCC = Environment and Climate Change Canada; ENV = Saskatchewan Ministry of Environment; n/a = not applicable.

14.2.2.1.2 Summary of Selected Valued Components

Wildlife VCs were selected to capture a range of potential effects of the Project on wildlife, while simultaneously avoiding the inclusion of multiple species with the same or similar (i.e., redundant) pathways of effects or assessment (Section 6.3.1). To avoid missing habitat conditions or ecological processes not associated with a specific indicator species (Simberloff 1998), species with a variety of habitat requirements and different ecological roles were selected. Where effects on wildlife were not addressed by the wildlife VCs that were selected, these effects have been broadly captured by assessment of upland, wetland, and riparian ecosystems in the vegetation assessment (Section 13). In addition, ecological health risks were examined for 16 aquatic, semi-aquatic, and terrestrial wildlife species or receptors (i.e., amphibians, birds, and mammals; Table 14.2-1) to determine the sensitivity of animals from exposure to chemical substances and metals through fresh water, ingesting soil and sediment, and eating aquatic and terrestrial plants, fish, and other animals. Eight of the receptors examined in the ecological health risk assessment were also selected as wildlife VCs (i.e., woodland caribou, moose, black bear, grey wolf, beaver, little brown myotis, rusty blackbird, and mallard) to represent the range of receptor niches and to inform the effects analysis. Results from the ecological health risk assessment (TSD XXI, Environmental Risk Assessment) were used to support the assessment of wildlife VCs and associated habitats.

Wildlife VCs selected for the Project are as follows:

- **Woodland caribou:** The boreal population of woodland caribou is important ecologically, culturally, and socio-economically, and caribou were traditionally harvested by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN-JWG 2020b), though some Indigenous Groups continue to occasionally hunt caribou, depending on availability (TSD II: BNDN; TSD III: BRDN; BNDN-JWG 2020b; BNDN-JWG 2021b; CRDN-JWG 2020a). Woodland caribou is listed under Schedule 1 of the SARA as Threatened (Government of Canada 2023) and are provincially ranked as S3 (i.e., vulnerable/rare to uncommon; SKCDC 2021; SKCDC 2020). Woodland caribou have been recorded in the RSA, and Indigenous Groups noted that woodland caribou habitat is in the RSA (TSD III BRDN; TSD V.2: CRDN). A movement route was also identified at the narrows of the north arm of Patterson Lake between the proposed fresh water intake and the proposed treated effluent and treated sewage discharges for the Project (BNDN-JWG 2019b; Annex VIII.1; Annex VIII.2; Annex VIII.3). Indigenous Groups are concerned that caribou movement and abundance are affected by noise, fire regime (i.e., pattern of fire seasonality, frequency, intensity, duration, and extent), and infrastructure being added to the landscape (TSD II: BNDN; TSD V.2: CRDN; BRDN-JWG 2019a; BNDN-JWG 2020a,b; BRDN-JWG 2020a; CRDN-JWG 2020b; MN-S-JWG 2020a,b). Woodland caribou require large, contiguous tracts of habitat so they can maintain low population densities across their range. Woodland caribou may act as an umbrella species for other species in boreal forests, because caribou require sufficiently large habitat areas that its conservation results in improvement in conservation prospects for other species such as wolverine, fisher, and American marten (Hebblewhite 2017).

- **Moose:** Moose is an important species ecologically, culturally, and socio-economically and are harvested by people, including Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2020b; CRDN-JWG 2020b; MN-S-JWG 2020b; NexGen 2019a). Moose have been recorded and hunted in the LSA and RSA (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; CRDN-JWG 2020a; Annex VIII.1). Indigenous Groups identified moose habitat and hunting locations in the RSA (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN). Indigenous Groups have expressed concern that moose are moving south, are being killed by larger populations of wolves, and may be affected by poaching (MN-S-JWG 2019a; MN-S-JWG 2020a,b). Indigenous Groups also expressed that mining projects, mineral exploration activities, increased traffic and forest fires contribute to a loss of moose habitat, resulting in a decrease in abundance and habitat availability (TSD II: BNDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; CRDN-JWG 2020b). Moose is a highly interactive species in boreal environments as a primary source of protein and energy for predators and scavengers, and an increase in moose density could negatively affect woodland caribou populations by increasing carnivore density (Wittmer et al. 2005; Festa-Bianchet et al. 2011). Moose are herbivores with linkages to aquatic environments and thus may be affected by environmental contaminants through both land and water. Further, Indigenous Groups expressed concern about the health of moose (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.2: CRDN; CRDN-JWG 2020c; MN-S-JWG 2019a). Changes in the abundance, distribution, or health of moose as a result of the Project could have important influences on ecosystems and people.
- **Grey wolf:** Grey wolf is important ecologically, culturally, and socio-economically and has been recorded in the LSA and RSA (Annex VIII.1). Indigenous Groups trap wolves for fur (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR). Indigenous Groups noted that grey wolf populations are increasing (resulting in an unbalanced predator-prey relationship) (MN-S-JWG 2019a; BRDN-JWG 2020a; BRDN-JWG 2021b; MN-S-JWG 2020a). Grey wolf is of interest from a conservation perspective because it preys on large ungulates, including woodland caribou, and influences prey population dynamics (Latham et al. 2013). Grey wolves may be exposed to environmental contaminants through consumption of varying prey such as deer, moose, and caribou that make up most of their diet in Saskatchewan (Urton 2004). Grey wolves are wide-ranging and use a variety of habitats, making the species an indicator for other generalist carnivores such as wolverine and coyote (*Canis latrans*).
- **Black bear:** Black bear is important ecologically, culturally, and socio-economically. Black bear has been recorded in the LSA and RSA (Annex VIII.1) and are hunted by Indigenous Groups and LPA community members for their hides and meat (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN-JWG 2020b). Indigenous Groups requested that black bear be included as a VC because of their importance to community members, and indicated concerns that black bear are changing their habits due to the presence of humans and the attraction to human developments (TSD II: BNDN; MN-S-JWG 2019a). Their diet consists of a vast array of food types including roots, buds, fruit, nuts, insects, fish, mammals, and carrion (Garshelis et al. 2016), and may be exposed to environmental contaminants due to this varying diet. Black bears are wide-ranging and encompass a variety of habitats (Garshelis et al. 2016), making the species an indicator for other wide-ranging wildlife species.

- **Beaver:** Beaver signs (i.e., runs/feeding sign, active houses, old/inactive houses and dams) were recorded in the LSA and RSA (Annex VIII.1). Beaver is important ecologically, culturally, and socio-economically and are hunted and trapped by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2019b; BRDN-JWG 2021b; CRDN-JWG 2020b,c). Indigenous Groups expressed concerns about disturbance to beaver habitat from forest fires (TSD II: BNDN; TSD V.2: CRDN). Beavers are herbivores that prefer to consume trembling aspen (*Populus tremuloides*) and willows (*Salix* spp.) but will consume the leaves, twigs, and bark of many woody plant species that grow near waterbodies (Jenkins and Busher 1979) and may be exposed to environmental contaminants due to their reliance on both land and water resources. Beaver is an indicator species for effects on other semi-aquatic mammals such as muskrat and river otter, which also rely on aquatic environments.
- **Little brown myotis:** Little brown myotis has been recorded in the RSA (Annex VIII.2). The species is listed under Schedule 1 of the SARA as Endangered (Government of Canada 2023) and provincially ranked as S4B/S4N (i.e., apparently secure as it applies to the breeding and non-breeding population; SKCDC 2020, 2021). Little brown myotis are insectivores, and they may be affected by environmental contaminants through ingestion of insects. Assessment of little brown myotis is representative of effects on northern myotis (also recorded in the RSA), which is also listed under Schedule 1 of the SARA as Endangered (Government of Canada 2023) and is dependent on open forest or edge habitat in wet areas for foraging on insects. Assessment of little brown myotis is also representative of effects on late successional stage forests, which is representative of habitat suitable for fisher and marten.
- **Olive-sided flycatcher:** Olive-sided flycatcher has been recorded in the LSA and RSA (Annex VIII.1). The species is listed under Schedule 1 of the SARA as Special Concern (Government of Canada 2023) and is provincially ranked as S4B/S4M (i.e., apparently secure as it applies to the breeding and migratory population; SKCDC 2020, 2021). The species may be affected by environmental contaminants through their ingestion of insects. Olive-sided flycatchers provide a representative indicator for other aerial insectivores recorded in the RSA (e.g., barn swallow, common nighthawk), and for songbirds that use coniferous forest, snags, forest edges, and openings near meadows and ponds. Assessment of olive-sided flycatcher is also representative of habitat-related effects on spruce grouse that occupy similar forest edge habitats.
- **Rusty blackbird:** Rusty blackbird is listed under Schedule 1 of the SARA as Special Concern (Government of Canada 2023) and provincially ranked as S3B/SUN/S3M (i.e., vulnerable/rare to uncommon as it applies to the breeding and migratory populations, but status is uncertain due to conflicting information; SKCDC 2020, 2021). Rusty blackbirds have been recorded in the RSA (Annex VIII.2). Due to their ingestion of insects (COSEWIC 2017), rusty blackbirds may be affected by environmental contaminants. The species provides a representative indicator for other insectivorous species that may also be affected by environmental contaminants due to their diets that are similar to those of bank swallow, barn swallow, and common nighthawk. Rusty blackbirds occupy various wetlands and wet forests including bogs, fens, swamps[6], wet meadows, wet forest openings, and floodplain forests (Greenberg and Droege 1999; COSEWIC 2017; Avery 2020). Assessment of rusty blackbird is also representative of effects on horned

[6] The National Wetlands Working Group (NWWG 1997) defines these types of wetlands as follows: "Bog: peatland receiving water exclusively from precipitation and not influenced by groundwater, *sphagnum*-dominated vegetation. Fen: peatland receiving water rich in dissolved minerals; vegetation cover composed dominantly of graminoid species and brown mosses. Swamp: peatland dominated by trees, shrubs and forbs; waters are rich in dissolved minerals" (pg. 9).

grebe and yellow rail, which use similar small waterbodies and are potentially located in but were not recorded in the RSA.

- **Common goldeneye:** Common goldeneye uses aquatic habitats in the LSA and RSA (Annex VIII.1; Annex VIII.2). The species depends on water quality for successful breeding and foraging and has the potential for exposure to contaminant pathways. Indigenous Groups and LPA community members identified ducks in general as important species that are hunted and are a key part of traditional diets (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2021b; CRDN-JWG 2020b,c; NexGen 2019a). The MN-S specifically indicated that common goldeneye is preferred for eating over other duck species, such as mallard (MN-S-JWG 2019b). Common goldeneye, along with other wildlife that may use the aquatic and wetland habitats in the LSA and RSA such as osprey and horned grebe, is represented in the ecological risk assessment by common loon due to their consumption of fish. Assessment of common goldeneye is also representative of effects on these species that use similar waterbodies.
- **Mallard:** Mallard has been recorded in the LSA and RSA (Annex VIII.1; Annex VIII.2) and can be found in almost any wetland or waterbody varying from lakes to ephemeral (i.e., temporary) wetlands (Drilling et al. 2020). The species is important ecologically, culturally, and socio-economically. Indigenous Groups and LPA community members identified ducks in general as important species that are hunted and are a key part of traditional diets (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2021b; CRDN-JWG 2020b,c; NexGen 2019a). The BRDN specifically noted that mallard is harvested for food (BRDN-JWG 2019a). During the breeding season, mallard mainly eat invertebrate species such as aquatic insect larvae, worms, snails, fresh water shrimp, and native wetland plants (del Hoyo et al. 1992; Drilling et al. 2020). Given the reliance on water, wetland plants, and aquatic insects, mallard has the potential for exposure to contaminant pathways. Assessment of mallard is representative of effects on horned grebe and yellow rail, which use similar small waterbodies.
- **Canadian toad:** Canadian toad breeds in aquatic habitats within the LSA and RSA (Annex VIII.2). Breeding habitats include natural and constructed ponds, streams, and lakes with shallow margins, as well as rivers and ephemeral waterbodies (Roberts and Lewin 1979; Russell and Bauer 2000; Westworth and Associates 2002). The BRDN expressed concern that radiation or pollution from the oilsands may be affecting amphibian abundance (BRDN-JWG 2019b). Assessment of Canadian toad is representative of effects on northern leopard frog, which is listed under Schedule 1 of the SARA as Special Concern (Government of Canada 2023) but was not observed during baseline studies (Annex VIII.1; Annex VIII.2).

14.2.2.2 Measurement Indicators

Measurement indicators are used to characterize changes to attributes of the environment from the Project, other human developments, and natural factors. The changes in measurement indicators are used to predict overall effects on VCs and assessment endpoints (Section 6.3.2, Assessment Endpoints and Measurement Indicators). Three measurement indicators were identified and used for wildlife VCs (Table 14.2-2). Importantly, the measurement indicators for wildlife VCs are connected to intermediate components and VCs in the EA such as air quality, hydrology, surface water quality, terrain and soils, and vegetation. Accordingly, the assessments of these components were fundamental to understanding the total effects of the Project on wildlife VCs (Section 6.3.3, Intermediate Components). Results from the ecological health risk assessment were also incorporated into the survival and reproduction measurement indicator for wildlife VCs.

The measurement indicators for wildlife VCs are defined as follows:

- **Habitat availability** (i.e., habitat quantity and quality): changes to the amount of different quality habitats (e.g., hectares), and animal use of available habitat.
- **Habitat distribution** (i.e., habitat arrangement and connectivity): changes to spatial configuration and connectivity of habitats, and the spatial distribution and movement of animals. An area was considered well connected if the landscape facilitates wildlife movement between habitat patches. Movement between patches is a function of the degree of hostility or risk of the landscape (i.e., matrix) between suitable habitat patches, distance between suitable patches, and the movement ability (i.e., mobility) of the VC. For example, animals may still travel across poor or unsuitable habitats, but a wolf or moose would likely be more successful than a Canadian toad or beaver due to differences in mobility (i.e., wolves have higher mobility than toads). Most bird and bat VCs have high mobility by flying over unsuitable or risky habitat patches. Generally, the assessment assumed that an increase in linear feature density (e.g., more roads and trails) would be correlated with a reduction in habitat connectivity for all VCs.
- **Survival and reproduction**: changes to animal abundance from altering survival and/or recruitment. Survival and reproduction also considered the results from the ecological health risk assessment and exposure of aquatic and terrestrial species or receptors to chemical substances or metals (i.e., constituents of potential concern [COPCs]; TSD XXI).

Each measurement indicator was assessed quantitatively where sufficient information existed to support a numerical assessment, and qualitatively where necessary, with the support of scientific literature.

14.2.2.3 Assessment Endpoints

Assessment endpoints are qualitative expressions that represent the key properties of VCs that should be protected; as such, assessment endpoints incorporate the concept of sustainability and function as significance thresholds (Section 6.3.2). The significance of effects from the Project and other human developments on wildlife VCs was evaluated by linking changes in measurement indicators to the influence on self-sustaining and ecologically effective populations (Table 14.2-2). Details on the application of self-sustaining and ecologically effective populations as a significance threshold are provided in Section 14.2.9, Residual Effects Classification and Determination of Significance. The compilation and interpretation of the results from analyzing changes in measurement indicators provided lines of evidence that collectively provided a determination of whether the assessment endpoints were maintained or achieved (Section 6.3.2). The results from the ecological health risk assessment provided another important line of evidence in the determination of significance of effects on wildlife VCs (Section 6.3.4, Environmental Risk Assessment Receptors).

Table 14.2-2: Valued Components, Rationale, Measurement Indicators, and Assessment Endpoints

VCs	Rationale	Measurement Indicators	Assessment Endpoints
▪ Woodland caribou ▪ Moose ▪ Grey wolf ▪ Black bear ▪ Beaver ▪ Little brown myotis ▪ Olive-sided flycatcher ▪ Rusty blackbird ▪ Common goldeneye ▪ Mallard ▪ Canadian toad	▪ Traditional and/or current food source ▪ Federal and/or provincial species at risk protected by legislation ▪ Socio-economic/cultural importance ▪ Ecological importance ▪ Potential to be exposed to chemical changes in air, soil, surface water, dietary items, or sediment quality resulting from the Project	▪ Habitat availability (quantity and quality) ▪ Habitat distribution (arrangement and connectivity) ▪ Animal survival and reproduction	▪ Self-sustaining and ecologically effective populations

VC = valued component.

14.2.3 Spatial Boundaries

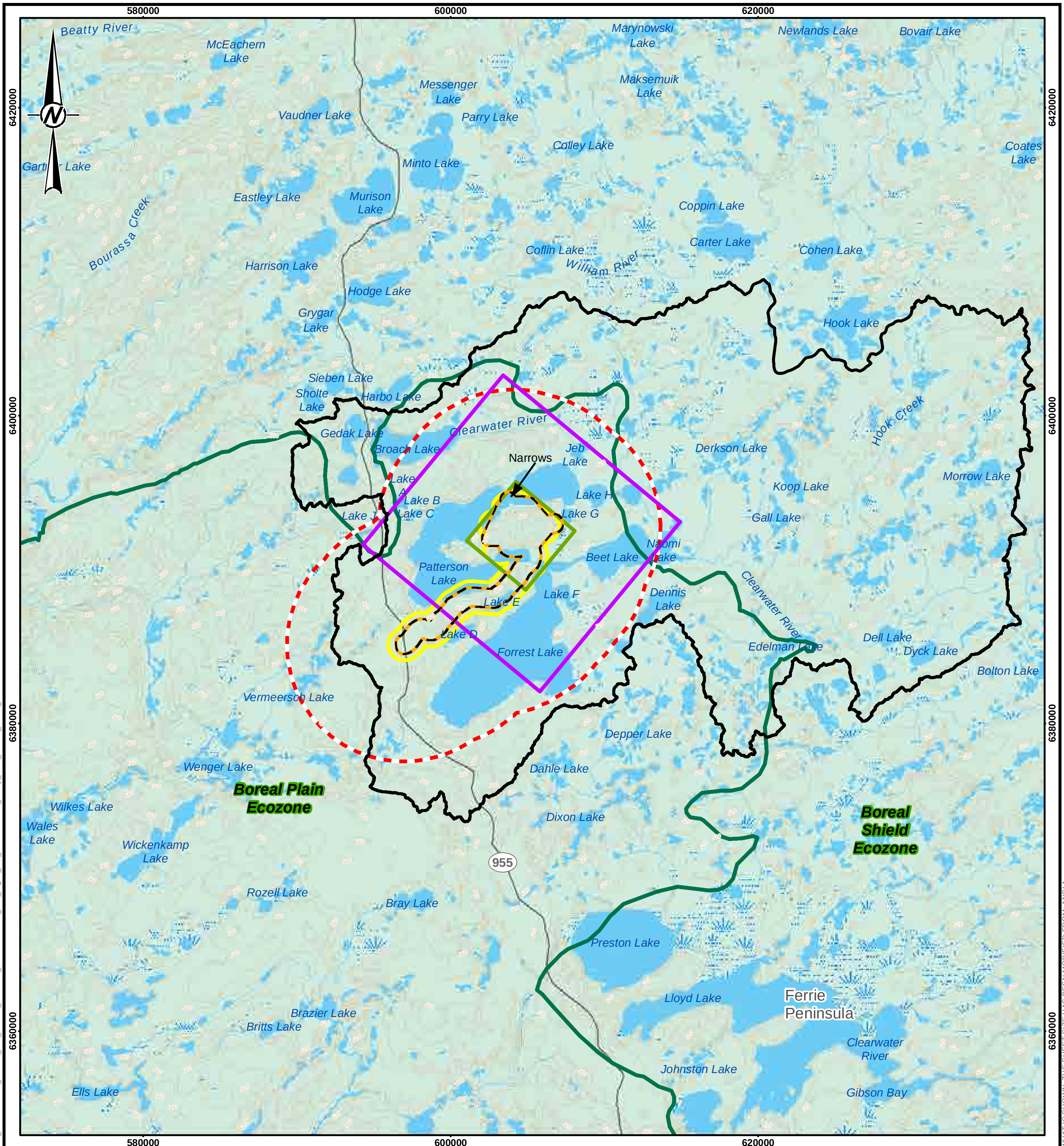
Spatial boundaries used for the baseline field surveys differed from those used for the EA. The field survey boundaries were selected based on an early Project design, and the study areas for the EA (i.e., assessment boundaries) were more refined considering the potential effects from the more detailed Project design and additional ecological context understood as the Project progressed. Nonetheless, the baseline field survey data remain appropriate for the EA boundaries. The following discussion elaborates further on the rationale for the different spatial boundaries for collecting field data and assessing effects from the Project on wildlife.

14.2.3.1 Baseline Survey Boundaries

Field surveys for wildlife and wildlife habitat were completed within specific baseline study areas, which were defined according to knowledge of ore deposit location, preliminary Project site layout, provincial requirements, and surveys completed for other northern mining developments. Canada North Environmental Services (CanNorth) conducted wildlife surveys within a site study area and a broader LSA. The baseline site study area consisted of a 25 km^2 area centred on the preliminary site layout and was selected to capture site-specific effects, while the baseline LSA consisted of a 225 km^2 area centred on the preliminary site layout and was intended to provide larger-scale information on existing conditions (Annex VIII.2; Annex VIII.3). Omnia Ecological Services (Omnia) conducted wildlife surveys within the baseline LSA, baseline RSA, and baseline caribou RSA (Annex VIII.1). The baseline LSA (41 km^2) was defined by applying a 1 km buffer to the preliminary Project site layout and existing access road, which was intended to capture direct effects from the physical footprint and indirect effects from sensory disturbance associated with construction noise and truck traffic (Annex VIII.1). The baseline RSA consisted of a 400 km^2 area centred on the preliminary site layout and access road and was anticipated to collect information on species with larger home ranges (Annex VIII.1). The baseline caribou RSA (2,380 km^2) was derived from an estimated mean (i.e., average) annual home range of 407 km^2, which was based on a two-year study or 92 radio-collared caribou (McLoughlin et al. 2016). During this study, 24 individuals died before the end of the second study year, so their ranges were smaller than those surviving the full two years. The mean diameter of the home range was applied as a buffer to the preliminary site layout and access road to delineate the baseline caribou RSA (Annex VIII.1).

The baseline study areas were designed to measure and characterize existing environmental conditions on a continuum of scales from the preliminary site layout to broader local and regional areas. Many sampling and survey locations were concentrated on and adjacent to the preliminary site layout and existing access road within the baseline site study area and LSA (e.g., listed plant species and vegetation plots, small mammal sampling, and amphibian and breeding bird point counts [Annex VIII.1; Annex VIII.2]). Other surveys for animal signs (e.g., tracks, droppings/scat) and abundance, such as surveys for ungulates, semi-aquatic furbearers, and waterfowl, were more evenly distributed across the baseline LSA and RSA (Annex VIII.1).

The assessment study areas presented in the next subsection capture the information collected from field studies in the baseline study areas and reflect more recent and detailed Project design information. Specifically, the assessment LSA is overlapped by the CanNorth baseline site study area and LSA and the Omnia baseline LSA (Figure 14.2-1). The RSA for the wildlife assessment includes most of the CanNorth baseline LSA and Omnia baseline RSA (Figure 14.2-1).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- LOCAL ROAD
- SECONDARY HIGHWAY
- WATERCOURSE
- ECOZONE BOUNDARY
- WATERBODY
- WETLAND
- WOODED AREA
- ASSESSMENT LOCAL STUDY AREA
- ASSESSMENT REGIONAL STUDY AREA
- CANNORTH BASELINE SITE STUDY AREA
- CANNORTH BASELINE LOCAL STUDY AREA
- OMNIA BASELINE LOCAL STUDY AREA
- OMNIA BASELINE REGIONAL STUDY AREA

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REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

WILDLIFE BASELINE AND ASSESSMENT STUDY AREAS

CONSULTANT

wsp

PROJECT		20144150	PHASE	3310 - 2
DESIGN	JV	2023-02-08	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-08		
CHECK	SM	2023-02-08	**FIGURE 14.2-1**	
REVIEW	JV	2023-02-08		

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14.2.3.2 Environmental Assessment Boundaries

The assessment of wildlife and wildlife habitat was completed using the same spatial boundaries to those for vegetation, which consist of a site study area, maximum disturbance area, LSA, and RSA (Figure 14.2-2). The exception was woodland caribou, which included additional spatial boundaries required for the assessment of Project-specific and cumulative effects. The selection of the assessment study areas considered VC-specific and ecosystem-centred attributes and boundaries, and the predicted spatial extent (i.e., zone of influence [ZOI]) of Project effects and other existing and future activities/developments (CEA Agency 2018).

Site Study Area

The Project footprint (i.e., site study area) covers 228 ha and includes the existing access road and bridge and all proposed Project site infrastructure. To the degree possible, the Project footprint was minimized to reduce both the area of restricted access to Indigenous and other land users and the effects on the terrestrial environment.

Maximum Disturbance Area

A maximum disturbance area was used for the assessment to address uncertainty in the final design of the Project so that adverse effects on wildlife were not underestimated (i.e., the maximum disturbance area is four times larger than the currently anticipated Project footprint). The maximum disturbance area, which covers 981 ha, represents the smallest scale of assessment and an area where the potential direct effects of the anticipated Project on soils, vegetation, and wildlife can be assessed accurately and precisely. The spatial boundary of the maximum disturbance area was delineated by applying buffers to the outer edges of the anticipated Project infrastructure (Section 6.4.1, Spatial Boundaries). The spatial boundary was also constrained to the shoreline of Patterson Lake (Figure 14.2-2).

Local Study Area

The LSA for the EA is approximately 2,832 ha (28 km^2) and is defined by a 500 m buffer around the maximum disturbance area. The LSA provides local context for assessing Project effects (Figure 14.2-2). Data and information collected at the local scale provide detailed and precise measurements of existing conditions to predict direct and indirect Project-related changes to measurement indicators for wildlife VCs. The LSA also includes disturbance from previous and existing anthropogenic (i.e., human-related) activities, such as NexGen's exploration camp and core sheds, public trails, cutlines, clearings, and the intersection of the access road and Highway 955.

The LSA was established to capture the direct effects on wildlife from the physical removal and alteration of soils and vegetation (i.e., wildlife habitat) and potential harmful interactions with Project activities, infrastructure, and facilities (e.g., vehicle-animal collisions, birds and bats colliding with electrical distribution lines). The 500 m buffer around the maximum disturbance area is expected to capture most of the small-scale indirect effects on wildlife VCs from changes in soils and vegetation due to dust deposition and strong avoidance of Project-related activities that create sensory disturbance. For example, the strongest effects from dust on vegetation are typically near the source, such as roads (Walker and Everett 1987; Farmer 1993). Walker and Everett (1987) found effects were primarily within 50 m of a road, while Meininger and Spatt (1988) detected stronger effects within 50 m and weaker changes within 50 to 500 m from a road (both studies in Alaska). At the Ekati Mine in the tundra of the Northwest Territories (NWT; where dispersion is not impeded by shrubs and trees), dust generated from a high-traffic, 28 km haul road was found to decrease lichen cover up to 1 km (Chen et al. 2017).

However, at the nearby Diavik Mine, measured changes to plant communities were within 500 m of the mine (Watkinson et al. 2021).

The degree and distance that wildlife have been shown to avoid human developments and activities varies with species, type of disturbance and level of activity, and landscape characteristics (Gill et al. 2001; Benítez-López et al. 2010; Suraci et al. 2021). Using data from 49 studies, Benítez-López et al. (2010) found that birds and mammals avoided infrastructure up to 1 km and 5 km, respectively, and the responses were greater (i.e., higher avoidance) in open areas compared to more forested areas. Wildlife responses within a ZOI are typically stronger adjacent to the disturbance and decrease with increasing distance from the source up to some distance that represents natural habitat conditions (Eigenbrod et al. 2009; Ficetola and Denoël 2009).

The LSA boundary was selected to capture the strongest avoidance effects from the Project on wildlife. For example, habitat for caribou is considered unsuitable within 500 m of human developments and activities, including forest cutovers (i.e., areas that have been cleared of trees), and this habitat is intended to represent the influence of sensory disturbance and perceived predation risk (Environment Canada 2011; ECCC 2020). Moose have been documented showing a preference for seismic lines, utility lines, and logging roads (Higgelke 1994; Serrouya and D'Eon 2002) and may be drawn to salt on and around highways in winter (Miller and Litvaitis 1992). Alternatively, Laurian et al. (2008) found that moose showed annual avoidance of areas up to 500 m from highways and up to 1,000 m from forest roads. In a subsequent study, moose avoidance of roads varied seasonally from 100 to 250 m (Laurian et al. 2012). Provincial setback distances for migratory birds vary from 150 to 300 m depending on the type of activity (ENV 2017). Therefore, selection of a 500 m ZOI for the LSA is supported by applicable literature on wildlife responses to disturbance for many VCs. Indirect effects that may extend beyond the LSA were also considered in the EA for species that may be more sensitive or activities that may be more disruptive, as applicable.

Regional Study Area

Due to the inter-relationships among physical and biological components in aquatic and terrestrial ecosystems, a common RSA for the EA was defined for the aquatic and terrestrial assessments and provides a watershed-based context for interpreting the effects of the Project and RFDs. More specifically, the Clearwater River watershed boundary of the RSA links the exposure of COPCs in dust, soils, plants, water, and aquatic-related food pathways to wildlife using the watershed. The COPC pathways were evaluated through the ecological health risk assessment (TSD XXI). The RSA includes the LSA, Forrest Lake, Beet Lake, and Naomi Lake and the watershed east and north of the confluence of the Clearwater and Mirror rivers as described in the hydrology assessment (Section 9.2.2, Valued Components, Intermediate Components, and Measurement Indicators). The RSA also overlaps the transition between the Boreal Plain and Boreal Shield ecozones and likely includes any potential variability in diversity between the two ecozones. The assessment of fish and fish habitat at the watershed scale (Section 11.2.3, Spatial Boundaries), which links to potential wildlife food sources and the combined coarse- and fine-filter approach applied to the assessment of vegetation (Section 13.2.2.1, Valued Components) and wildlife VCs (Section 14.2.2.1, Valued Components), represents the use of both VC- and ecosystem-centred approaches to defining the RSA (CEA Agency 2018). The RSA was also an effective scale for determining Project effects and effects of RFDs on overall biodiversity.

The RSA is the largest scale at which data were collected, compiled, and analyzed; covers 107,491 ha (1,075 km^2; Figure 14.2-2); and addresses potential indirect effects associated with ZOIs that may extend beyond the LSA (CEA Agency 2018). The spatial extent of the RSA is ecologically relevant for assessing incremental and cumulative effects from the Project, other previous and existing developments and activities, RFDs, and natural factors on small- and wide-ranging wildlife VCs. Individuals of species with small daily and seasonal ranges (e.g., beaver, common goldeneye, mallard) that would be affected by the Project are expected to mostly range within the RSA.

For wide-ranging VCs (i.e., animals that travel over large ranges), such as wolf, black bear, and moose, individuals likely interact with natural and human-related factors beyond the RSA, either daily or seasonally. For example, McLoughlin et al. (2019) estimated the mean size of core use in the annual home range of resident wolves in the Boreal Shield to be 660 km^2 and the mean annual home range to be 2,865 km^2. Average annual home range size for adult male and female black bears were 316.5 km^2 and 79.8 km^2, respectively (McLoughlin et al. 2019). Stenhouse et al. (1995) reported the mean home range size of moose in northern Alberta to be 97 km^2 (i.e., for a density of 0.18 moose per km^2) and 174 km^2 in the NWT (i.e., 0.16 moose per km^2). Recent surveys in the northwest Boreal Plain Ecozone of Saskatchewan (i.e., south of the Project) estimated moose density at 0.20 moose per km^2 (Arsenault et al. 2019), which suggests that home range size would be similar to moose studied in northern Alberta and the NWT. Therefore, the RSA is considered an appropriate size to capture the home ranges and movements of wide-ranging VCs, and the interpretation and discussion of effects also includes factors that can influence these species outside of the RSA.

The Project would be located in Wildlife Management Zone (WMZ) 75. However, the WMZ was not used for the RSA as it extends across much of the northern portion of the province (i.e., an area equal to 58,191 km^2) and would likely result in under-representing the magnitude or severity of effects from the Project and RFDs. In contrast, the RSA is expected to capture a large enough portion of populations to make ecologically relevant and confident predictions about the effects from the Project and RFDs on VCs that are likely to be distributed inside but may also extend outside the RSA. The potential influence of the Project and RFDs on predator-prey interactions is also relevant at this scale (e.g., increased access for predators and prey alters the risk of predation on caribou). Beyond regional context was considered for each VC, as appropriate. The RSA was used to assess the significance of incremental and cumulative effects from the Project and other developments on all wildlife VCs, except caribou.

Woodland Caribou Study Areas

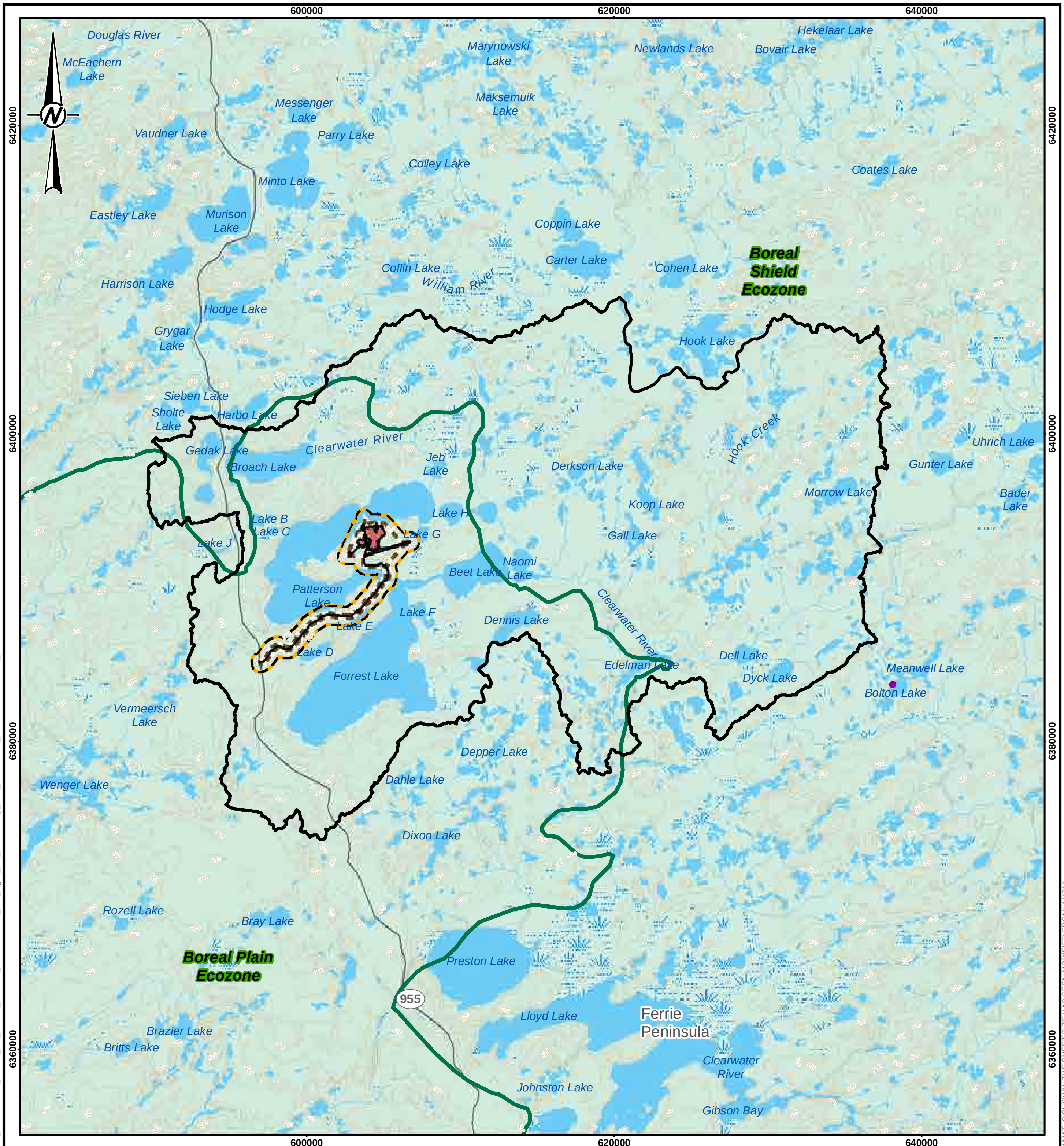
For woodland caribou, quantitative assessments were completed for the LSA, caribou home range, RSA, and SK2 West Caribou Administration Unit (ENV 2021) to provide a more complete understanding of the magnitude, geographic extent, duration, and context of predicted effects from habitat alterations due to the Project, previous and existing developments, and RFDs (Table 14.2-3). The woodland caribou home range used to assess effects (43,521 ha, or 435 km^2; McLoughlin et al. 2016) is based on the mean annual home range size of female caribou that survived a full two years in the Boreal Shield and was centred on the Project footprint (Figure 14.2-3). During engagement meetings, the ENV suggested that the SK2 West Caribou Administration Unit does not fully reflect the biological requirements for caribou that occupy the area of the proposed Project and that an additional scale to the LSA and SK2 West Caribou Administration Unit, such as home range, should be considered in the analysis of Project-specific and cumulative changes on caribou and caribou habitat in the Patterson Lake watershed (Riemer 2019). Conditions at the scale of the caribou home range also provide ecological context to support caribou mitigation and offsetting actions. The wildlife RSA was also used in the assessment of woodland caribou where there were linkages to effects from other assessments of intermediate components and VCs such as effects on water quality, vegetation ecosystems, and moose and wolf and associated predator-prey dynamics.

The SK2 West Caribou Administration Unit (48,287 km^2) was used to assess habitat loss at a scale to support information on the status of critical habitat (i.e., 65% undisturbed habitat or not more than 35% disturbed habitat) in the SK2 Caribou Conservation Unit (ECCC 2020; Figure 14.2-3). Therefore, the SK2 West Caribou Administration Unit is the appropriate scale for a cumulative effects assessment and the scale at which significance was determined. A qualitative assessment of the SK2 West Caribou Administration Unit north sub-unit (12,750 km^2; ENV 2021) was also completed to provide relevant ecological context for predicted effects from the Project on caribou that inhabit an area more similar to the natural disturbance regime in the Boreal Shield (Neufeld et al. 2020), and includes the baseline caribou RSA. In summary, multiple spatial scales were used for a robust woodland caribou assessment that addresses the individual-level behaviour and effects, Project interaction pathways, population-level dynamics, and resource management requirements.

Table 14.2-3: Spatial Boundaries for Assessment of Wildlife Valued Components

Assessment Area	Area	Description/Rationale
Site study area	228 ha (2.3 km^2)	▪ Equivalent to the anticipated Project footprint, which includes all proposed mine infrastructure and facilities (199 ha) and access road (29 ha)
Maximum disturbance area	981 ha (9.8 km^2)	▪ Incorporates a level of uncertainty into the Project design so that effects are not underestimated. The maximum disturbance area was defined using bounding points around the outermost components of the Project footprint
LSA	2,832 ha (28 km^2)	▪ 500 m buffer around the maximum disturbance area ▪ Defined by the expected extent of the direct and small-scale indirect effects (i.e., ZOIs) from the Project on surrounding wildlife and wildlife habitat ▪ Provides local context for assessing residual effects on wildlife VCs
RSA	107,491 ha (1,075 km^2)	▪ Watershed draining to the Clearwater River above the Mirror River confluence ▪ Provides broader scale context to capture and assess Project effects and is linked to aquatic-related pathways in the ecological health risk assessment ▪ Relevant scale for considering large predator-prey dynamics that may be influenced by the Project ▪ Appropriate scale for a cumulative effects assessment on wildlife VCs and the scale at which significance was determined, with the exception of caribou
Woodland caribou home range	43,521 ha (435 km^2)	▪ Area of the mean home range size of female caribou in the Boreal Shield centred on the Project footprint ▪ Additional scale used to assess Project-related changes on caribou and caribou habitat in context of existing conditions in the Patterson Lake watershed ▪ Appropriate scale to provide inputs for caribou mitigation and offsetting actions
SK2 West Caribou Administration Unit	4,828,726 ha (48,287 km^2)	▪ Defined using provincial management boundaries ▪ Large enough to represent a geographical area within the SK2 Woodland Caribou Conservation Unit that is meaningful for management of woodland caribou given their ecology and life history, and a scale to support information on the status of critical habitat in the Conservation Unit ▪ Appropriate scale for a cumulative effects assessment on woodland caribou, and the scale at which significance was determined

VC = valued component; LSA = local study area; RSA = regional study area; ZOI = zone of influence.



LEGEND

- BOLTON LAKE WILDERNESS RETREAT
- ELEVATION CONTOUR (20 m INTERVAL)
- LOCAL ROAD
- SECONDARY HIGHWAY
- WATERCOURSE
- ECOZONE BOUNDARY
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

0 8 16

1:360,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

SPATIAL BOUNDARIES FOR THE WILDLIFE AND WILDLIFE HABITAT ASSESSMENT

CONSULTANT

wsp

PROJECT		20144150	PHASE	3310 - 2
DESIGN	JV	2023-02-08	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-08	FIGURE 14.2-2	
CHECK	SM	2023-02-08		
REVIEW	JV	2023-02-08		

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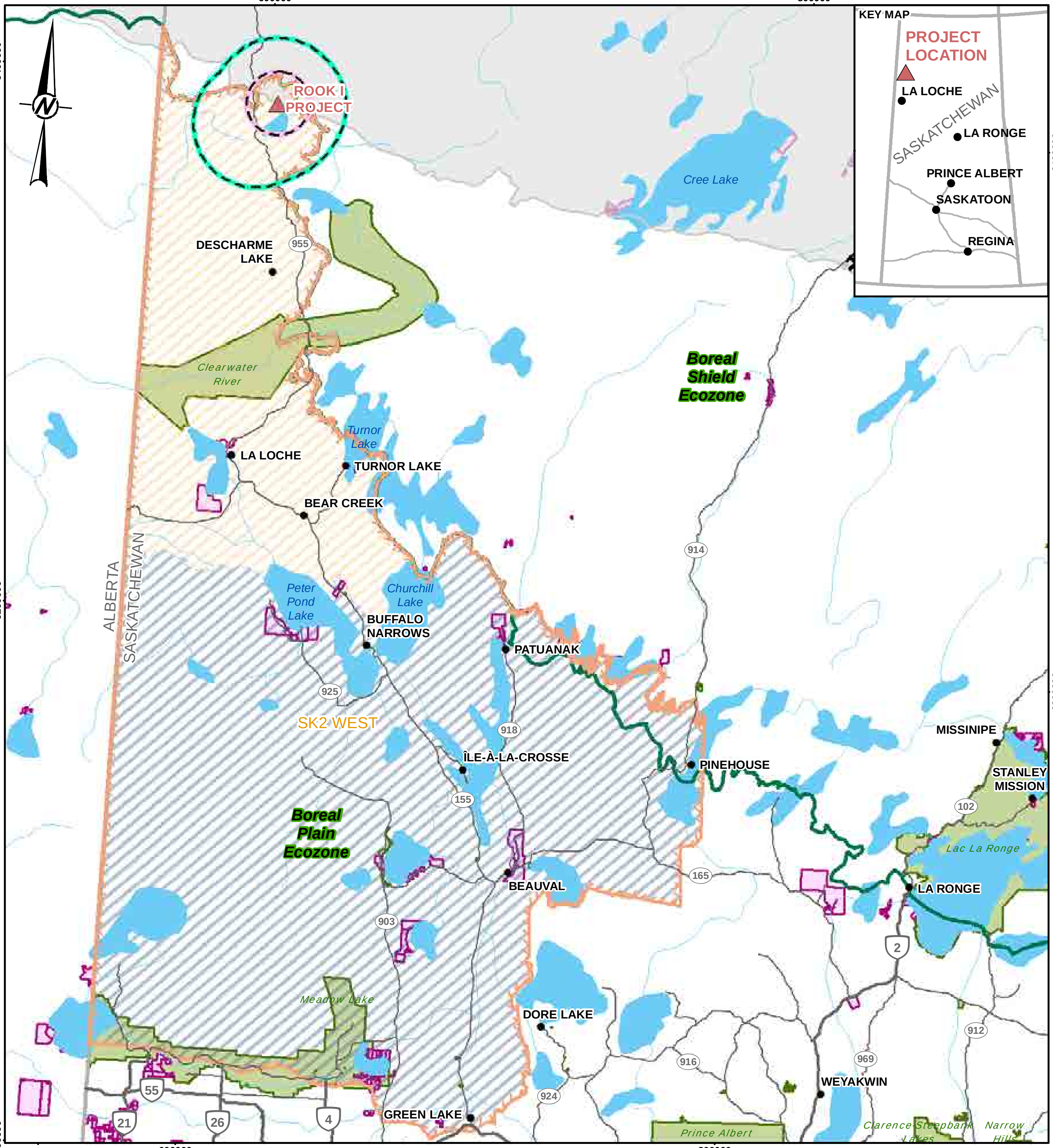

LEGEND

- POPULATED PLACE
- URANIUM MINING FACILITY (ACTIVE)
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- WATERCOURSE
- ATHABASCA BASIN
- ECOZONE BOUNDARY
- INDIAN RESERVE
- PROVINCIAL PARKS
- WATERBODY
- PROJECT LOCATION
- CARIBOU REGIONAL STUDY AREA (OMNIA)
- CARIBOU HOME RANGE ASSESSMENT AREA
- SK2 WEST ADMINISTRATION UNIT
- SK2 WEST CARIBOU ADMINISTRATION UNIT NORTHERN SUB-UNIT
- SK2 WEST CARIBOU ADMINISTRATION UNIT SOUTHERN SUB-UNIT

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REFERENCE(S)
1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES AND ECODISTRICTS OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).
2. PARKS OBTAINED FROM IHS MARKIT CANADA ULC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

WOODLAND CARIBOU BASELINE AND ASSESSMENT STUDY AREAS

CONSULTANT

wsp

PROJECT		20144150	PHASE	3110 - 2
DESIGN	JV	2023-02-08	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-08	FIGURE 14.2-3	
CHECK	SM	2023-02-08		
REVIEW	JV	2023-02-08		

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14.2.4 Temporal Boundaries

The temporal scope of the assessment focuses on the 43-year period from initial Construction to the end of Decommissioning and Reclamation (i.e., Closure) as defined by the following Project phases (Section 6.4.2, Temporal Boundaries):

- **Construction Phase (Construction):** includes site preparation; mine, process plant, and additional infrastructure development; transportation of people and materials to and from the Project; and all activities associated with commissioning the Project up until Operations commences. The duration of Construction is expected to be four years.
- **Operations Phase (Operations):** includes all activities associated with mining and processing ore; tailings management; management of waste rock, domestic waste, and hazardous materials; water management; release of treated effluent; site maintenance; progressive reclamation; and transportation of staff and materials to and from the Project up until Decommissioning and Reclamation commences. The duration of Operations is expected to be 24 years.
- **Decommissioning and Reclamation Phase (Closure):** includes two stages expected to occur over 15 years:
  - **Active Closure Stage:** includes active decommissioning and reclamation activities that occur post-Operations, such as backfilling mine workings, removal of physical infrastructure, recontouring and revegetating disturbed areas, waste disposal and removal, and any other activities required to achieve decommissioning objectives and return the site to a safe and stable condition prior to the Transitional Monitoring Stage. The duration of the Active Closure Stage is expected to be five years.
  - **Transitional Monitoring Stage:** includes monitoring and reporting activities that occur post-Active Closure that would continue until monitoring and reporting verifies that the performance criteria have been met. Once performance criteria have been fully demonstrated, an application to be released from the CNSC licence would be submitted to the CNSC for approval. Once that is achieved, and upon Provincial approval, the land would be transferred under Provincial management through the Institutional Control Program. The duration of the Transitional Monitoring Stage is nominally 10 years; however, NexGen acknowledges this duration would be dependent on the achievement of performance criteria.

Project effects on wildlife would begin during Construction with the removal and alteration of habitat and continue through Operations and Closure and for a period after Closure until effects are reversed or determined to be permanent (e.g., residual areas covered by waste rock storage areas [WRSAs]). In consideration of these factors, effects on wildlife were analyzed and predicted from Construction through Closure and typically beyond, which generates the maximum potential spatial and temporal extent of effects and provides confident and ecologically relevant effects predictions. Where applicable, residual effects were also assessed in terms of specific temporal snapshots of the Project defined by intermediate components (e.g., air quality, hydrology, water quality) that may have a linkage to potential effects on wildlife VCs. These temporal snapshots represent phases or periods when adverse effects are predicted to be most pronounced (Section 6.4.2).

The temporal boundaries applied to cumulative effects assessments include the duration of residual effects from previous and existing developments that would overlap with residual effects from the Project, and the period during which the residual effects from RFDs would overlap with the Project.

14.2.5 Assessment Cases

The concept of assessment cases was applied to the wildlife and wildlife habitat assessment to estimate the incremental and cumulative effects from the Project and other developments (Section 6.5, Assessment Cases). The approach incorporated temporal boundaries for analyzing the potential effects from previous, existing, and approved projects and RFDs before, during, and after the anticipated lifespan of the Project. There are no known approved (but not yet constructed) projects in the LSA and RSA for wildlife VCs. Assessment cases for the Project included a Base Case, Application Case, and RFD Case.

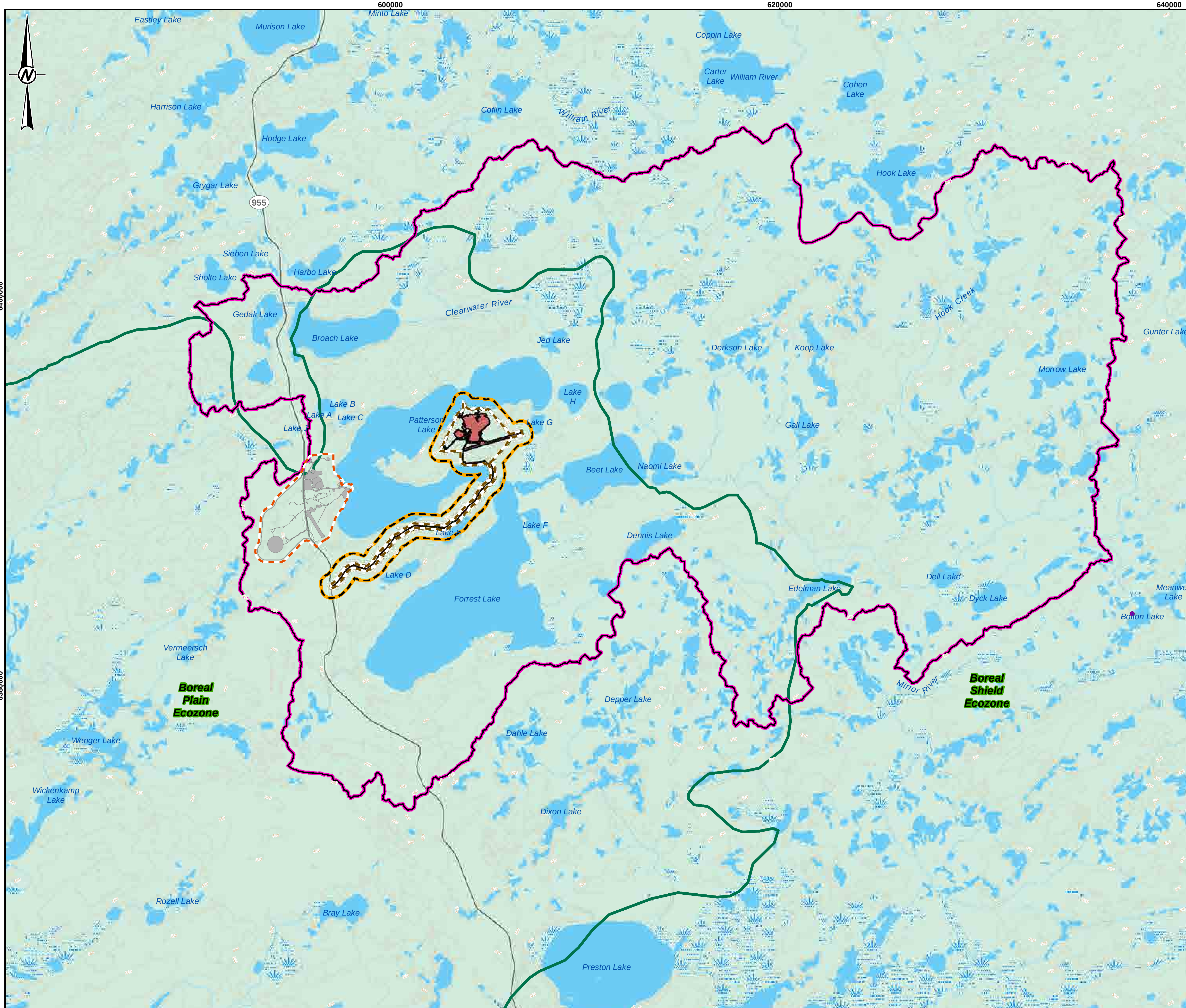
Base Case for wildlife and wildlife habitat is represented by existing conditions. The Base Case describes the existing environment in the LSA and RSA before application of the proposed Project to provide an understanding of the current conditions that may be influenced by the Project. The temporal boundary of the Base Case includes the combined effects from previous and existing human disturbances and natural factors (e.g., fire, floods, disease, insects) on the environment and wildlife and wildlife habitat. As such, existing conditions represent the cumulative effects of historical and current environmental pressures that have influenced the observed condition/patterns of wildlife VCs (CEA Agency 2018).

Application Case for wildlife and wildlife habitat represents predictions of the combined effects of the previous and existing projects/activities and natural factors in the Base Case plus the potential effects from the proposed Project. This case was also used to identify and assess incremental, Project-specific changes that are predicted to occur to wildlife VCs.

Reasonably Foreseeable Development Case for wildlife and wildlife habitat includes the Base Case, Application Case, and RFDs that have not yet been approved. Reasonably foreseeable developments are defined as projects and activities that fit any of the first three and both of the last two criteria from the list below:

- are currently under regulatory review or have officially entered a formal regulatory application process;
- have been publicly disclosed by other proponents;
- may be induced by the Project;
- have the potential to change the Project or the effects predictions; and
- occur in the spatial assessment boundary defined by the VCs.

A key criterion for selecting other projects to include in the RFD Case was that the projects must cause similar effects on wildlife VCs influenced by the Project (Hegmann et al. 1999). The Fission Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021), was included in the RFD Case (Figure 14.2-4). Public information describes a projected three-year construction period and a seven-year operating period (production and processing; Fission 2019, 2021). The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years; Section 6.5.3, Reasonably Foreseeable Development Case). The duration of effects from direct habitat loss for the Fission Patterson Lake South Property was assumed to be from construction to the end of decommissioning (i.e., 15 years), plus a defined number of years for species-specific functional habitat to be regenerated (Table 14.2-4).



LEGEND

- BOLTON LAKE WILDERNESS RETREAT
- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- ECOZONE BOUNDARY
- WATERBODY
- WETLAND
- WOODED AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

0 6 12

1:200,000 KILOMETRES

REFERENCE(S)

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3. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

REASONABLY FORESEEABLE DEVELOPMENT IN THE REGIONAL STUDY AREA

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
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Table 14.2-4: Assumed Duration of Cumulative Effects from Direct Habitat Loss from Fission Patterson Lake South Property for Wildlife Valued Components

<table>
<tr><th>Wildlife VC</th><th>Duration of Direct Habitat Loss from Construction to End of Decommissioning</th><th>Additional Years for VC-Specific Functional Habitat to be Regenerated after Decommissioning[(a)]</th><th>Maximum Duration of Cumulative Effects from Direct Habitat Loss for the RFD Case</th></tr>
<tr><td>Woodland caribou</td><td rowspan="5">15 years</td><td>40 years</td><td>55 years</td></tr>
<tr><td>Moose
Rusty blackbird
Mallard
Canadian toad</td><td>6 to 10 years</td><td>25 years</td></tr>
<tr><td>Grey wolf
Black bear</td><td>5 years</td><td>20 years</td></tr>
<tr><td>Beaver</td><td>20 years</td><td>35 years</td></tr>
<tr><td>Little brown myotis
Olive-sided flycatcher
Common goldeneye</td><td>60 to 80 years</td><td>95 years</td></tr>
</table>

a) Details on VC-specific return of functional habitat following reclamation are provide in residual effects analysis for each VC.
VC = valued component; RFD = reasonably foreseeable development.

The proposed surface infrastructure layout plan (i.e., anticipated physical footprint) of the Fission Patterson Lake South Property includes the proposed highway bypass, airstrip, and all proposed mine site infrastructure (Fission 2019, 2021). A hypothetical maximum disturbance area, as applied in Section 14.2.3 to the Project, was also used for the Fission Patterson Lake South Property to address uncertainty in project design. The CRDN specifically mentioned the potential for cumulative effects from the Project and the nearby proposed Patterson Lake South Property (CRDN 2019b; MN-S-JWG 2020a; CRDN-JWG 2021). The assessment includes a quantitative analysis where possible and a qualitative analysis where necessary of predicted changes on measurement indicators and associated effects from the Fission Patterson Lake South Property on wildlife VCs.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. Sensory disturbance effects from the Project are conservatively predicted to occur from Construction to five years after Closure (i.e., a duration of 48 years). The duration of transitional monitoring for the Fission Patterson Lake South Property was not publicly available and was assumed to be the same as for the Project (i.e., 10 years); closure was assumed to be 15 years. Thus, the duration of sensory disturbance effects for the Fission Patterson Lake South Property were assumed to be from construction to five years after closure (i.e., 30 years). If assumed sensory disturbance from the Fission Patterson Lake South Property were to completely overlap sensory disturbance associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 30 years.

For caribou, the assessment also included a qualitative analysis of anticipated effects from future harvest areas of Carrier Forest Products and Mistik Management Ltd. Forest Management Plans (FMPs). The Carrier Forest Products and Mistik Management Ltd. The FMPs are located south of La Loche and well outside of the RSA; however, both companies operate within the SK2 West Caribou Administration Unit (Figure 14.5-4). Both FMPs have recently been extended for 20-year periods: Carrier Forest Products from 2016 to 2036 and Mistik Management Ltd. from 2019 to 2039. Areas that have been harvested as part of the operations of these FMPs were included in the description of the existing environment (i.e., Base Case) for caribou. Publicly available information about future harvest activities is included in the RFD Case for caribou.

Natural Disturbance and Climate Change

As a scenario within the RFD Case, potential effects from climate change, including how natural factors (e.g., fire, insects) may be altered resulting from climate change, was considered within the assessment. Indigenous Groups indicated concerns about cumulative effects from human development, policies, and climate change (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN). Section 22, Assessment of Effects of the Environment on the Project, outlines the future climate extreme projections for the Project. From the median (i.e., 50% exceedance probability) values for the 2050s and 2080s, the projected future climate extremes indicate a future that is likely to be warmer and wetter on an annual basis. Temperature is projected to increase, resulting in increased warm nights and reduced ice and frost days. Precipitation is also projected to increase, resulting in increased annual total wet-day precipitation, and very wet and extremely wet days.

Wetland ecosystem availability and condition may be adversely affected by climate change in the RFD Case. Wetlands are considered one of the ecosystems most sensitive to predicted changes in temperature and to the resultant changes in precipitation and timing and volume of snowmelt. The annual mean temperature and evapotranspiration rate (i.e., rate at which water vapour is released to the atmosphere by plants and soil) are predicted to increase 2.4°C and 9.1%, respectively, under a climate change scenario, with possible changes in surface water elevations in some waterbodies (Section 9.4.1, Waterbody Water Surface Elevation). However, it is anticipated that increased annual total precipitation would offset potential water deficits within wetland ecosystems associated with increases in temperature and evapotranspiration rate. Although seasonal deficits may occur (i.e., drought), they would be anticipated to occur within the natural variability and resiliency of wetland ecosystems and would not affect overall ecosystem availability (Section 13.5.2.2.1, Ecosystem Availability). However, because of the large degree of variation in climate change projections, there is uncertainty in predicting climate-related changes to wetland ecosystem availability.

It is also predicted that changes to annual temperature, rainfall, and evapotranspiration could lead to varied results including increased pest and disease persistence or potential increases in primary productivity, which could ultimately result in shifts in plant species composition (Sauchyn et al. 2009). Effects of increased evapotranspiration are anticipated to be offset by wetter annual conditions; however, seasonal distribution of changes is predicted to be variable within these annual trends, potentially causing short periods of stress on wetland vegetation (i.e., summer drought), which may adversely affect the long-term composition and overall condition of wetland ecosystems. Consequently, wetland ecosystem condition could be reduced in the RSA due to climate change, although the magnitude of changes is uncertain due the large degree of variation in climate change projections (Section 13.5.2.2.3, Ecosystem Condition).

Longer, warmer growing seasons may cause changes to upland ecosystem availability (Section 13.5.1.2.1, Ecosystem Availability). Changes are anticipated to be more pronounced within Ecological Land Classification (ELC) units that are associated with specific nutrient and moisture regimes and therefore may be less resilient to climate change effects (i.e., Black spruce/Labrador tea/feathermoss [BP14], White birch - white spruce - balsam fir [BP11]). Sites with coarse, rapidly drained soils (i.e., jack pine forests [BP02, BP03, BS03, BS04]) are not anticipated to experience large-scale changes from increases in precipitation or nutrient availability. Availability in these communities would likely be driven by changes in the fire regime (i.e., severity, frequency).

Forest fires occur when fuel, weather, and ignition factors successfully combine. The fire regime is closely related to weather and climate. Heat waves, droughts, and regional weather patterns (e.g., high-pressure ridges) can increase the risk and alter the behaviour of forest fires and are anticipated to increase fire frequency (Hart et al. 2019). Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale. Large stand-replacing fires are a driver of forest composition, structure, and function, and therefore overall availability. However, forests within the RSA may be resilient to fire, particularly with respect to jack pine stands, as self-replacement is the most common post-fire trajectory (Hart et al. 2019). Well-drained black spruce stands (e.g., BP14) tend to be less resilient to fire disturbance and less likely to return to the same state post-fire (Hart et al. 2019).

Changes in temperature may lead to increased potential for insect invasion, particularly by mountain pine beetles (*Dendroctonus ponderosae*). However, as discussed in Section 13.5.2.2.1, jack pine forests within the RSA may be less susceptible to mountain pine beetle infestation due to the short fire return interval observed within the RSA. Changes to wildlife habitat availability due to insect invasion as a result of climate change are uncertain.

Overall, the magnitude of wildlife habitat change induced by climate change is uncertain because of the variability in climate projection models. As such, potential changes from natural disturbance factors and climate change are qualitatively discussed for wildlife VCs.

14.2.6 Existing Conditions

Existing conditions for wildlife and wildlife habitat were characterized to provide context for the assessment of incremental and cumulative effects from the Project and other developments in the LSA, RSA, woodland caribou home range, and SK2 West Caribou Administration Unit. Existing conditions were characterized based on results from field studies carried out between 2018 and 2020, Indigenous and Local Knowledge (see sources in Section 14.2.1, Incorporation of Indigenous and Local Knowledge), and other available data sources. The existing conditions represent the expected conditions that exist in 2021 and prior to Project initiation. Conditions were evaluated quantitatively where information was available, and qualitatively where necessary, using the most up-to-date information.

14.2.6.1 Baseline Field Surveys and Desktop Data Sources

Data used to characterize existing conditions for wildlife VCs and three of the listed species not selected as VCs (i.e., northern myotis, common nighthawk, barn swallow; Section 14.5.12) were collected from the following baseline field surveys and desktop information sources:

- The Wildlife Baseline Report 1, Mammals, Waterfowl, and Raptors (Annex VIII.1), which summarizes baseline conditions for wildlife obtained during field programs completed between 2018 and 2020, including:
  - winter track count survey (2018, 2020);
  - winter backtrailing survey (2019);
  - spring ungulate pellet group / browse availability survey (2018, 2019);
  - small mammal trapping and tissue analysis (2018);
  - semi-aquatic furbearing mammals shoreline survey (2018);
  - aerial waterfowl and raptor stick nest survey (2018);
  - covert camera survey (2018, 2019, 2020);
  - species at risk and sensitive species incidental observations (2018, 2019, 2020);
  - regional fur harvest data (1985/1986 to 2017/2018) for Fur Conservation Area N-19 (La Loche) that overlaps the RSA; and
  - ENV caribou habitat mapping.

- The Wildlife Baseline Report 2, Amphibians, Birds and Bats (Annex VIII.2) and Wildlife Baseline Report 3, Bird Migration and Bats (Annex VIII.3), which summarizes baseline conditions for wildlife obtained during field programs completed in 2018 and 2020, including:
  - amphibian acoustic survey (2018);
  - common nighthawk survey (2018);
  - yellow rail survey (2018);
  - breeding bird survey (2018);
  - bat echolocation survey (2018, 2020);
  - avian migration survey (2020); and
  - species at risk and sensitive species incidental observations (2018, 2020).
- Provincial wildlife harvest and population information.
- Scientific literature and technical reports about wildlife and wildlife habitat in the RSA and in the woodland caribou home range and SK2 West Caribou Administration Unit.
- Species at risk resources including the Saskatchewan Conservation Data Centre (SKCDC 2021) and the Species at Risk Public Registry (Government of Canada 2023).
- Federal status reports and recovery strategy documents available through the Species at Risk Public Registry (Government of Canada 2023).
- Results of ELC mapping in the LSA and RSA completed as part of the vegetation assessment (Section 13.2, Component Methods) to quantify habitat for wildlife VCs.

14.2.6.2 Habitat Mapping

Habitat mapping was used to provide spatially explicit descriptions of habitat availability and distribution under existing conditions, which represents an estimate of available habitat from changes due to past and present human developments and activities, and forest fires that occurred during the past 40 years. Habitat mapping included using ELC mapping completed for the LSA and RSA (Section 13.2).

14.2.6.2.1 Habitat Models

Habitat mapping was completed for the LSA and RSA for all wildlife VCs. Excluding woodland caribou, habitat was categorized using a two-category (i.e., suitable or unsuitable) or four-category (i.e., high suitability, moderate suitability, low suitability, or unsuitable) system, as appropriate for each VC. Mapping habitat suitability was completed using available data (e.g., ELC mapping), a literature review of habitat selection and species ecology, and experienced opinion. This approach has been used extensively and repeatedly in EAs to predict the potential effects of habitat alteration and supports the evaluation of land management alternatives by quantifying and displaying the distribution of habitat quality across a landscape in various land use or development scenarios (Marzluff et al. 2002). Details of wildlife habitat mapping for wildlife VCs are provided in Appendix 14B, Wildlife Habitat Models. Habitat models for two VCs (i.e., common goldeneye and Canadian toad) were simplified as they are largely dependent on aquatic habitat; models for those VCs are described in Section 14.3.9.1 and Section 14.3.11.1, respectively. Habitat models included fire and anthropogenic disturbance data as described below (Section 14.2.6.2.2, Fire and Anthropogenic and Disturbance Features).

For woodland caribou, habitat suitability mapping for SK2 West Caribou Administration Unit followed the approach used by Environment Canada (2011; ECCC 2020) and the ENV (ENV 2020a). Habitat suitability maps were developed by the ENV in 2020 to provide a simplified classification of caribou habitat into high, moderate, and low-suitability values (ENV 2020a). Habitat values were assigned to forest stands based on the forest ecosite classification system (McLaughlan et al. 2010), and account for varying seasonal habitat values associated with foraging, calving, and predator refuges (ENV 2014). The same classification system was applied to the LSA and portions of the RSA and caribou home range that overlap the Boreal Plain Ecozone. For those portions of the RSA and caribou home range that are within the Boreal Shield Ecozone, forest ecosites were categorized as high, moderate, and low suitability based on habitat selection models determined for caribou in the SK1 Range (McLoughlin et al. 2019) and other scientific literature on caribou habitat preferences.

Similar to other wildlife VCs, caribou habitat suitability mapping included fire and anthropogenic disturbance data (Section 14.2.6.2.2). A 500 m buffer was applied to all anthropogenic disturbances and affected habitat types, including waterbodies. Ecosites burned by fire in the last 40 years were also classified as disturbed, but no buffer was applied (ECCC 2020). The habitat within the 500 m buffer was assumed to be functionally unavailable to caribou (i.e., converted to unsuitable indirect disturbance) due to its proximity to anthropogenic disturbance and associated increase in perceived predation risk or sensory disturbance. The absolute and relative amount (%) of the LSA, RSA, caribou home range, and SK2 West Caribou Administration Unit disturbed by anthropogenic infrastructure and by fire within the last 40 years was calculated for caribou habitat suitability mapping.

14.2.6.2.2 Fire and Anthropogenic and Disturbance Features

Wildfire disturbance mapping for the LSA, RSA, caribou home range, and SK2 West Caribou Administration Unit followed techniques developed for the SK1 Range to reduce overestimating the spatial extent of burned area (Kansas et al. 2016). Fire disturbance data were applied based on a 40-year fire history period (1981 to 2020). Burn severity data were determined by the Wildfire Management Branch using a normalized burn ratio calculation to classify burn severity and identify residual patches within burned areas. Where available, the Wildfire Management Branch burn severity data (1988 to 2018) were used to replace coarse polygon mapping associated with the wildfire history data. Burn severity data used the difference of normalized burn ratios to back-cast fire (i.e., estimating past fire extents through historical remote sensing data) and post-fire residual patches with greater accuracy than wildfire history mapping. However, burn severity data were not available for fire years earlier than 1988 or after 2018. In the absence of burn severity data, wildfire history data were used to delineate the extent of fire (1981 to 1987 and 2019 to 2020). Fire disturbance for the LSA, RSA, and caribou home range is illustrated in Figure 14.2-5.

Anthropogenic disturbance mapping for the LSA, RSA, and caribou home range was completed (Section 13.2.6.1.5, Anthropogenic Features Mapping) and included:

- Axiom orthorectified aerial map (4.88 cm pixel; June 2019) of the existing exploration camp and access road;
- anthropogenic features included in the baseline predictive ecosystem mapping (Annex VII.1, Vegetation Baseline Report 1 [Mapping]);
- SK2 West Caribou Administration Unit anthropogenic disturbance layer (ENV 2021); and
- anthropogenic disturbance layer (Environment Canada 2015a,b).

For the SK2 West Caribou Administration Unit outside of the RSA, the disturbance layer was supplemented with National Road Network data (NRN 2019). To calculate the amount of anthropogenic disturbance in the LSA, RSA, caribou home range, and SK2 West Caribou Administration Unit, variable buffers (e.g., 2 m, 12 m) were applied to create physical footprints for each linear feature type and actual measured areas for defined polygons of disturbance (Table 14.2-5 and Table 14.2-6). Anthropogenic disturbance for the LSA, RSA, and caribou home range is illustrated in Figure 14.2-6.

Table 14.2-5: Existing Anthropogenic Disturbance Types within the Local Study Area, Regional Study Area, and Caribou Home Range

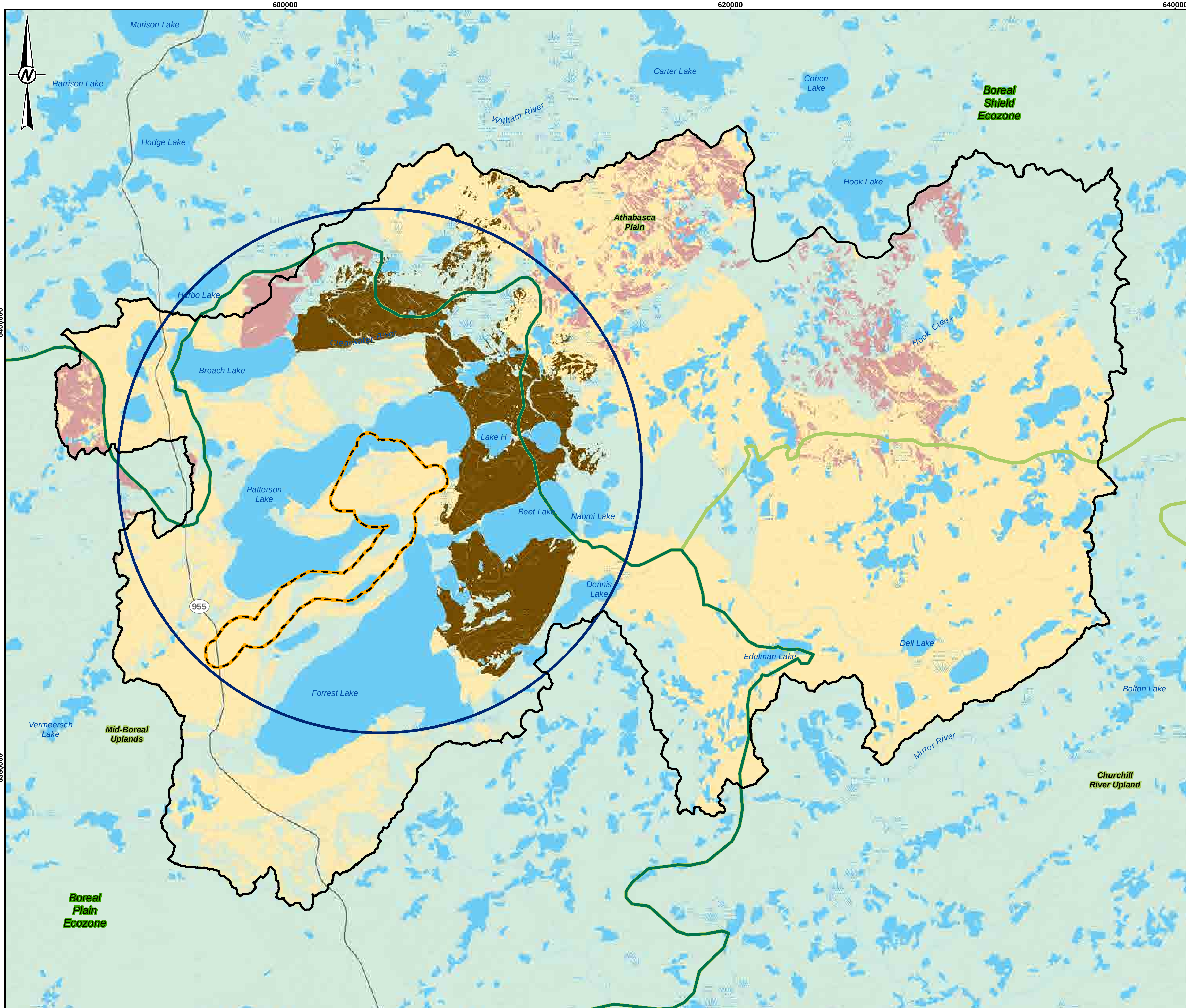
Type of Disturbance	Feature Type	Footprint Width (m)
Cutlines / seismic lines	Linear / polygon[(a)]	2 / Actual
Trail	Linear / polygon[(a)]	6 / Actual
Rough road	Linear	12
Existing access road	Polygon[(a)]	Actual
Highway 955	Linear	30
Clearing	Polygon	Actual
Existing exploration disturbance	Polygon	Actual
Oil and gas development	Polygon	Actual
Outfitting (fishing) camp	Polygon	Actual
Unknown disturbance[(b)]	Linear / polygon[(a)]	15 / Actual

a) Includes data from ENV and ECCC (linear) as well as digitized disturbance data (polygon) taken from the Axiom orthorectified aerial map.
b) Classified as unknown disturbance according to ECCC disturbance layer (Section 13.2.6.1, Ecological Land Classification) and may be characterized by infrastructure, unvegetated areas, areas adjacent to settlements (e.g., reservoirs next to communities, gravel pit, adjacent residential dwellings).
ENV = Saskatchewan Ministry of Environment; ECCC = Environment and Climate Change Canada.

Table 14.2-6: Existing Anthropogenic Disturbance Types within the SK2 West Caribou Administration Unit

Type of Disturbance	Feature Type	Footprint Width (m)
Cutlines / seismic lines	Linear / polygon[(a)]	2 / Actual
Trail	Linear / polygon[(a)]	6 / Actual
Rough road	Linear	12
Existing access road	Polygon[(a)]	Actual
Highway 955	Linear	30
Pipeline / power line right-of-way	Linear	15
Airstrip	Linear / polygon[(a)]	175 / Actual
Clearing	Polygon	Actual
Cutblock[(b)]	Polygon	Actual
Inactive mine	Polygon	Actual
Existing exploration disturbance	Polygon	Actual
Oil and gas development	Polygon	Actual
Outfitting (fishing) camp	Polygon	Actual
Unknown disturbance[(c)]	Linear / polygon[(a)]	15 / Actual

a) Includes data from ENV and ECCC (linear) as well as digitized disturbance data (polygon) taken from the Axiom orthorectified aerial map.
b) Considered cutblocks in 2015 according to ECCC disturbance layer.
c) Classified as unknown disturbance according to ECCC disturbance layer (Section 13.2.6.1) and may be characterized by infrastructure, unvegetated areas, and areas adjacent to settlements (e.g., reservoirs next to communities, gravel pit, adjacent residential dwellings).
ENV = Saskatchewan Ministry of Environment; ECCC = Environment and Climate Change Canada.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED
- ECOREGION BOUNDARY
- ECOZONE BOUNDARY
- LOCAL STUDY
- REGIONAL STUDY
- CARIBOU HOME RANGE ASSESSMENT AREA

FIRE DISTRUBANCE

- RECENT BURN (1-5 YEARS)
- EARLY-STAGE REGENERATION (6-20 YEARS)
- LATE-STAGE REGENERATION (21-40 YEARS)

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

EXISTING FIRE DISTURBANCE IN THE LOCAL STUDY AREA, REGIONAL STUDY AREA AND WOODLAND CARIBOU HOME RANGE

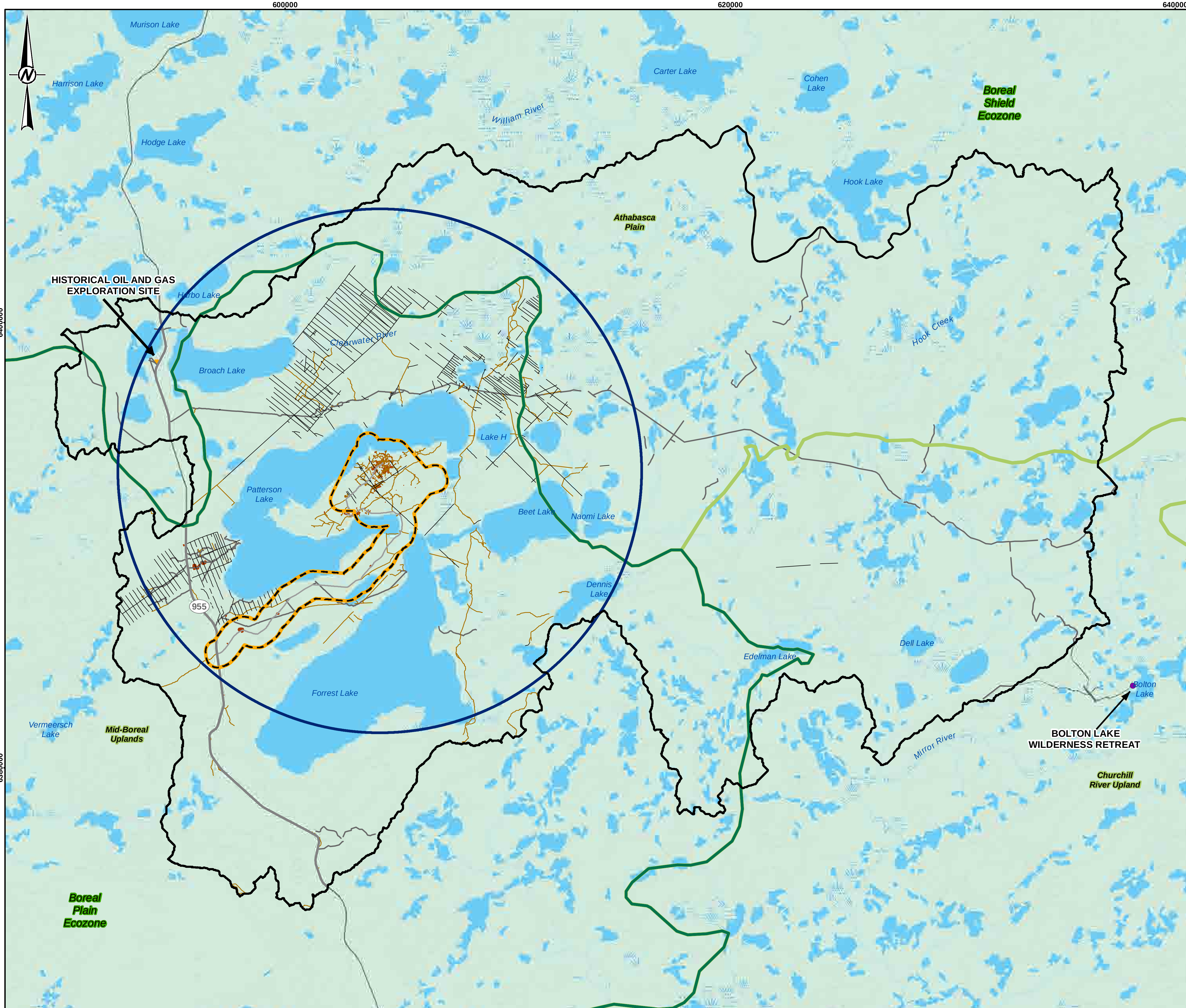
CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	AS	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.2-5**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- BOLTON LAKE WILDERNESS RETREAT
- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED
- ECOREGION BOUNDARY
- ECOZONE BOUNDARY
- LOCAL STUDY
- REGIONAL STUDY
- CARIBOU HOME RANGE ASSESSMENT AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

EXISTING ANTHROPOGENIC DISTURBANCE IN THE LOCAL STUDY AREA, REGIONAL STUDY AREA AND WOODLAND CARIBOU HOME RANGE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	AS	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.2-6**	
REVIEW	JV	2023-02-09		

14.2.7 Project Interactions and Mitigations

Interactions (i.e., linkages) between Project components or activities, and the corresponding potential changes to measurement indicators, were identified by a pathway analysis that was then used to inform the residual effects analysis for the wildlife VCs (Section 6.7, Pathways Analysis). The first part of the analysis was to identify all potential effects pathways for all phases of the Project (Section 6.7.1, Identification of Project Interactions). Each pathway was initially assumed to have a linkage to potential effects on wildlife VCs.

Potential pathways from Project activities to wildlife VCs were identified using the following:

- review of the Project description (Section 5) and potential effects scoping by the project development, environmental, and socio-economic teams for the Project;
- input from Indigenous, regulatory, and public engagement (Section 2) and Indigenous and Local Knowledge (Section 3);
- scientific knowledge;
- previous experience with mining projects; and
- consideration of potential effects identified from the Terms of Reference (Section 1, Appendix 1A).

Potential adverse effects of the Project were then identified, and practicable mitigation was applied to avoid, minimize, and/or rehabilitate adverse effects on wildlife VCs (Section 6.7.2, Identification of Mitigation). Avoidance and minimization are widely recognized as the most important approach for biodiversity conservation (BBOP 2021). Avoidance designs and actions integrated into the Project were developed iteratively between the Project's environmental and project development teams. Minimization techniques and technology were also identified and implemented collaboratively between Project teams.

Each potential effect pathway was evaluated using proposed mitigation to predict whether the pathway had the potential to cause residual adverse effects (Section 6.7.3, Pathway Screening). A screening-level assessment was applied using Indigenous and Local Knowledge, scientific knowledge, logic, experience with similar developments, and an understanding of the effectiveness of mitigation (i.e., level of certainty that mitigation would work) to assign each pathway to one of the following categories:

- **No pathway:** Analysis reveals that the pathway could be removed (i.e., the effect is avoided) by mitigation so that the Project would result in no measurable environmental change relative to existing conditions or guideline values and, therefore, would have no residual effect on wildlife and wildlife habitat.
- **Secondary pathway:** The pathway could result in a measurable but minor environmental change relative to existing conditions or guideline values, but this change would be sufficiently small that it would have a negligible residual effect on wildlife and wildlife habitat. Therefore, the pathway is not expected to contribute to effects of RFDs to cause a significant effect.
- **Primary pathway:** The pathway is likely to result in an environmental change relative to existing conditions or guideline values and could cause a greater than negligible effect on wildlife and wildlife habitat.

Project interactions determined as no pathway or secondary pathways were not carried forward for further assessment (Section 6.7.3). Primary pathways that could result in changes to the environment with one or more associated measurement indicators and have the potential to cause a greater than negligible effect on wildlife VCs were carried forward to the residual effects analysis and residual effects classification (Section 14.5, Residual Effects Analysis).

Reclamation was considered as a mitigation for removal of natural soils and vegetation. However, the time lag between Project effects and the reclamation of disturbed areas meant that an effect could be potentially present for a long period of time before reclamation would be effective. Therefore, reclamation mitigation did not lead to a determination of "no pathway" for wildlife VCs.

Offsetting aims to achieve no net loss, or ideally, a net gain for wildlife VCs by addressing residual effects not already accounted for by avoiding and minimizing effects and restoring habitat. Offsets can include land purchases or land management decisions that achieve averted loss, and other kinds of conservation actions implemented outside the area of influence of the Project, such as off-site ecosystem improvements or habitat restoration. An offset requirement is expected for woodland caribou for the Project to meet the requirements outlined in the provincial draft Range Plan for Woodland Caribou in Saskatchewan for the SK2 West Caribou Administration Unit (ENV 2021). Because offsetting is associated with uncertainty in terms of the specific actions that might be undertaken and, like reclamation, takes time to implement, offsets were not assumed to remove pathways. Instead, offsets, if required, were considered as a factor that would reduce or remove residual effects after residual effects were analyzed and characterized, and significance was determined (Section 14.5.1.3.2, Significance Determination).

14.2.8 Residual Effects Analysis

The residual effects analysis measures and describes the effects of the proposed Project on wildlife VCs relative to existing conditions. The residual effects analysis was conducted using the spatial boundaries (Section 14.2.3) and temporal boundaries (Section 14.2.4, Temporal Boundaries) identified for the assessment. Residual effects are described for each of the measurement indicators for the primary pathways identified for wildlife VCs in the LSA and RSA (Section 14.4.3, Primary Pathways). The residual effects analysis was completed for the Application Case and the RFD Case (Section 6.8, Residual Effects Analysis).

The residual effects analysis was completed by quantitively and qualitatively predicting changes to wildlife and wildlife habitat VC measurement indicators in the LSA and RSA, and caribou home range and SK2 West Caribou Administration Unit for woodland caribou. These measurement indicators are as follows:

- **Changes in habitat availability and animal use** were estimated quantitatively by calculating differences in the amount of different types of suitable habitat for each VC and qualitatively by considering potential changes in habitat use (e.g., avoidance due to sensory disturbance).
- **Changes in habitat distribution**, including the effects on wildlife movement and habitat connectivity, were estimated by qualitatively examining changes to the distribution of habitat patches within the LSA and RSA (all VCs) and the caribou home range and SK2 West Caribou Administration Unit (woodland caribou). Potential barriers to movement in the context of the mobility of VCs were also assessed.
- **Changes in survival and reproduction (i.e., abundance)** were identified qualitatively and quantitatively using the results from changes in habitat and knowledge of potential changes in abundance from other Project components and activities. Where possible, predictions of change were made using data collected in the study areas and supported by scientific literature. In addition, ecological health risks were examined for 16 aquatic and terrestrial wildlife species or receptors (amphibians, birds, and mammals) to determine the sensitivity of animals from exposure to COPCs through drinking water, ingesting soil and sediment, and eating aquatic and terrestrial plants, fish, and other animals (TSD XXI). Results from the aquatic and terrestrial ecological health risk assessments were used to support the assessment of wildlife VCs (Section 6.3.4; Section 14.2.2.2, Measurement Indicators).

14.2.9 Residual Effects Classification and Determination of Significance

The residual effects analysis uses a reasoned narrative to describe anticipated changes to each measurement indicator caused by the proposed Project and the associated effects on each VC. The residual effects analysis also considers effects from both the Project and RFDs. These narrative descriptions of anticipated effects represent the foundation for the residual effects classification and significance determination. Residual effects are summarized or classified in tabular form using effects criteria, which are intended to provide structure and comparability across VCs and intermediate components assessed for the Project (Section 6.9.1, Residual Effects Classification).

Residual effects classification and determination of significance were also completed as part of the screening level assessment for the seven listed species (i.e., species listed as Threatened or Endangered on provincial or federal conservation lists) not selected as VCs: northern myotis, common nighthawk[7], barn swallow, Ashton cuckoo bumble bee (previously gypsy cuckoo bumble bee), yellow-banded bumble bee, transverse lady beetle, and nine-spotted lady beetle (Section 14.5.12; Appendix 14A). Effects were classified and significance determined using the same measurement indicators and primary pathways identified for VCs.

The residual effects classification used direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence as criteria. For wildlife and wildlife habitat, magnitude is expressed as the change in habitat availability and distribution and changes in animal survival and reproduction. The approach to classify each residual effect criterion is provided in Table 14.2-7.

Table 14.2-7: Definitions Applied to Effects Criteria Classifications for the Assessment of Valued Components

Criterion	Rating	Definition
Direction	Positive	Change in measurement indicator results in net improvement or benefit to the wildlife VC
	Neutral	Change in measurement indicator results in net balance to the wildlife VC
	Negative	Change in measurement indicator results in net degradation or loss to the wildlife VC
Magnitude	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect size (e.g., hectares of habitat loss, change in habitat distribution, and connectivity relative to existing conditions)
Geographic extent	Maximum disturbance area	Change in measurement indicator is confined to the maximum disturbance area
	Local	Change in measurement indicator extends beyond the maximum disturbance area but within the LSA
	Regional	Change in measurement indicator extends beyond the LSA but is confined to the RSA
	Beyond regional	Change in measurement indicator extends beyond the RSA
Duration	Qualitative narrative or numeric quantification	Change in measurement indicator is described by effect duration (e.g., months, years, decades, permanent)
Reversibility	Reversible	Change in measurement indicator is reversible within a clearly defined time period
	Irreversible	Change in measurement indicator is predicted to influence the component indefinitely
Frequency	Occasional	Change in measurement indicator is expected to occur rarely (e.g., once or a few times)
	Periodic	Change in measurement indicator is expected to occur consistently at regular intervals or associated with temporal events (e.g., during spring freshet, growing season, migration period)
	Continuous	Change in measurement indicator is expected to occur all the time

[7] In February 2023, an order was posted to amend Schedule 1 of the *Species at Risk Act* (Government of Canada 2023). The status of common nighthawk was updated from Threatened to Special Concern.

Table 14.2-7: Definitions Applied to Effects Criteria Classifications for the Assessment of Valued Components

Criterion	Rating	Definition
Probability of occurrence	Unlikely	Change in measurement indicator is not expected to occur, but not impossible
	Possible	Change in measurement indicator may occur, but is not likely
	Probable	Change in measurement indicator is likely to occur, but is uncertain
	Certain	Change in measurement indicator will occur

VC = valued component; LSA = local study area; RSA = regional study area.

While most criteria could be assigned categorical ratings for wildlife VCs, predicted effect sizes were provided in specific terms (i.e., narrative or numeric quantification) in the residual effects characterization (Table 14.2-6). Similarly, duration was described in specific terms (e.g., years). Applying a category rating to a criterion such as magnitude might lead to confusion or misinterpretation of the effects assessment, or result in the criterion not being easily categorized in a meaningful way. For example, characterizing magnitude solely using an ordinal scale (i.e., low, moderate, or high) for wildlife VCs is often not appropriate as additional context is required to properly characterize the effects. Universal effect size boundaries, such as a 20% change in a measurement indicator at the RSA or LSA scale used to define a high-magnitude effect, work poorly because these size boundaries fail to consider context. Ecological context can include wildlife species status and trends, current threats, the amount of historical disturbance in and beyond the RSA, resilience, and adaptability. Depending on the ecological context, and the context from the cumulative effects from previous and existing developments and activities that also interact with a VC, a 20% change from existing conditions in the study area may be required to cause a high magnitude effect on one VC, whereas a 2% change in the study area may be sufficient to cause a high magnitude effect for another VC (Section 6.9.1).

The significance of adverse residual effects on wildlife VCs was evaluated using the assessment endpoints as significance thresholds and followed the approach described in Section 6.9.2, Significance Determination. The significance of effects was predicted as a binary response, with effects classified as significant or not significant. Adverse residual effects were determined to be significant if the wildlife VC is not expected to be self-sustaining or ecologically effective at the scale of the RSA, except caribou, which was assessed at the scale of the SK2 West Caribou Administration Unit. The RSA was defined using ecological and watershed boundaries and is at a scale suitable for the application of cumulative effects management strategies for most terrestrial VCs (Section 14.2.3.2, Environmental Assessment Boundaries) and, therefore, an appropriate and relevant scale for evaluating population integrity for wildlife VCs.

Self-sustaining and ecologically effective populations are populations that would be maintained into the future without the need for immigration of individuals from other populations. They are healthy, functioning, and robust populations capable of withstanding environmental change and accommodating stochastic (i.e., random) processes. Wildlife populations that are capable of stabilizing at a lower abundance and are not expected to be extirpated (i.e., local extinction of a species) because of unrelated stochastic events (e.g., unpredictable events such as floods or forest fire) are considered self-sustaining, and it is assumed that no additional mitigation beyond that proposed for the Project and territorial management actions (e.g., harvest regulations) would be required to maintain these populations. Loss of ecological function occurs when a wildlife population can no longer perform its ecological role, such that it may trigger ecological changes that result in degraded or simplified ecosystems (Soulé et al. 2003). The potential to lose ecological function is more common for highly interactive wildlife that have important ecological effects on other species, such as predators (e.g., grey wolves) or ecosystem engineers (e.g., beavers; Soulé et al. 2003).

The ability of a VC to accommodate disturbance was evaluated using the concepts of ecological adaptability and resilience. Adaptable wildlife species are those that can change their behaviour, physiology, or population characteristics (e.g., reproduction rate) in response to a disturbance such that the integrity of the population remains more or less unchanged. For example, certain wildlife populations can accommodate loss of some individuals without a change in overall population status or trajectory (known as compensatory mortality; Connell et al. 1984) or can adjust their physiology or behaviour to accommodate disturbance (Knopff et al. 2014; Chapron et al. 2014). Adaptable species can accommodate substantial disturbance and sometimes thrive in highly modified environments, whereas species with low adaptability can accommodate little or no disturbance.

Resilience is a concept that is distinct from, yet closely related to, adaptability. Biological populations often have inertia and will continue to function after disturbance up to the point where the disturbance becomes severe and lasts long enough that the population undergoes a fundamental change. Adaptability influences the duration and magnitude of effect required for this change to happen, whereas resilience defines the ability of a species or ecosystem to recover from disturbance. Highly resilient wildlife species have the potential to recover quickly from disturbance (e.g., after reclamation is achieved or a mortality source is removed), whereas species with low resilience will recover more slowly or may not recover at all (Weaver et al. 1996).

Resilience, adaptability, and existing conditions provide important ecological context for the determination of significance. Existing conditions represent the combined effects of previous and current human activities and natural factors that have shaped the observed conditions/patterns of each VC in the RSA, and caribou at the scale of the SK2 West Caribou Administration Unit. These conditions represent the starting point for assessing Project effects and were considered as context to help define how close each VC might be to its resilience limits when making the significance determination for the Project and RFDs.

Critical thresholds, such as amount or distribution of habitat required to maintain a self-sustaining population or the specific number of individuals required to maintain an ecologically effective population size, are rarely available for wildlife VCs. Moreover, ecological thresholds vary by species, landscape type, and spatial scale (Swift and Hannon 2010; Environment Canada 2013a). As such, a detailed and transparent account of whether the predicted effects from the Project and other developments would cause the defined significance threshold to be exceeded was prepared for each VC by combining residual effects criteria, available scientific literature, data collected in the study areas, and logical reasoning (i.e., a weight of evidence, or reasoned narrative approach). Using ecological context combined with residual effects criteria in a reasoned narrative (or argument) to determine significance is a method accepted by the Government of Canada (2018). The determination of significance was also placed in context of how changes from the Project and other developments could influence biodiversity (Section 6.3.5, Biodiversity).

Confidence in the significance prediction was identified and discussed for each VC as part of the reasoned narrative. If the threshold for where a significant effect would occur in the range of potential values had high uncertainty, and if the effect could be assessed as significant or not significant, a precautionary approach was applied, and the effect was identified as significant. The greater the uncertainty, the earlier a significant effect would be identified on the continuum of cumulative change from the Project and RFDs, where applicable.

14.2.10 Prediction Confidence and Uncertainty

The purpose of the assessment is to predict the future conditions for wildlife and wildlife habitat with the addition of the Project and the Fission Patterson Lake South Property (and forestry for caribou). As with all predictions of future conditions, the predictions made in this assessment embody some degree of uncertainty. The assessment applied a precautionary (i.e., conservative) approach to address uncertainty by identifying the greatest magnitude, duration, and geographic extent of potential adverse effects when a range of outcomes were possible. Consequently, uncertainty was addressed in a manner that increased the level of confidence that residual effects were conservatively estimated. The key uncertainties for wildlife and wildlife habitat and the way they were addressed were presented as part of this assessment (Section 14.6, Prediction Confidence and Uncertainty).

14.2.11 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs are proposed to address the uncertainties associated with the effects predictions and to evaluate the performance of mitigation. In general, monitoring is used to verify the effects predictions. Monitoring is also used to identify any unanticipated effects and to support the implementation of adaptive management to limit these effects. Typically, monitoring includes one or both of the following categories that may be applied during the Project lifespan:

- **Regulatory compliance monitoring:** monitoring activities, procedures, and programs undertaken to confirm the implementation of approved design standards, mitigation and conditions of approval, and NexGen commitments (e.g., inspecting construction equipment for cleanliness prior to arriving on site, inspecting noise suppression [mufflers] on vehicles to make sure they are functioning properly).
- **Follow-up monitoring:** programs designed to test the accuracy of effects predictions, reduce or address uncertainties, determine the effectiveness of mitigation, or provide appropriate feedback to operations for modifying or adopting new mitigation designs, policies, and practices (e.g., implementation of adaptive management). Results from these programs can be used to increase the certainty of effect predictions in future EAs.

Where relevant, conceptual monitoring programs would be proposed to confirm predictions and to address the uncertainties associated with the effects predictions and mitigation, and upon Project approval, would be included in the Integrated Management System.

The implementation of robust and long-term environmental testing and monitoring has also been requested by Indigenous Groups to verify protection of the environment, including community-led monitoring during construction and operation of the Project (TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR).

In addition to environmental monitoring programs typically implemented for projects (i.e., as noted above), NexGen is working with local Indigenous Groups to implement independent environmental monitoring. In combination with standard Project monitoring processes, independent Indigenous monitoring would be used to verify Project performance and to determine if mitigations and controls are effective in protecting the receiving environment.

Adaptive management measures may also be proposed to address the uncertainties associated with the effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

14.3 Existing Conditions

The existing environment for wildlife VCs is a summary of biological and environmental information collected in the LSA and RSA (Section 14.2.3). Summaries of the habitat availability and distribution, and survival and reproduction of wildlife VCs are provided to characterize the Base Case against which Project effects are evaluated. Detailed information on baseline field studies conducted to support the characterization of existing conditions for wildlife and wildlife habitat in the LSA and RSA from 2018 to 2020 is provided in the wildlife baseline reports (Annex VIII.1, Annex VIII.2, and Annex VIII.3).

14.3.1 Woodland Caribou

Woodland caribou in this assessment refers to the boreal ecotype. Boreal woodland caribou is listed as vulnerable/rare to uncommon (S3) in Saskatchewan (SKCDC 2021; SKCDC 2020) and as Threatened under Schedule 1 of the federal SARA. There are two woodland caribou conservation units in Saskatchewan, SK1 and SK2, which are delineated based on the boundaries of the boreal ecozones (Acton et al. 1998; ECCC 2020). Unit SK1 is in the Boreal Shield Ecozone, and SK2 is in the Boreal Plain Ecozone, covering the northern and southern portions of woodland caribou distribution in Saskatchewan, respectively. The northern population of caribou in Saskatchewan (SK1) is ranked as "self-sustaining" (McLoughlin et al. 2019; ECCC 2020). The southern population (SK2) is ranked "as likely as not self-sustaining" (ECCC 2020). Within SK2, the Government of Saskatchewan has designated three caribou administration units: SK2 West, SK2 Central, and SK2 East. SK2 West has been further subdivided into a northern sub-unit and southern sub-unit in based on different types and levels of human activity/developments and to allow for separate management options and targets (ENV 2021).

The Project's caribou home range study area (43,521 ha, or 435 km^2; McLoughlin et al. 2016) overlaps the SK2 West Range, northern sub-unit (75% of the caribou home range study area), and the SK1 Range (25% of the caribou home range study area; Figure 14.2-3). The Project's caribou home range study area is located within a Tier 1 Caribou Habitat Management Area, as identified in the final SK2 West Caribou Range Plan (ENV 2021). Tier 1 Caribou Habitat Management Areas have high to moderate caribou habitat potential, high levels of observed caribou use, and low levels of human-caused disturbance; as such, the management objective for Tier 1 Caribou Habitat Management Areas is to retain caribou habitat (ENV 2021).

Woodland caribou was identified as a culturally important species that was hunted traditionally for their meat and hides (TSD II BNDN; TSD III: BNDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN-JWG 2020b). Woodland caribou was reported to still be occasionally harvested by some Indigenous Group members depending on their availability (TSD II: BNDN; TSD III: BRDN; BNDN-JWG 2020b; BNDN-JWG 2021b; CRDN-JWG 2020a). The CRDN stated that although their community generally no longer hunts caribou, they have a strong interest in the recovery of caribou populations so they can continue harvesting them in the future (CRDN-JWG 2021). During community information sessions, LPA community members identified woodland caribou as a valuable component of the environment and a key interest and concern (NexGen 2019a).

The following subsections describe the existing conditions of woodland caribou habitat availability, habitat distribution, and survival and reproduction in the LSA, caribou home range, RSA, and SK2 West. These three measurement indicators are intricately linked. For woodland caribou, the existing conditions of habitat availability are described with respect to habitat associations, natural (e.g., forest fire) and anthropogenic disturbances, and habitat suitability. Habitat distribution is described with respect to habitat arrangement and connectivity and linear features. Survival and reproduction are described based on the availability of suitable habitat for life requisites, adult survival and calf recruitment (i.e., vital rates linked to population stability), predators and alternate prey dynamics, sensory disturbance (linked to health and physiological effects), and hunting pressure.

Habitat conversion to early seral forests as a result of anthropogenic (i.e., human) and natural (e.g., fire) disturbances has led to an increase in higher quality and quantity of preferred forage (e.g., young trees, shrubs) for moose and deer. The increase in prey abundance or biomass subsequently leads to increased densities of wolves (and other predators), which ultimately results in an increased rate of encounter between wolves and caribou and wolf hunting efficiency (James et al. 2004; Smith 2004; Schneider et al. 2010; Latham et al. 2011b,c; Whittington et al. 2011; ENV 2013). This phenomenon is termed disturbance-mediated apparent competition (DeMars et al. 2019) and explains the decline of boreal woodland caribou populations across much of Canada (ECCC 2020).

14.3.1.1 Habitat Availability

Habitat Associations

Woodland caribou require large, contiguous tracts of habitat so the species can space apart from other ungulates and predators. Woodland caribou primarily select mature to old forest in peatland-dominated landscapes that have a high abundance of lichen (primary food source); typically, these areas are in black spruce bogs and black spruce-tamarack fens (Rettie et al. 1997; Stuart-Smith et al. 1997; Anderson 1999; Schneider et al. 2000; Rettie and Messier 2001; Dunford 2003; Dyke 2008; ASRD and ACA 2010; Latham et al. 2011a; ENV 2013). The selection of boreal wetland and low-productivity peatland complexes is also an important anti-predator strategy to create spatial separation from other prey species, which reduces the risk of encounters with predators (Bergerud et al. 1984; Bradshaw et al. 1995; Rettie and Messier 2000; James et al. 2004; Environment Canada 2011). In the Boreal Shield, caribou were also shown to select for (i.e., prefer) mature stands (i.e., stands more than 40 years old) of jack pine and black spruce dominated forests (McLoughlin et al. 2019).

In the Boreal Shield, conifer-dominated forests predominate over the early stage deciduous or mixed-wood forests (preferred by primary prey [e.g., moose]) and predators (e.g., wolves, black bears) remain at low densities on the landscape (McLoughlin et al. 2019). Neufeld et al. (2020) similarly found that in Saskatchewan's Boreal Shield, low net primary productivity favours coniferous forest at all seral stages, resulting in limited post-disturbance production of deciduous browse.

Uplands cover approximately 77% of the LSA and 70% of the RSA; however, over half of the upland ecosites have been burned by fire in the past 40 years, meaning most upland ecosystems in the LSA and RSA are regenerating (Section 13.3.1, Upland Ecosystems). Jack pine ecosites are the most common undisturbed upland ecosites in the LSA (Jack pine/lichen [BP02]) and RSA (Jack pine – black spruce / feathermoss [BS04]), which is supported by observations about the vegetation in the Patterson Lake area by the BNDN and BRDN (TSD II: BNDN; TSD III: BRDN). Wetlands, including open water, cover approximately 20% of the LSA and 30% of the RSA; the most common undisturbed wetland ecosites in the LSA is Labrador tea shrubby bog (BP20), and black spruce treed bog (BP19) in the RSA (Section 13.3.2, Wetland Ecosystems). These mature upland and bog ecosites are typically selected by caribou, which is supported by Indigenous and Local Knowledge that woodland caribou prefer habitat dominated by muskeg and in low-lying areas (TSD III: BRDN; MN-S-JWG 2020a,b), and that the Patterson Lake region provides good caribou habitat that was dominated by pine (TSD III: BRDN). Woodland caribou are also known to select peatlands (i.e., bog ecosites, treed fens) for calving (Rettie and Messier 1998). Similarly, the BRDN reported that woodland caribou select muskeg habitat for calving where they are less exposed to predators (TSD II: BNDN). However, given the large amount of recent fire disturbance in the LSA, caribou home range, and RSA, there is limited suitable habitat available in the Base Case (Figure 14.3-1). The occurrence of forest fires in the RSA is supported by observations made by the CRDN about several forest fires occurring at Patterson and Forrest lakes in recent years (TSD V.2: CRDN).

During baseline surveys in 2018 and 2019, woodland caribou or caribou sign (e.g., cratering, tracks, scat [also referred to as pellets]) were observed in four locations (Annex VIII.1):

- along Highway 955 corridor;
- north shore of Forrest Lake;
- east of Forrest Lake and south of Lake F, between Beet Lake and Dennis Lake; and
- east of Patterson Lake, between Lake H and Jeb Lake.

During pellet group surveys, caribou pellet groups were most frequently detected in open bog (BP22) and black spruce/Labrador tea/feathermoss (BP14) ecosites (Annex VIII.1). A herd of approximately 150 to 200 caribou was reported in March 2020 by the CRDN between Lloyd Lake and Preston Lake within SK1, immediately east of SK2 West (CRDN-JWG 2020c). The CRDN reported woodland caribou habitat south of Forrest Lake and extending into the Dahle Lake / Depper Lake area and west, and outside of the RSA, to the northwest of Gedak Lake (Figure 25; TSD V.2: CRDN); however, the CRDN stated that the caribou in the Dahle Lake area have largely disappeared since 2012 to 2013 (TSD V.2: CRDN). The MN-S reported that a caribou herd used to be at Hodge Lake, north of the RSA, where they would cross the lake and move west each spring but are no longer there (MN-S-JWG 2020b). The BRDN noted that the Patterson Lake area supported good caribou habitat where they were hunted in the past (TSD III BRDN) and an LPA community member commented that woodland caribou are in the vicinity of the proposed Project (NexGen 2019a).

Disturbance

The ultimate cause of province-wide caribou population declines is related to the loss, fragmentation, and transformation of caribou habitat to early seral forests from increased fire and human activity and development, and the subsequent increase in predation by wolves (Rettie and Messier 1998; ENV 2013). Caribou recruitment, distribution, and persistence (i.e., the probability of a species survival over a defined time period) are all negatively affected by the level of disturbance within caribou ranges (e.g., Schaefer and Mahoney 2007; Vors et al. 2007; Wittmer et al. 2007; ECCC 2020), though other research indicates that natural disturbances alone may not result in decreased carrying capacity or adult female survival (Stewart et al. 2020; Konkolics et al. 2021).

Natural Disturbance

Wildfires have had a stronger effect on habitat availability in northern Saskatchewan than in other parts of Canada because it is the dominant disturbance agent (Kansas et al. 2016). Large-scale wildfires have the potential to reduce habitat availability for caribou and may increase habitat value for other ungulates during regeneration (e.g., moose). Indigenous Groups have reported that the effect of forest fires on woodland caribou habitat is one of the largest contributing factors affecting their populations and distribution in the region (TSD II: BNDN; TSD V.2: CRDN; BNDN-JWG 2020a; BNDN-JWG 2020b; BNDN-JWG 2021b; MN-S-JWG 2020b). The MN-S and BRDN commented that fires destroy caribou food habitat for up to 50 years, causing caribou to move out of burned areas to find suitable vegetation (MN-S-JWG 2020b; BNDN-JWG 2021b). The influence of fire on caribou habitat availability is dependent on extent, frequency, and availability of alternate suitable habitat (ENV 2013).

The natural disturbance (i.e., wildfire) regime in SK2 West is geographically concentrated within the northern portion of the range and more characteristic of the fire regime in the Boreal Shield (SK1) than in the Boreal Plain (i.e., SK2; Boulanger et al. 2014; Boucher et al. 2018). Natural disturbance in the SK2 West north sub-unit was estimated at 61% (SPSA 2019), which is similar to the relative amount of natural disturbance in SK1 (58%). Fire mapping for the wildlife and vegetation RSA (Section 13.3.1.1) estimated that 58% has been disturbed by fire in the last 40 years, which does not include overlapping buffers from anthropogenic disturbance (Figure 14.2-5). Indigenous Groups have noted increased fires in recent years, including in the RSA, which was attributed in part to climate change and the government's approach to wildfire response in the north (TSD II: BNDN; TSD V.2: CRDN; BNDN-JWG 2020a; MN-S-JWG 2020a; MN-S-JWG 2020b; BNDN-JWG 2020b).

The alteration by wildfire of mature to old growth coniferous forests with extensive terrestrial lichen forage can reduce the amount of available suitable habitat in the short term (Kansas et al. 2016). However, post-fire regeneration can result in lichen-rich forest or peatland complexes in the long term (Dunford 2003). While fire initially reduces availability of caribou habitat (i.e., loss of lichen), it can also be beneficial because it helps generate coniferous trees (i.e., jack pine) and prevent replacement of lichens by inedible feather mosses in mature forest (COSEWIC 2014). Provincial government burn severity mapping for fires greater than 100 ha from 1988 to 2018 (ENV 2018) show that the wildfire polygons overestimate actual habitat loss. It is likely that post-fire, residual, or remnant areas (i.e., unburned patches within a large fire event) and waterbodies remain as available habitat for caribou on the landscape (Dunford 2003; Kansas et al. 2016), and caribou may select high quality, isolated residual patches if lichen forage is intact and if there is a high likelihood of calf security (Kansas et al. 2016; Skatter et al. 2017). Residual patches may act as refuges, providing better detection of predators in the surrounding recently burned areas. However, if these post-fire residual patches of suitable habitat are interspersed among anthropogenic disturbances, and movement between patches is limited, then their availability and function are reduced. Research conducted in SK1 indicated residual patches were not utilized by caribou as often during the post-calving period, when lichen availability becomes more important for both the cow and calf (Skatter et al. 2017).

While the total area burned by wildfires each year is highly variable and affected by weather, the area containing the RSA is noted for its short fire-return interval (Parisien et al. 2004; SPSA 2019; ECCC 2020). However, habitat conversion to early seral forests in the RSA and SK2 West north sub-unit as a result of wildfires may not have as strong an effect on caribou population(s) that occupy or use the area as it would for more productive forests in southern latitudes. The peatland habitat that makes up caribou range may not generate a substantial increase in moose forage (e.g., willow, birch; DeMars et al. 2019) while regenerating after a wildfire as is typically observed in post-fire forests where net primary productivity is higher. As such, wildfire may not have as large an influence on habitat availability in northern boreal caribou ranges as the federal recovery strategy model predicts because there is a decoupling or relaxation of disturbance-mediated apparent competition (ECCC 2020).

Natural disturbances in the LSA and caribou home range study area in the Base Case are shown in Figure 14.2-5. Burned areas five years old or less were grouped as a Recent Burn and burned areas more than five years old were assigned as early-stage (6 to 20 years post-fire) and late stage (21 to 40 years post-fire). The calculation of disturbances, following the federal and provincial approach to determining available caribou habitat, is detailed below.

Anthropogenic Disturbance

The northern portion of SK2 West has a relatively smaller anthropogenic footprint than the southern portion of the range. The RSA and caribou home range study area overlap the SK2 West north sub-unit (Figure 14.2-3). Anthropogenic disturbances in the northern portion of SK2 West and RSA are primarily attributed to secondary roads, trails, and seismic/cutlines while anthropogenic disturbance in the southern portion is higher due to forestry, an increase in linear feature density (e.g., roads, transmission lines), and extensive oil and gas development (SPSA 2019).

The CRDN and BNDN have reported that habitat alteration and loss from mineral exploration activities has contributed to decreases in the populations and herd sizes of woodland caribou in the region (TSD II: BNDN; TSD V.2: CRDN). Caribou may respond negatively to anthropogenic disturbance by avoiding areas of otherwise suitable habitat because of the proximity of those areas to disturbance (Weclaw and Hudson 2004). Avoidance may vary by type and intensity of disturbance (CPAWS Wildlands League 2013) and by season (Dyer et al. 2001, 2002; Polfus et al. 2011; Eftestøl et al. 2016), and can occur at multiple spatial scales (Leblond et al. 2011; Apps et al. 2013). The MN-S, BNDN, and BRDN commented that caribou are particularly sensitive to linear disturbance on the landscape, which are a barrier to their movement and facilitate travel for predators (TSD II: BNDN; BNDN-JWG 2021b; BRDN-JWG 2019a; MN-S-JWG 2020b). Woodland caribou may avoid habitats within 5 km of development (Smith et al. 2000; Dyer et al. 2001; Courtois et al. 2008; Vistnes and Nellemann 2008; Nagy 2011; Polfus et al. 2011; Leblond et al. 2011, 2013; CPAWS Wildlands League 2013; Johnson et al. 2015; Eftestøl et al. 2016). In particular, caribou are thought to avoid areas of high road density because of the increased predator mobility (Nellemann and Cameron 1998; Faille et al. 2010; Pinard et al. 2012; Apps et al. 2013). However, in areas with low densities of linear features and low densities of predators, such as in SK1, collared caribou were found to select for linear features in winter at the home range scale and in all seasons at the population scale, and avoidance was only shown at the home range scale in the snow-free season (McLoughlin et al. 2019). Research indicates that the SK1 population is sensitive to small increases in anthropogenic disturbance and small decreases in adult survival (ECCC 2020). Given similarities in disturbance regime between the SK2 West north sub-unit and SK1 Range, caribou populations may also be sensitive to small increases in anthropogenic disturbances in the SK2 West north sub-unit.

Sensory disturbance associated with anthropogenic activities has an indirect effect on caribou habitat distribution. A 500 m buffer around anthropogenic disturbances was applied by Environment and Climate Change Canada (ECCC) as part of their disturbance calculations to account for the loss of functional habitat as a result of sensory disturbances (Environment Canada 2011). Avoidance of noise by caribou was identified by several Indigenous Groups (BRDN-JWG 2020a; MN-S-JWG 2020b; BNDN-JWG 2020b; CRDN-JWG 2020b). In the north sub-unit of SK2 West, fire is the primary disturbance type, and sensory disturbance from human development is expected to have a small adverse effect on caribou (Section 14.3.1.1, Habitat Availability).

Indigenous Groups have noted that caribou are particularly sensitive to sensory disturbances from mining and mineral exploration activities and human activities (e.g., snowmobiles, all-terrain vehicles), which contributes to changes in their distribution (TSD II: BNDN; TSD V.2: CRDN; BNDN-JWG 2020b; BRDN-JWG 2020a; CRDN-JWG 2020c; MN-S-JWG 2020b).

Anthropogenic disturbances in the LSA and caribou home range study area in the Base Case are shown in Figure 14.2-6, and include linear features (i.e., Highway 955, cutlines / seismic lines, trails, access roads, a rough road) and non-linear developments (i.e., clearing, existing exploration, one historical oil and gas development). The calculation of disturbances, following the federal and provincial approach to determining available caribou habitat, is detailed below.

Federal and Provincial Assessments of Habitat Availability in SK2 and SK1 Ranges

Habitat alteration (i.e., habitat loss, degradation, and fragmentation) from both anthropogenic and natural sources and increased predation as a result of habitat alteration are closely interrelated, and act cumulatively to have direct and indirect effects on caribou (ECCC 2020). The ECCC indicated that the probability of a population remaining stable or undergoing growth is directly influenced by the amount of disturbance within that range, meaning that the likelihood of population persistence decreases as the amount of disturbance increases.

The ECCC has identified that a threshold of 65% undisturbed habitat within the SK2 range is necessary to support a self-sustaining population. The ECCC critical habitat assessment found that 30% of SK2 is currently disturbed from fires within the last 40 years and that 20% is disturbed from anthropogenic sources (disturbance plus a 500 m buffer), with some of the two disturbance types overlapping (ECCC 2020). The total disturbed habitat is 45%, leaving 55% undisturbed habitat (ECCC 2020). This percentage does not meet the minimum 65% threshold of undisturbed habitat necessary to support a self-sustaining population; therefore, the caribou population in SK2 is not likely to be self-sustaining (ECCC 2020).

The threshold of undisturbed critical habitat to support a self-sustaining population in SK1 is 40%, which is lower than the threshold needed in other boreal caribou ranges (ECCC 2020). The ECCC critical habitat assessment found that 58% of the SK1 range is currently disturbed from fires and 3% is disturbed from anthropogenic sources (including a 500 m buffer); after removing the overlapping disturbances in the calculation, SK1 has 40% undisturbed habitat. As such, the caribou population in SK1 is considered to be self-sustaining (McLoughlin et al. 2019; ECCC 2020).

The most recent provincial analysis of SK2 West estimates that the range is 61% disturbed, with 25% of disturbance attributed to anthropogenic sources and 36% of disturbance attributed to natural disturbances (ENV 2021). The amount of critical habitat in SK2 West, and in the entire SK2 caribou conservation unit, does not meet the minimum 65% threshold of undisturbed habitat necessary to support a self-sustaining population; therefore, the caribou population in SK2 is not likely to be self-sustaining (ECCC 2020).

Provincial Habitat Suitability Mapping

Habitat suitability maps were developed by the ENV in 2020 to provide a simplified classification of caribou habitat into high, moderate, and low-quality values (ENV 2020a). Habitat values were assigned to forest stands based on the forest ecosite classification system coverage type (McLaughlan et al. 2010), and account for varying seasonal habitat values associated with foraging, calving, and predator refuges (ENV 2014). Portions of the RSA and caribou home range for the Project are within the Boreal Shield and outside of the habitat suitability mapping provided by the ENV. Therefore, to extend the habitat suitability mapping to cover the RSA and the caribou home range, the Boreal Shield ecosites were categorized as high, moderate, and low suitability based on habitat selection models determined for caribou in the Boreal Shield (McLoughlin et al. 2019; Table 14.3-1) and other scientific literature on caribou habitat preferences.

Table 14.3-1: Caribou Habitat Suitability Classifications for Boreal Shield Ecosites in the Caribou Home Range

Habitat Suitability	Ecosite[a]
High	BS03 - Jack pine/blueberry/lichen
	BS04 - Jack pine - black spruce/feathermoss
	BS17 - Black spruce treed bog
Moderate	BS09 - Black spruce - jack pine/feathermoss
	BS18 - Labrador tea shrubby bog
	BS21 - Tamarack treed fen
	BS22 - Leatherleaf shrubby poor fen
	BS23 - Willow shrubby rich fen
	BS24 - Graminoid fen
Low	BS13 - White birch - black spruce - trembling aspen
	BS14 - White birch/lingonberry - Labrador tea
	BS26 - Rush sandy shore

a) McLaughlin et al. 2019.

Assessment of Habitat Availability in the Caribou Study Areas

Habitat availability in the Base Case in the LSA, caribou home range, RSA, and SK2 West was calculated as per the methods described in Section 14.2.6, Existing Conditions.

Approximately 97% of the LSA is disturbed in the Base Case; largely by existing anthropogenic features and the associated 500 m buffer (Table 14.3-2). Caribou habitat represents about 1% of the LSA.

Within the caribou home range study area, 5,855.7 ha (13.5%) is undisturbed habitat, 28,525.6 (65.5%) is disturbed habitat, and 9,140.0 ha (21.0%) is water in the Base Case (Table 14.3-2). Disturbed habitat is considered not suitable for caribou (ECCC 2020). Natural disturbances (no buffer) and anthropogenic disturbances (including a 500 m buffer) represent 17.1% and 48.4%, respectively, of the caribou home range. The caribou home range study area was applied to centre on the proposed Project footprint (Section 14.2.3.2) and is characterized by an existing aggregation of human development features and activities such as the exploration disturbance and existing access road, a historical oil and gas development, trails, Highway 955, a rough road (seasonal trail), and seismic lines / cutlines (Figure 14.3-1). Undisturbed habitat is represented by high-, moderate-, and low-quality habitats (Table 14.3-3).

In the RSA, 19,189 ha (17.9%) is undisturbed habitat, 72,844 ha (67.8%) is disturbed habitat, and 15,458 ha (14.4%) is water in the Base Case (Table 14.3-2). Natural disturbances (no buffer) and anthropogenic disturbances (including a 500 m buffer) represent 40.7% and 27.1% of the RSA, respectively. The relative amount of natural disturbance in the RSA (40.7%) is similar to the SK2 West north sub-unit (38.9%; Table 14.3-2). However, the proportion of anthropogenic disturbance in the RSA (27.1%) is more similar to that in the SK2 West south sub-unit (23.9%). Much of the northwest portion of the RSA, which includes the caribou home range study area, contains an aggregation of human infrastructure and development activities associated with Highway 955, the existing exploration camp and access road, trails, a rough road, and seismic lines / cutlines.

In the SK2 West Caribou Administration Unit, 2,236,923.1 ha (46.3%) is undisturbed habitat for caribou in the Base Case (Table 14.3-2). Natural disturbances (no buffer) and anthropogenic disturbances (including a 500 m buffer) represent 22.0% and 21.1% of the SK2 West Caribou Administration Unit, respectively. This disturbed area (43.1% of SK2 West) is considered not suitable for caribou (ECCC 2020). Water covers 510,399.0 ha (10.6%). The majority (32.0%) of undisturbed habitat in SK2 West consists of moderate habitat suitability with 6.7% and 7.2% represented as high- and low-quality habitats, respectively (Table 14.3-3).

The disturbance calculations presented in this EIS followed the approach used by the ENV (Section 14.2.6), but this represents a difference from values reported by the ENV for SK2 West (ENV 2021). The ENV calculated anthropogenic and natural disturbances in SK2 West to be 61.2%, with 24.8% associated with anthropogenic disturbance (including a 500 m buffer) and 36.5% of disturbance as a result of wildfires. The amount of total disturbed habitat in this EIS was calculated to be 43.1%, a difference of 18.1%. The discrepancy between the EIS and ENV calculations is largely as a result of the estimation of natural disturbances and is described below.

The ENV analysis of natural disturbance (36.5%) included fires that occurred between 1977 and 2016. The EIS analysis of natural disturbance (22%) included fires that occurred between 1981 and 2020. Fire years between 1977 and 1980 were removed from the analysis in the EIS because those fires occurred more than 40 years ago, and natural disturbance is defined by burns that occurred in the last 40 years (ECCC 2020). In addition, as described in Section 13.2.6.1.4, Fire Mapping, burn severity data determined by the Wildfire Management Branch for the years 1988 to 2018 were used to replace coarse polygon mapping associated with the wildfire history data to identify residual patches within burned areas. The ENV calculation assumed that an entire fire polygon was burned, which can overestimate natural disturbance (Skatter et al. 2017); as such, the calculation of natural disturbances in the EIS is expected to be more accurate for the 40-year period by using the burn severity data.

In addition to the discrepancy between natural disturbances, there is a 3.7% discrepancy between the EIS (21.1%, including 500 m buffer) and ENV (24.8%, including 500 m buffer) values calculated for anthropogenic disturbance. The ENV values were calculated based on the anthropogenic disturbance layer created for the provincial draft Range Plan for Woodland Caribou in Saskatchewan for SK2 West, which was created using anthropogenic disturbance visible on Landsat satellite imagery at a scale of 1:50,000 (ENV 2021). As recommended by the ENV at the time of the assessment (Haugen 2021), the EIS calculated existing disturbances using the ECCC (Environment Canada 2015a,b) disturbance data supplemented by National Road Network data. The data source used in the EIS provided a finer-scale assessment of disturbances compared to the Landsat satellite imagery and was assumed to explain the small difference in values.

Despite the differences in total disturbance values as a result of different data sources used for the calculations, both the ENV assessment (61.2% disturbed) and the EIS assessment (43.1% disturbed) demonstrate that SK2 West has surpassed the disturbance threshold (i.e., more than 35% disturbance) described in the federal recovery strategy, which indicates that the SK2 West caribou are not likely to be self-sustaining (ECCC 2020).

Table 14.3-2: Disturbed and Undisturbed Woodland Caribou Habitat among Study Areas and Caribou Ranges

Habitat Suitability[(a)]	LSA		Caribou Home Range		RSA		SK2 West North Sub-unit		SK2 West South Sub-unit		SK2 West	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Natural disturbances[(b)]	115.5	4.1	7,448.3	17.1	43,759.4	40.7	168,898.6	38.9	568,083.1	16.0	1,062,819.5	22.0
Anthropogenic disturbances[(c)]	2,625.7	92.7	21,077.3	48.4	29,084.1	27.1	494,736.4	13.3	849,686.1	23.9	1,018,584.7	21.1
Total disturbed	**2,741.2**	**96.8**	**28,525.6**	**65.5**	**72,843.5**	**67.8**	**663,635.0**	**52.1**	**1,417,769.2**	**39.9**	**2,081,404.2**	**43.1**
Water	57.9	2.0	9,140.1	21.0	15,458.3	14.4	85,867.8	6.7	424,531.2	11.9	510,399.0	10.6
Undisturbed	32.4	1.1	5,855.7	13.5	19,188.9	17.9	523,609.1	41.1	1,713,314.0	48.2	2,236,923.1	46.3
Total	**2,831.6**	**100.0**	**43,521.4**	**100.0**	**107,490.7**	**100.0**	**1,273,111.9**	**100.0**	**3,555,614.4**	**100.0**	**4,828,726.2**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
a) ENV 2020a; habitat suitability designations of high, moderate, low, and unclassified contribute to undisturbed habitat for caribou.
b) Wildfire based on a fire history period (1981 to 2020).
c) Linear and non-linear disturbances, including but not limited to cutlines / seismic lines, trails, rough roads, existing access road, Highway 955, airstrips, clearings, NexGen non-linear development, forest harvest areas, oil and gas developments, outfitting (fishing) camps, unknown disturbances (plus a 500 m buffer).
LSA = local study area; RSA = regional study area.

Table 14.3-3: Woodland Caribou Habitat Availability in the Local Study Area, Caribou Home Range, Regional Study Area, and SK2 West Caribou Administration Unit at Base Case

Habitat Suitability[a]	LSA		Caribou Home Range		RSA		SK2 West Caribou Administration Unit	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High[b]	7.5	0.3	2,821.0	6.5	12,641.4	11.8	322,427.2	6.7
Moderate[b]	24.6	0.9	2,540.9	5.8	6,015.2	5.6	1,545,421.2	32.0
Low[b]	0.3	<0.1	72.5	0.2	182.0	0.2	345,911.2	7.2
Unclassified[c]	0.0	<0.1	421.2	1.0	330.5	0.3	23,163.5	0.5
Water	57.9	2.0	9,140.1	21.0	15,450.9	14.4	510,399.0	10.6
Natural disturbances[d]	115.5	4.1	7,448.3	17.1	43,524.3	40.5	1,062,819.5	22.0
Anthropogenic disturbances[e]	2,625.7	92.7	21,077.3	48.4	29,346.4	27.3	1,018,584.7	21.1
Total	**2,831.6**	**100.0**	**43,521.4**	**100.0**	**107,490.7**	**100.0**	**4,828,726.2**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) ENV 2020a; habitat suitability designations of high, moderate, low, and unclassified contribute to undisturbed habitat for caribou.

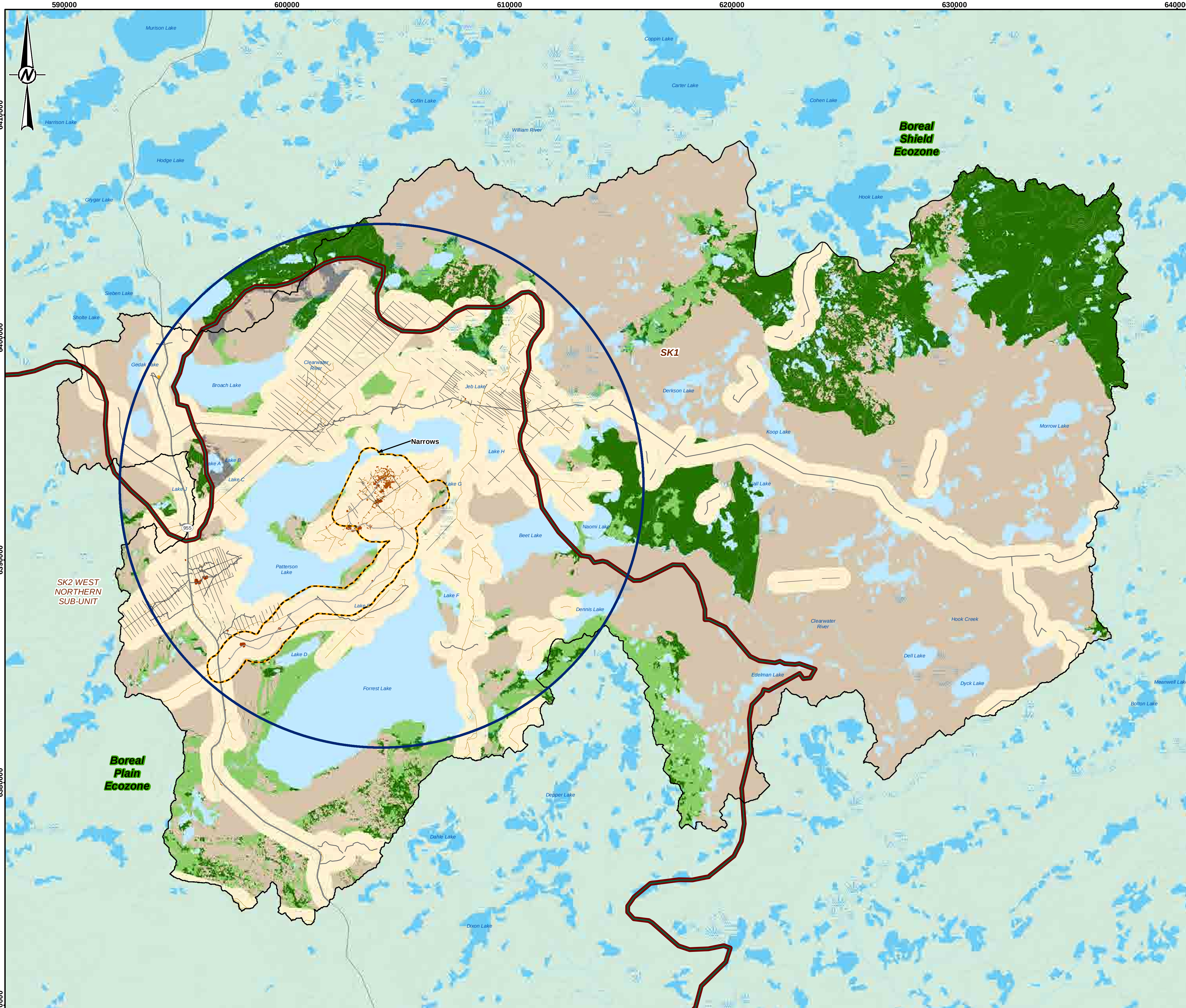
b) Boreal shield ecosites were categorized as high, moderate, and low suitability based on results of the habitat selection of caribou in the Boreal Shield (McLoughlin et al. 2019) and other scientific literature; habitat suitability designations of high, moderate, and low contribute to undisturbed habitat for caribou.

c) Characterized as unknown/unclassified in ENV (2020a) habitat suitability maps. Considered to be undisturbed habitat for caribou.

d) Wildfire based on a fire history period (1981 to 2020).

e) Linear and non-linear disturbances, including but not limited to cutlines / seismic lines, trails, rough roads, existing access road, Highway 955, airstrips, clearings, NexGen non-linear development, forest harvest areas, oil and gas developments, outfitting (fishing) camps, unknown disturbances (plus a 500 m buffer).

< = less than; LSA = local study area; RSA = regional study area; ENV = Saskatchewan Ministry of Environment.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- CARIBOU ADMINISTRATION UNIT BOUNDARY
- CARIBOU HOME RANGE ASSESSMENT AREA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT POTENTIAL

- HIGH
- MODERATE
- LOW
- ANTHROPOGENIC DISTURBANCE
- NATURAL DISTURBANCE
- UNCLASSIFIED

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

WOODLAND CARIBOU HABITAT IN THE LOCAL STUDY AREA, CARIBOU HOME RANGE AND REGIONAL STUDY AREA AT BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MB	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09	**FIGURE 14.3-1**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

14.3.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

The distribution of high and moderate suitability woodland caribou habitat in the north sub-unit of SK2 West is influenced by natural disturbance (i.e., forest fire) and anthropogenic disturbance (Figure 14.5-2; Section 14.3.1.1). High and moderate suitability habitat patches in the north sub-unit of SK2 West, around the proposed Project, are more thinly distributed than in the central part of SK2 West and interspersed by large patches of natural fire disturbance.

Within the LSA and caribou home range for the Project, high and moderate suitability habitat is limited and intersected by large patches of anthropogenic disturbance (Figure 14.3-1). There may be undefined smaller patches of low suitability habitat than represented in Figure 14.3-1, which conservatively assumes no functional habitat within 500 m of anthropogenic features (ECCC 2020). For example, a movement route for caribou, moose, and black bear was identified at the narrows of Patterson Lake North Arm during JWG meetings (BNDN-JWG 2019b), which links habitat currently classified as low suitability. Although there is connectivity and use of low suitability habitat, habitat connectivity in the Base Case is already fragmented by Highway 955 and resource exploration activities.

For wide-ranging species such as caribou, well-distributed habitat is necessary to facilitate movement and access to resources across space and time (Johnson et al. 1992; Rettie and Messier 2001; Nathan et al. 2008). Prior to human settlement, the arrangement and connectivity of caribou habitat across Canada and in SK2 West, the LSA and RSA, and the caribou home range study area would have been influenced by natural disturbances such as fire, blowdown events, and insect infestations. Scientific studies have demonstrated a range retraction of boreal woodland caribou as a result of increasing anthropogenic disturbances from human settlement in the southern portion of their range (Schaefer 2003; ENV 2021). Indigenous Groups have reported that more recent reduced abundance and a shift in the distribution of caribou is attributed to several factors including forest fires TSD II: BNDN; TSD V.2: CRDN; BNDN-JWG 2020a; BNDN-JWG 2020b; BNDN-JWG 2021b; MN-S-JWG 2020b), overhunting (TSD II: BNDN), and mining and mineral exploration activities (TSD II: BNDN; TSD V.2: CRDN; CRDN-JWG 2020c; MN-S-JWG 2020b).

Disturbances that restrict movements or act as semi-permeable barriers (e.g., roads) may exacerbate indirect habitat loss caused by avoidance of disturbance features (Dyer et al. 2002). Restricted movement rates and reduced home range sizes increase the amount of time spent in lower suitability habitats and therefore increase vulnerability to predation (Rettie and Messier 2000; Morales et al. 2010; Beauchesne et al. 2014; Muhly et al. 2015). Caribou confined to smaller home ranges could be forced into less suitable habitat and be more easily detected by predators (Beauchesne et al. 2014).

The area of the Project is on the boundary between SK1 and SK2 populations and caribou in this area may move across this boundary or cross into Alberta, but the extent of movement is unknown. Contiguous distribution of habitat is important for caribou populations to persist. Research conducted in the 1990s in the region now identified as SK2 showed that habitat fragmentation resulted in a meta-population structure (i.e., spatially separated populations of the same species) with limited interaction among groups of caribou (Rettie and Messier 1998). These results suggested that caribou populations/herds in Saskatchewan were likely isolated; however, radio-collar data from Alberta indicate there is movement across provincial borders (Government of Alberta 2017). Additionally, no genetic evidence was found to subdivide populations in the SK1 from those in the SK2 (Priadka et al. 2018), and caribou that were radio-collared in the McLoughlin et al. (2019) study showed movement between SK1 and SK2. The BNDN commented that gene flow between herds, particularly between the more stable SK1 herds and the declining herds to the west, was an important resource for western herds (BNDN-JWG 2021b).

Linear Features

The density of linear features is used to assess the magnitude of effects on wildlife species that are sensitive to this type of human disturbance. Caribou avoidance of roads and areas with high density of linear features has been well documented (Nellemann and Cameron 1998; Faille et al. 2010; Arlt and Manseau 2011; Polfus et al. 2011; Johnson et al. 2015). The density of linear features, including primary and secondary roads, can act as movement barriers for caribou and restrict their access to suitable habitat, which was also noted by Indigenous Groups (TSD II: BNDN; BRDN-JWG 2019a; MN-S-JWG 2020b). The BNDN commented that linear features such as cutlines and roads are facilitating the movement of wolves, which is contributing to decreases in caribou populations (BNDN-JWG 2021b). In caribou ranges in western Canada, linear feature densities have ranged from 1.2 km/km^2 to 10 km/km^2 (DeMars and Boutin 2018, DeMars et al. 2019, Nagy-Reis et al. 2021). DeMars and Boutin (2018) suggested that a linear feature density of less than 1 km/km^2 is needed to lessen predation effects on caribou. Table 14.3-4 summarizes linear feature density in each of the assessment study areas (i.e., spatial boundaries).

According to disturbance mapping analysis of SK2 West in 2016 (ENV 2021), there was approximately 16,813 km of non-permanent linear features (i.e., legacy forest harvest roads, seismic exploration roads, seismic lines) and 2,007 km of permanent linear features (i.e., primary and secondary highways, municipal roads, and major improved bush roads); this results in a linear feature density in SK2 West of 0.39 km/km^2 (ENV 2021; Figure 14.3-1). A total linear feature density of 0.22 km/km^2 in SK2 West was calculated for this EIS; the difference is likely associated with the use of ECCC 2015 disturbance data (Environment Canada 2015a,b) supplemented with the National Road Network data, rather than Landsat satellite imagery at a scale of 1:50,000 (Section 14.3.1.1). In the Saskatchewan Boreal Shield (SK1), the estimated density of linear features was 0.11 km/km^2 (McLoughlin et al. 2019).

In the RSA, linear density is estimated at 0.55 km/km^2. The current density of roads (i.e., Highway 955, existing access road, and rough road) is 0.15 km/km^2. Other linear features (i.e., trails, cutlines, and seismic lines) contribute an additional 0.40 km/km^2 with most of the disturbance aggregated near the western boundary, which is also overlapped by the LSA and caribou home range study area (Section 14.3.2.1, Habitat Availability; Figure 14.3-1). In the Base Case, traffic along Highway 955 may adversely influence the local behaviour and movement of animals and the population connectivity of caribou in SK2 West and other ranges, but the strength of the effect is unknown. Highway 955 is mainly associated with mineral exploration at the Project and the Fission Patterson Lake South Property, traditional land use by Indigenous Group members, and other recreational land use. In the Base Case, the density of linear features in SK2 West and the RSA is expected to be having a negligible influence on caribou movement and population connectivity since the densities are less than 1 km/km^2.

The density of linear features within the LSA is higher than the RSA and is estimated at 2.85 km/km^2. Roads (Highway 955, existing access road, and rough road) represent 0.86 km/km^2 and other linear features (i.e., trails, cutlines, and seismic lines) contribute an additional 1.99 km/km^2. In the LSA, suitable caribou habitat outside of the 500 m buffer is limited to small, unburned patches of moderate- and high-quality habitats (Figure 14.3-1).

In the caribou home range area, linear density was estimated at 1.17 km/km^2; roads (Highway 955, existing access road, and rough road) represented 0.23 km/km^2 and other linear features (i.e., trails, cutlines, and seismic lines) contributed 0.94 km/km^2 of linear density. Within the caribou home range study area, high and moderate suitability habitat is restricted to the outer extents of the range, which is largely due to the aggregation of existing disturbance and presence of Patterson, Broach, Forrest, and Beet lakes, which do not contribute to critical habitat for caribou (Figure 14.3-1). In addition, in the Base Case, traffic activity along the existing access road is expected to be low and mainly for mineral exploration activities.

In the Base Case, the linear feature density in the LSA and caribou home range likely partially impedes local caribou movements between suitable patches since the densities are more than 1 km/km^2. The traffic levels are anticipated to be low, but the linear features may increase travel for predators. Note that linear density is influenced by the scale under review; linear feature density is higher at the local scale, while much lower at the regional scale. This indicates that habitat is less connected at the scale of a caribou home range (435 km^2), but caribou movement is expected to be less restricted around the larger landscape.

Table 14.3-4: Base Case Linear Feature Density

Region	Linear Feature Density (km/km^2)	Source
SK2 West	0.39	ECCC 2015 estimate
	0.22	EIS 2021 update[(a)]
SK Boreal Shield (SK1)	0.11	McLoughlin et al. 2019
RSA	0.55 (0.15 roads + 0.40 trails/cutlines / seismic lines)	Measured
Caribou home range	1.17 (0.23 roads + 0.94 trails/cutlines / seismic lines)	Measured
LSA	2.85 (0.86 roads + 1.99 trails/cutlines / seismic lines)	Measured

a) Linear feature density for SK2 West for the EIS incorporates the National Road Network data to update the ECCC 2015 estimate.
ECCC = Environment and Climate Change Canada; LSA = local study area; RSA = regional study area; EIS = Environmental Impact Statement; SK = Saskatchewan.

14.3.1.3 Survival and Reproduction

Seasonally Important Habitat Areas

The sensitive late winter / calving period in Saskatchewan occurs from 1 April to 31 July (ENV 2021). Caribou survival and reproduction are related to the availability of suitable habitat that supports life history processes, including being able to space out to lower densities and detection by predators. In existing conditions, high and moderate suitability habitat is limited to fragmented habitat patches in and surrounding the LSA (Figure 14.3-1). More connected high and moderate suitability habitat is located east of Forrest Lake and west and south of Highway 955 (Figure 14.5-2), outside the LSA. The reproductive success of females and survival of calves are negatively affected if calving and post-calving habitats are unavailable, inadequate, or degraded (McCarthy et al. 2011; ECCC 2020). Habitat suitability is strongly influenced by the capacity of the habitat to provide refuge from predation (Rettie and Messier 2000; ECCC 2020). While vulnerability to predation has been thought to increase with the extent of disturbed landscape within caribou home ranges (Courtois et al. 2007) due to disturbance-mediated apparent competition, recent research indicates that for ecosystems with low primary productivity (e.g., Boreal Shield), the relationship between caribou population growth and natural disturbance may not be well linked or even decoupled (DeMars et al. 2019; Neufeld et al. 2020).

Existing fragmentation from anthropogenic disturbance in the LSA and caribou home range likely locally restricts caribou movement and/or may allow human and predator movement, which might be influencing the survival and reproduction of caribou. Restricted movement resulting in reduced access to resources within a caribou range can decrease lifetime reproductive success (McLoughlin et al. 2007).

Adult Survival and Calf Recruitment

Caribou population monitoring has been historically limited in Saskatchewan compared to other jurisdictions. Boreal caribou density estimates across Canada range from 4.3 caribou per 1,000 km^2 to 18.7 per 1,000 km^2 (COSEWIC 2014). The study by McLoughlin et al. (2019) in the SK1 estimated a density estimate of 36.9 per 1,000 km^2, which is much higher than other regions across Canada. No density estimates are available for SK2. However, more recently, fecal pellet collection research has been conducted in SK2 West by the ENV over the past three years and is anticipated to result in updated population estimates.

Research conducted in the 1990s, in what is now considered the SK2 range, detected an adult survival rate of 0.84, with predation being the cause of death at 75% of mortality sites investigated (Rettie and Messier 1998). Calf recruitment, an important indicator of caribou population trends, has also followed similar trends as other parts of Canada. Females typically do not reproduce until three years of age and give birth to one calf per year (ECCC 2020). Caribou are sensitive to changes in predation rate because they have a low reproductive rate relative to other ungulates. Calf mortality due to predation can be especially high, particularly within the first 30 days after birth (Bergerud and Elliot 1986; Gustine et al. 2006). In many declining caribou populations, the proportion of calves that survive to one year of age is usually low, which results in a cow-calf ratio that is below thresholds associated with population stability (i.e., less than 29 calves per 100 cows; Environment Canada 2008; DeMars et al. 2011). Bergerud (2007) stated that calves should make up at least 15% of a population to provide persistence or growth. Between 1990 and 2013, 189 caribou groups were observed in SK2; of these, 14% were calves, 33% were bulls, and 53% were cows (ENV 2013, using SK2 region unpublished data).

Caribou populations that occupy the SK2 West north sub-unit and RSA are expected to be stable or near stable based on studies from the adjacent SK1 and Richardson ranges. Caribou that have been monitored in the ranges adjacent to SK2 West with the use of radio collars (i.e., McLoughlin et al. 2019 research of SK1 caribou, Alberta government monitoring of caribou in Richardson, East Side of the Athabasca, and Cold Lake ranges; Government of Alberta 2017) have shown movement across borders and range boundaries; therefore, information from those caribou studies can fill a gap in knowledge about caribou survival and reproduction in the Project study areas. Monitoring of SK1 caribou between 2014 to 2018, north and east of the RSA, found that survival rates for adult females averaged 0.90 (i.e., 90% of tracked adult females on average survive from one year to the next; range was 0.84 to 0.97; McLoughlin et al. 2019), which is above the national mean of 0.85 (Environment Canada 2011). Calf recruitment rates for caribou from late winter transect survey data and direct observation of calves averaged to 19.2 calves per 100 cows (i.e., 19.2% of females over 1.8 years old had calves, ranging from 13.4 calves per 100 cows in 2016 to 24.4 calves per 100 cows in 2018), which was expected based on caribou recruitment results obtained from across Canada (McLoughlin et al. 2019). The SK1 population was estimated to be stable over the period of the study (i.e., finite growth rate = 1.00). Similarly, the caribou population in the Richardson Range, located in northern Alberta and overlapping the Boreal Shield and Boreal Plain, has been close to stable since monitoring began in 2009 (Government of Alberta 2017). Using mortality and annual calf recruitment estimates from tracking 95 collared females, the mean annual population growth for the Richardson Range from 2008 to 2017 was 0.96 (Government of Alberta 2017).

Predators and Alternative Prey Dynamics

Predation can be a dominant limiting factor to woodland caribou populations (Hayes et al 2003; ECCC 2020). Predation by black bears and wolves has been explained as the most likely cause of high calf and adult mortality, respectively, in central Saskatchewan (Rettie and Messier 1998). The level of predation is affected by alternative prey (e.g., moose, deer) population dynamics and predator density and mobility.

Alternative Prey Population

Caribou demographics are tied to the density and distribution of moose and wolf populations. It is uncertain if moose density in SK2 West, particularly the north sub-unit and RSA, is sufficient to support a wolf density that could strongly limit caribou populations.

Currently, moose densities in the Project RSA do not likely affect predation on caribou. Bergerud (1996) suggested that boreal caribou populations become unstable when moose densities are sufficient (i.e., greater than 0.2 to 0.3 moose per km^2) to support more than 6.5 wolves per 1,000 km^2. Moose densities in low primary productivity regions such as northern Saskatchewan, Alberta, and the NWT vary from 0.05 to 0.50 moose per km^2 (McLoughlin et al. 2016; Arsenault et al. 2019). Recent surveys in the northwest Boreal Plain Ecozone of Saskatchewan (i.e., south of the RSA) estimated moose density at 0.2 moose per km^2 (Arsenault et al. 2019), which may limit caribou populations. In SK1, north and east of the RSA, moose density was estimated at 0.047 moose per km^2 (Neufeld et al. 2020), which is less likely to limit caribou populations. It is expected that moose densities in the RSA are in the range of 0.047 to 0.20 moose per km^2, similar to SK1 and northwest Boreal Plain Ecozone.

Predator Density and Mobility

It is unlikely that black bears play a critical role in limiting caribou populations in the Boreal Shield (McLoughlin et al. 2019) and perhaps the SK2 West north sub-unit and Project RSA. Current available population estimates of predators (i.e., wolf and black bear) and prey densities are low in the Saskatchewan Boreal Shield. McLoughlin et al. (2019) estimated wolf population density to be approximately 3.1 wolves per 1,000 km^2 in the Boreal Shield. While bear density was not estimated, both wolf and bear home ranges were larger on average, indicating lower densities (McLoughlin et al. 2019). Further, the caribou calf to cow ratio observed (19.2 to 19.5 calves per 100 cows) was as expected for populations not experiencing high wolf densities. In the Boreal Shield, low densities of alternate prey relative to caribou were found and the ratio of moose to caribou was almost equal, in contrast to southern areas where disturbance-mediated apparent competition is expected to be a major limiting factor to caribou (Neufeld et al. 2020). McLoughlin et al. (2019) found that black bears spent the majority of their time foraging in mixed coniferous-deciduous habitat and avoiding caribou calving habitat during critical periods of calf vulnerability, and predation of caribou is likely due to opportunistic encounters. Black bear populations are considered stable or increasing in the province and are hunted under regular licences in both spring and fall seasons (Section 14.3.4.3, Survival and Reproduction).

Wolves are likely the primary predator limiting caribou populations in the Project RSA. Since 2014, wolves have been hunted under a big game management licence in certain forest fringe WMZs in response to a high number of predation claims from ranchers. Increased hunting pressure on wolf populations could decrease caribou predation; however, it may result in wolves moving into less heavily hunted WMZs such as the WMZ containing the RSA, thus increasing encounters with caribou. Indigenous Groups indicated that there are a lot more wolves around recently due to low fur prices resulting in less trapping of wolves, and that wolves are killing game including woodland caribou (BRDN-JWG 2020a; BRDN-JWG 2021b; MN-S-JWG 2019a; MN-S-JWG 2020a).

Linear features in the Project RSA likely influence local predation rates on caribou. Access facilitates mortality from wolf predation, as access provides ease of movement into previously less accessible areas (e.g., Bergerud et al. 1984; James and Stuart-Smith 2000). Highway 955 may provide a movement corridor for wolves and black bears, particularly during periods when traffic volume is low. The seasonal trail (rough road) to the Bolton Lake Wilderness Retreat Resort Lodge that extends east–west through the RSA (Figure 14.2-6; Figure 14.3-1) may also provide a movement corridor for wolves and black bears, resulting in an increased probability of encountering caribou. Linear features allow winter vehicular use such as snowmobiles, which compact deep snow, allowing more wildlife travel opportunities, particularly wolves, in areas that would have otherwise been inaccessible due to deep snow (James and Stuart-Smith 2000).

Sensory Disturbance

Under existing conditions, woodland caribou in the LSA and caribou home range may be experiencing some physiological stress from exploration activities and road and trail use; however, the level of stress is unknown. Sensory disturbance may affect caribou through physiological stress, but these effects are difficult to quantify (Dantzer et al. 2014). In general, sensory disturbance is most detrimental in late winter, when animals tend to be in poor physical condition, and during the reproductive season (spring / early summer), when caribou are raising young (Wolfe et al. 2000; Eftestøl et al. 2016). Effects would vary depending on proximity to a development footprint and associated level of disturbance. Murphy and Curatolo (1987) determined that caribou near oilfield infrastructure (i.e., pipelines and roads) in Alaska spent less time lying down, more time running, and had higher movement rates than caribou located away from these disturbances. Using simulated seismic exploration noise in northeast Alberta (i.e., propane cannons fired every one to two minutes for one hour with a magnitude of 90 dB to 110 dB), Bradshaw et al. (1997) found that disturbed caribou moved notably faster and crossed habitat boundaries (i.e., habitat patches) substantially more often than undisturbed caribou. Lower levels of noise may result in unobserved internal reactions such as increased heart rate that are energetically costly (Herrero et al. 2005).

Existing noise levels in the Project LSA and RSA are low, but periodic exploration and recreational noise activities may be causing increased energy expenditures by caribou as they move away from the noise. Average existing ambient nighttime and daytime noise levels in the noise RSA (which covers the wildlife LSA and extends into the RSA) ranged from 21 A-weighted decibel (dBA) during the night to 42 dBA during the day (Section 7.3.3, Existing Conditions).

Hunting Pressure

Hunting can affect caribou populations (Jalkotzy et al. 1997; Rettie et al. 1998); however, there is expected to be limited risk of human-caused mortality to caribou from hunting in SK2 West and the Project RSA under existing conditions. Recreational hunting of caribou has not been permitted in the province since 1987. Further, Indigenous subsistence harvest levels of caribou in SK2 are likely low based on comments from Indigenous Groups:

- "There's no real local hunt. If people happen to see one they might shoot it. The boys might go hunting to Cree Lake and pass through some of the bigger lakes and if they see three or four they'll shoot them." (MN-S-JWG 2020a)
- "Some of the places we've traditionally hunted now have less caribou. They're moving around to different areas to find food." (BNDN-JWG 2020b)
- "We've already had caribou taken off our menu. People are warning each other to leave caribou alone if they see them." (CRDN-JWG 2020b)
- "The caribou declined so people have voluntarily stopped hunting them because they want to see their numbers return through the former historical ranges. It is kind of a self-imposed conservation strategy that CRDN Elders and community members are taking on themselves . . . even though people are hunting caribou less, the right to hunt caribou and CRDN's interest in relation to caribou has never been stronger." (CRDN-JWG 2021)

- A generation or two ago, "moose was always the primary species, but they would harvest caribou when they found them." (BNDN-JWG 2021b)

There is no mandatory or voluntary reporting for Indigenous harvest, so harvest estimates are difficult to determine (ENV 2013; Tether 2017; McLoughlin et al. 2019). However, Indigenous Groups have identified select harvest of only bulls for subsistence and/or voluntary hunting avoidance are actions taken that respect and help maintain caribou populations (ENV 2021). In the Base Case, the influence of hunting on caribou abundance in the RSA and SK2 West north sub-unit is expected to be small.

14.3.2 Moose

Moose is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021), nor is the species under consideration by Committee on the Status of Endangered Wildlife in Canada (COSEWIC; Government of Canada 2023). Moose are managed by the Government of Saskatchewan at the scale of Moose Management Units across the province. The Project is located within Moose Management Unit 19, which is comprised of WMZs 74, 75, and 76. Moose Management Unit 19 is bounded to the north, east, and west by the provincial boundaries and extends south to areas west of Highway 914 and to areas east of Highway 914. Long-term management objectives include maintaining the winter calf to cow ratio at more than 40 calves per 100 cows in all forest Moose Management Units, safeguarding that moose are not adversely affected by land use activities occurring in primary moose habitat and providing hunting opportunities that Saskatchewan sport hunters take advantage of on an annual basis (Government of Saskatchewan 2017).

Indigenous Groups identified moose as a key part of their culture and traditional diets, and hunting moose is important for community well-being and maintaining traditional ways of life (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2020b; CRDN-JWG 2020b; MN-S-JWG 2020b). Members of LPA communities also noted moose as an important VC of the environment that are relied upon for harvesting (NexGen 2019a).

The following subsections describe the existing conditions of moose habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For moose, habitat availability is described by habitat associations, forest fire, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, home range size and dispersal, and linear features; survival and reproduction are described by population status, and vital rates and threats.

14.3.2.1 Habitat Availability

Habitat Associations

Moose is a generalist species but has been shown to prefer deciduous aspen, shrubland, and wetland habitats interspersed with trees and shrubs. Optimal moose habitat consists of deciduous shrub and ground strata (i.e., layers) within deciduous, mixed, and coniferous forests that offer edge or disturbed areas with early successional vegetation (Courtois et al. 2002; Osko et al. 2004; Poole and Stuart-Smith 2004; Nelson et al. 2008).

During baseline studies, moose were detected along roads and other anthropogenic features by remote cameras and during winter track count surveys conducted in 2020 along transects; moose were not detected on those transects during surveys conducted in 2018. Across both years, the density of moose trails was 0.002 trails per km-day (Annex VIII.1). Winter backtrailing baseline surveys conducted in 2019 included one moose, which was backtrailed (i.e., tracks were followed) for 7.1 km with the entire backtrailing event occurring within the regenerating coniferous and tall shrub dominated forest type (Annex VIII.1). During the backtrailing event, signs of bedding and browsing were observed in patches of deciduous forest and browsing activity was most frequently recorded for white birch and a smaller amount on alder and jack pine. Moose were detected using a variety of habitat types within the baseline study area during winter and summer. Baseline surveys may be used to determine the presence of moose within habitat types or along features within the baseline study area but the results were unable to determine the strength or direction of selection for habitat types.

Forest Fire

Moose often select areas that have burned within the past 10 to 26 years because of the abundance of browse in the regenerating shrub layer (Nelson et al. 2008). In upland habitats, functional habitat for moose is expected to become available 6 to 10 years after disturbance (i.e., after the development of a shrub layer). The prevalence of forest fire in the RSA over the past several decades may have increased moose habitat availability (Schwartz and Franzmann 1989). However, recent studies have found that in Saskatchewan's Boreal Shield, the relationship between natural disturbance and moose abundance may not be as strong as observed elsewhere (DeMars et al. 2019; Neufeld et al 2020). The low net primary productivity within the Boreal Shield favours coniferous forests during all seral stages, resulting in limited biomass of deciduous browse following disturbance (Neufeld et al. 2020). DeMars et al. (2019) found that in northeastern British Columbia, northern Alberta, and northeastern Saskatchewan, moose showed low use of burns regardless of burn age and land-cover type. Indigenous and Local Knowledge also report that large forest fires have altered moose habitat, and moose move away following fires but return when vegetation grows back to a certain height, though a slow rate of regrowth of vegetation in northern Saskatchewan was noted (TSD II: BNDN; TSD V.2: CRDN).

> . . . the fires burn in the north. And moose move on. They came back when they get some plants grow back to a certain height for new growth . . . . And up north there, it takes forever to grow . . . . Because it's so far north . . . . So, that's why lots of animals don't go back to that kind of area. (TSD II: BNDN)

Because the RSA is ecologically similar to the Boreal Shield, the positive link between natural disturbance (i.e., wildfire) and moose density may not be as strong as observed in more productive regions.

Burned areas where high densities of shrubs are available for browsing would provide attractive habitat patches for moose on the landscape. The most recent large fire to affect the RSA occurred in 2017, and a total of 7,138.3 ha (6.6% of the RSA) has burned within the last five years. Most fires affecting the RSA occurred between 21 and 40 years ago (46.7%), and 4.3% occurred between 6 and 20 years ago (Section 13.2.6.1.4; Table 14.2-6). The occurrence of forest fires in the RSA is supported by observations made by the CRDN about several forest fires occurring at Patterson and Forrest lakes in recent years (TSD V.2: CRDN). The regenerating habitat in the burned area may provide forage habitat for moose depending on the dominant regenerating cover (i.e., deciduous or coniferous) though DeMars et al. (2019) showed that the patterns of selection and avoidance of regenerating burned habitat may vary regionally. For example, baseline studies in the LSA and adjacent RSA indicated that the understory in the regenerating jack pine ecosites primarily consists of young jack pine trees (Section 13.3.1.3, Ecosystem Condition), which confirms the information provided by Indigenous and Local Knowledge of the vegetation in the Patterson Lake area (TSD II: BNDN; TSD III: BRDN), and that undisturbed black spruce ecosites have a prevalence of spruce seedlings in the understory (Section 13.3.2.3, Ecosystem Condition). Moose prefer to consume deciduous shrubs and trees and areas with conifer-dominated understories may be less preferred by moose for browsing relative to areas with deciduous understories.

Habitat Suitability

A habitat suitability model was developed for moose. The model included seasonal forage, movement, and cover requirements such as the overall annual preference for deciduous and shrubby wetlands, periodic spring/summer use of more open aquatic habitats, and use of mature coniferous stands during deep snow conditions (Appendix 14B). The model also included potential effects from sensory disturbance (noise, smells, dust, presence of people) on habitat quality by applying a ZOI to disturbances with expected high activity levels (i.e., Highway 955, existing access road, exploration activities) relative to other types of disturbance such as trails and cutlines / seismic lines (Appendix 14B).

In the Base Case, the LSA contains an estimated 56.7 ha (2.0%) of high suitability habitat, 732.1 ha (25.9%) of moderate suitability habitat, and 26.5 ha (0.9%) of low suitability habitat (Table 14.3-5). The RSA contains an estimated 12,556.8 ha (11.7%) of high suitability habitat, 58,996.2 ha (54.9%) of moderate suitability habitat, and 12,655.0 ha (11.8%) low suitability habitat (Table 14.3-5). Collectively, high, moderate, and low suitability habitat represent 815.3 ha (28.8%) and 84,208.0 ha (78.4%) of the LSA and RSA, respectively. Burned early- and late-stage regeneration ecosites comprised the majority of moderate and high suitability habitat in the LSA and RSA for moose. Suitable moose habitat is common in the RSA and relatively less abundant in the LSA, largely due to the aggregation of existing disturbance.

Table 14.3-5: Moose Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	56.7	2.0	12,556.8	11.7
Moderate	732.1	25.9	58,996.2	54.9
Low	26.5	0.9	12,655.0	11.8
Poor	2,016.3	71.2	23,282.7	21.7
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

High and moderate suitability habitat is present and well connected in the northeast portion of the LSA outside of a 500 m buffer of human developments with high levels of activity (e.g., Highway 955, existing access road; Figure 14.3-2). Suitable moose habitat in the LSA is associated with burned late-stage regeneration ecosites. High, moderate, and low suitability moose habitat is well distributed and well connected throughout the RSA under existing conditions (Figure 14.3-3). Low suitability habitat within the RSA is associated with recent fire in 2017 and is predominantly located in the central portion of the RSA, extending east from Broach Lake along the Clearwater River and south of Patterson Lake and Forrest Lake to the west side of Beet Lake. Poor suitability habitat within the RSA is primarily associated with lakes. Overall, suitable moose habitat is well distributed and connected across the LSA and RSA under existing conditions.

The distribution of suitable moose habitat in the RSA is supported by moose hunting locations reported by Indigenous Groups in the Patterson Lake area (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN). For example, the BNDN reported moose kill and processing sites within 25 km of the project (TSD II: BNDN), the MN-S reported hunting moose in the Patterson Lake area and both sides of Highway 955

(TSD IV: MN-S) and the CRDN highlighted the peninsula area between Patterson and Forrest lakes, and the lands around Broach Lake and Gedak Lake as good moose harvesting locations (TSD V.1: CRDN; TSD V.2: CRDN).

In addition, a movement route for moose, caribou, and black bear at the narrows of Patterson Lake North Arm was identified by the BNDN (BNDN-JWG 2019b). The CRDN and BNDN also commented about disturbance to wildlife habitat in the Patterson Lake area from recent forest fires and clearing activities associated with previous exploration activities (TSD II: BNDN; TSD V.2: CRDN). The CRDN specifically noted that clearing activities from previous exploration activities and construction of the existing access road removed vegetation that supported abundant moose in the Patterson Lake area (TSD V.1: CRDN; TSD V.2: CRDN).

Home Range and Dispersal

Moose are highly mobile and can have large annual home ranges that often encompass thousands of hectares (Murray et al. 2012; Street et al. 2015a), particularly in regions with low primary productivity (Mace et al. 1984; Risenhoover 1986). In a study conducted in the Mackenzie Valley, NWT, the mean annual home range for cow moose was 174 km^2, which was larger than reports from other parts of North America (Stenhouse et al. 1995). The study area had low moose density (0.14 to 0.16 moose per km^2) and was in the extreme northern portion of the boreal forest characterized by poorly drained open and partially closed black spruce and by moss-lichen and black spruce bog forest interspersed with small lakes and streams and periodic forest fires creating a variety of regenerative stages (Stenhouse et al. 1995). In northern Alberta, moose home range size was reported to be 97 km^2 (0.18 moose per km^2; Stenhouse et al. 1995). Recent surveys in the northwest Boreal Plain Ecozone of Saskatchewan (south of the RSA) estimated moose density at 0.20 moose per km^2 (Arsenault et al. 2019), which suggests that home range size in the RSA would be similar to moose studied in northern Alberta and the NWT.

Reported dispersal distances for moose range from a few kilometres to extreme cases of more than 1,000 km (Hoffman et al. 2006). Juvenile moose disperse short distances after being abandoned by cows, typically after their first year (Hoffman et al. 2006). Hoffman et al. (2006) suggest that high mobility allows moose to exploit suitable habitat patches in heterogeneous (i.e., variable) landscapes. Individual moose undergo seasonal movements as part of the annual lifecycle in many parts of their range (Andersen 1991; Ball et al. 2001; MNRF 2014); however, these types of movement patterns are not specifically known for moose in the RSA.

Linear Features

An increase in the density of linear features can affect moose movement and distribution due to an increase in hunters and predators (i.e., wolves, bears) because features such as roads can facilitate movement into previously less accessible areas (Horejsi 1979; Bergerud et al. 1984; McLellan 1988; Brody and Pelton 1989; Jalkotzy et al. 1997; Stuart-Smith et al. 1997; Rettie et al. 1998; James 1999; James and Stuart-Smith 2000). The MN-S commented that moose are generally moving south and increasing wolf populations in the north may be a contributing factor (MN-S-JWG 2019a; MN-S-JWG 2020a). Linear features may affect moose abundance in the LSA, particularly during the period when Patterson and Forrest lakes are not frozen, when exploration traffic is higher, and movement is restricted through this corridor between the lakes. Other narrower or less permanent anthropogenic disturbances (e.g., cutlines / seismic lines) in the RSA may be attractive to moose as early successional foraging habitat (Higgelke 1994; Serrouya and D'Eon 2002; Poole and Stuart-Smith 2003) and are unlikely to affect connectivity for moose under existing conditions. Moose have been documented showing a preference for seismic lines, utility lines, and logging roads (Higgelke 1994; Serrouya and D'Eon 2002) and may be drawn to salt on and around highways in winter (Miller and Litvaitis 1992). In contrast, Laurian et al. (2008) found that moose showed avoidance of areas up to 500 m from highways, and that highway and forest road crossing frequencies were 16 and 10 times lower than expected by chance, respectively. In a subsequent study, moose avoidance of roads varied seasonally from 100 to 250 m (Laurian et al. 2012).

Existing disturbance in the RSA is low (0.4%) and aggregated in the northwest portion (Figure 14.3-3). A seasonal trail (i.e., rough road) to the Bolton Lake Wilderness Retreat Resort Lodge extends east–west through the RSA, originating from Highway 955 then extending east on the north side of Patterson Lake following the Cree Lake Trail before turning south to extend to the lodge, located outside of the RSA (Figure 14.2-6). Access to the lodge via the rough road occurs during the winter season. The current density of roads (e.g., Highway 955, existing access road, and rough roads) in the RSA is 0.15 km/km^2. Other linear features (i.e., trails, cutlines, and seismic lines) contribute an additional 0.40 km/km^2 to the RSA with most of these features concentrated in the northwest portion the study area overlapping the LSA (Figure 14.3-3). The density of linear features within the LSA is higher than the RSA with roads (i.e., Highway 955, existing access road, and rough roads) representing 0.86 km/km^2 and other linear features (i.e., trails, cutlines, and seismic lines) contributing an additional 1.99 km/km^2.

Moose movement, behaviour, and habitat connectivity is known to be negatively affected by roads, with the magnitude of the effect increasing with greater traffic volumes (Mytton and Keith 1981; Laurian et al. 2008). Moose may adapt to road activity by altering the time of day that they use habitats near roads to when traffic activity is relatively lower (Neumann 2009). Indigenous Groups have indicated that the increase of roads and traffic in the region, including traffic on the Cluff Lake Road and in the Patterson Lake area associated with exploration activities, have affected wildlife movement patterns and distribution, including of moose (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; MN-S-JWG 2019a). Under existing conditions, it is reasonable to assume that Highway 955 and the existing access road may be affecting moose particularly during periods of higher exploration activity when there are more vehicles on the roads; however, the other linear features (including the rough road to the Bolton Lake Wilderness Retreat Resort Lodge) in the RSA are unlikely to be affecting moose movements.

During baseline winter track surveys for the Project, moose tracks were observed on the transect sampling road / anthropogenic disturbance (Annex VIII.1). Cameras deployed during baseline studies also detected moose more frequently along larger trails (i.e., cleared linear disturbance more than 2 m wide) and smaller trails (i.e., cleared linear disturbance less than 2 m wide) compared to roads that support truck traffic (Annex VIII.1). Although the camera study was not designed to make statistical inferences, the results are consistent with moose spending less time near features with higher levels of vehicle activity.

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

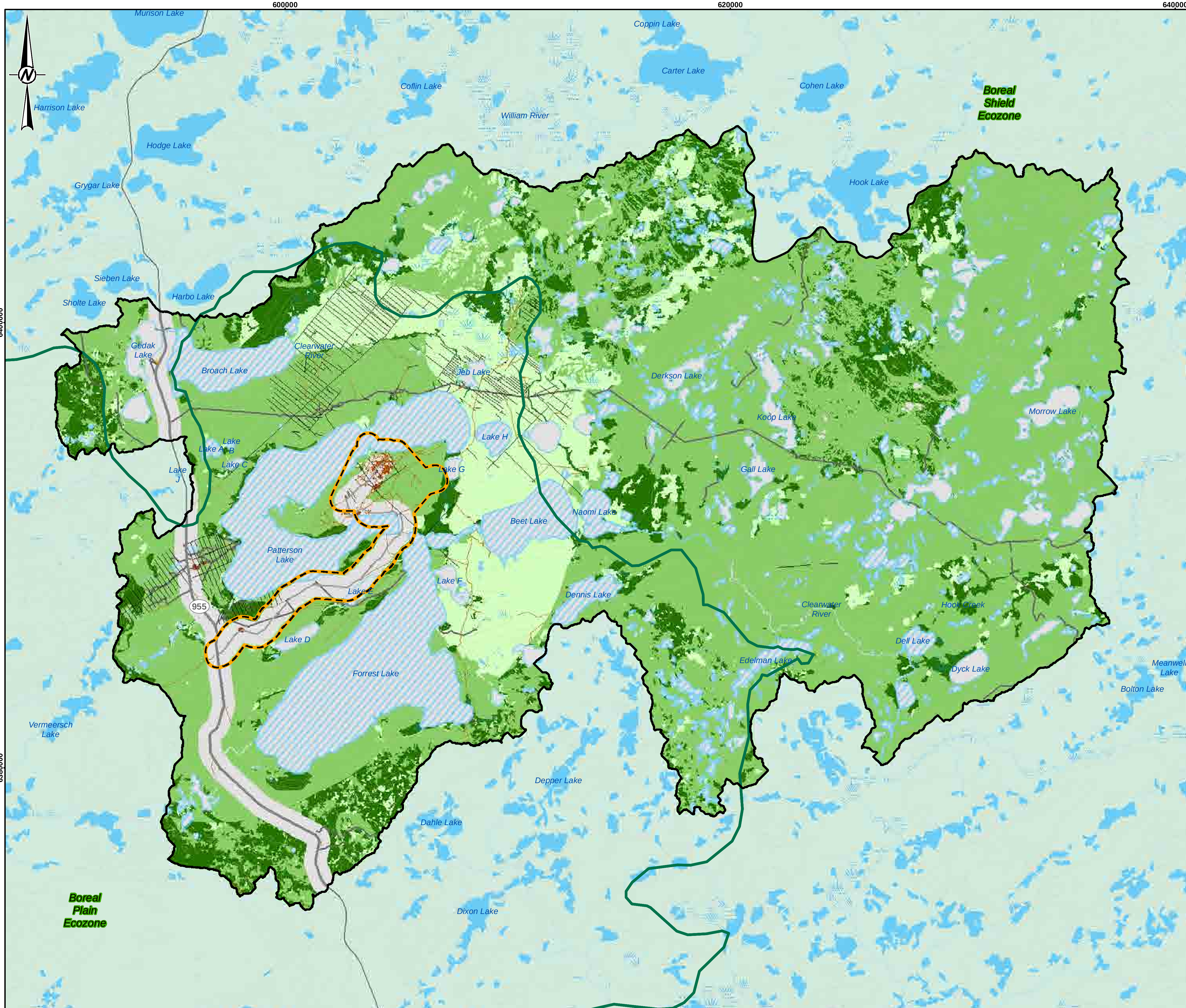
TITLE

MOOSE HABITAT IN THE LOCAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-2**	
REVIEW	JV	2023-02-09		



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MOOSE HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-3**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

14.3.2.3 Survival and Reproduction

Population Status

Baseline surveys confirmed moose use in the RSA, but moose density was not measured. Density is predicted to be similar to other populations that inhabit boreal forests with low net primary productivity, frequent fire regime, and limited availability of mature deciduous and mixed stand ecosites and deciduous shrubs and trees in the understory. Aerial surveys conducted in central Saskatchewan by the Government of Saskatchewan (2017) between 2006 and 2015 indicated moose populations in that area were declining. However, those surveys were conducted in central Saskatchewan (southern portion of the commercial forest) where habitat conditions, levels of anthropogenic disturbance, and predator-prey relationships differ from the existing conditions in the RSA. The existing habitat conditions in the RSA are expected to support a healthy moose population. The low level of existing anthropogenic disturbance and low wolf density (Section 14.3.3, Grey Wolf) suggest that the moose population overlapping the RSA is likely self-sustaining and ecologically effective.

The average density of moose observed during 13 surveys completed in the Saskatchewan Boreal Shield between 2008 and 2014 was 0.05 moose per km^2 (McLoughlin et al. 2016). Arsenault et al. (2019) found that winter population densities in the Boreal Plain of Saskatchewan varied from 0.091 moose per km^2 to 0.496 moose per km^2. Data from the northwest Boreal Plain Ecozone of Saskatchewan, south of the RSA, estimated moose density at 0.20 moose per km^2 (Arsenault et al. 2019). Based on all these data, moose density in the RSA is anticipated to be within the lower range of estimates recorded in the Boreal Plain (i.e., 0.10 to 0.20 moose per km^2).

The lower range of moose estimates in the Boreal Plain is supported by Indigenous and Local Knowledge shared by Indigenous Groups and LPA community members about moose populations decreasing in the Patterson Lake area (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; NexGen 2019a). The CRDN have observed declining moose populations in the area since 2014:

> It gets harder, I guess - to find a moose . . . . I'll get one in the fall, if that. But last year I got one moose and that was it for the three weeks we been there. And that's for two families; you know what I mean. . . . We got just one moose last year. Before we get like two, three, you know. (TSD V.2: CRDN)

The MN-S and BNDN have also observed a decrease in moose populations and reported that moose have moved farther away from the Patterson Lake area because of exploration activities and the slow rate of vegetation regrowth following wildfires (TSD II: BNDN; TSD IV: MN-S).

Vital Rates and Threats

Moose are long-lived ungulates with relatively high adult survival rates (e.g., 74.6% to 89.9%, including harvest; Murray et al. 2012), with a life expectancy of 12 to 20 years in hunted populations (Arsenault 2000). Moose are primarily threatened by disease and parasites, altered predator/prey relationships, direct and indirect habitat loss (affecting shelter, food availability, and movement), and hunting (Timmerman et al. 2002; Dussault et al. 2005; Street et al. 2015a,b). Moose populations are influenced by other ungulates and predators (MNRF 2014). Their primary predators are wolves and bears, which most often kill calves, though adults can also become prey (Ballard and Van Ballenberghe 1997; Section 14.3.3.1, Habitat Availability; Section 14.3.4.2, Habitat Distribution). The BRDN also noted that wolves are one of the key threats to moose populations (BRDN-JWG 2020a). Predation and snow conditions are interrelated factors that can affect moose survival and recruitment. All of these factors are expected to affect the survival and reproduction of the moose population overlapping the RSA in the Base Case.

14.3.3 Grey Wolf

Grey wolf is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021), nor is it a species under consideration by COSEWIC (Government of Canada 2023). Management objectives for grey wolf populations are primarily directed towards avoiding human-wildlife conflicts (Government of Saskatchewan 2017). Grey wolf was also identified by Indigenous Groups as a culturally important species for trapping (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR).

Existing conditions are described according to the measurement indicators of habitat availability, habitat distribution, and survival and reproduction (Section 14.2.2.2). For grey wolf, the existing conditions of habitat availability are described with respect to habitat associations, prey availability, natural (e.g., forest fire) and anthropogenic disturbances, and habitat suitability. Habitat distribution is described with respect to habitat arrangement and connectivity, home range size, and linear features. Survival and reproduction are described with respect to available population estimates and densities, relationships to habitat and prey availability, vital rates, and fur harvest.

14.3.3.1 Habitat Availability

Habitat Associations

Grey wolf is considered a habitat generalist species, capable of exploiting a variety of habitat types on the landscape as long as the animals are mostly free from human persecution and ungulate densities are sufficient to support a population (Arjo and Peltscher 2004). Habitat conditions in the RSA are ecologically similar to those found in the study by McLoughlin et al. (2019), which was informed by wolf habitat selection in the Boreal Plain and Boreal Shield. In general, wolves were found to select for open muskeg while avoiding areas composed of mature black spruce and young/mid-successional jack pine (McLoughlin et al. 2019). Wolves also selected for black spruce swamp (McLoughlin et al. 2019). Wolves in the RSA can be expected to seek out lower elevations linked with drainages (i.e., where there is potential beaver [prey] habitat) across the landscape during summer and winter. Similarly, open muskegs may also provide preferred forage for moose (Timmermann and McNicol 1988; Shipley 2010), which could attract wolves.

Prey Availability

Wolf habitat selection can change throughout the year in response to varying prey abundance and snowpack conditions as supported by studies in Alberta and Saskatchewan. For example, grey wolves in northeast Alberta were found to select upland habitats more often during the winter when white-tailed deer, their primary prey during winter, was most abundant (Latham et al. 2013). Similarly, Boutin et al. (2015) found that wolves in northeastern Alberta were commonly located in upland forested habitat and observed in fens less frequently in the winter than during the rest of the year. During the spring and summer, wolves consumed more beaver, and habitat selection reflected this shift in target prey such that wolves were more commonly associated with wetland areas during the snow-free season (Latham et al. 2013). This is consistent with Boutin et al. (2015), who found that during summer wolves were more commonly associated with bog habitat and upland forests with an understory dominated by blueberry.

In Saskatchewan’s Boreal Shield, mature jack pine was strongly avoided during the winter season and slightly selected for during the snow-free season, while mixed coniferous-deciduous forest was selected for during the winter (McLoughlin et al. 2019). McLoughlin et al. (2019) also observed a wolf diet biased towards caribou and beaver relative to moose, which was attributed to the small pack sizes observed (i.e., averaging four wolves per pack) for hunting smaller prey. Wolf pack sizes approaching an average of six wolves per pack were found to typically rely more heavily on hunting moose (McLoughlin 2021).

Disturbance

In the Base Case, disturbances created by forest fires and human development are unlikely to be negatively affecting habitat availability for wolves in the RSA based on existing literature. The extent of historical burns is shown in Figure 14.2-5 and that of existing anthropogenic activities is shown in Figure 14.2-6.

Natural Disturbance

Forest fire is the dominant type of natural disturbance within the RSA; upland habitat that has been burned within the past 40 years (since 1980) covers 63.7% of the LSA and 51.8% of the RSA (Section 13.3.1.1), which is supported by observations from the CRDN about several forest fires occurring at Patterson and Forrest lakes in recent years (TSD V.2: CRDN). Studies have reached different conclusions regarding the effects of natural disturbance on grey wolves, and the effects may vary depending on season and level of disturbance (Houle et al. 2010; Courbin et al. 2009). Disturbance created by forest fires can contain high densities of browse for moose (Oldemeyer and Regelin 1987) and thus be exploited by wolves hunting in the area. In contrast, recent studies (e.g., DeMars et al. 2019) in less productive northern latitudes found that moose showed low use of burns regardless of burn age and land-cover type (Section 14.3.2.1). Forest fire disturbance in the RSA likely has had little influence on grey wolf habitat availability because this species can use disturbed habitats for hunting.

Anthropogenic Disturbance

Existing anthropogenic disturbance (i.e., human activity) in the LSA and RSA includes Highway 955, mineral exploration, hunting, and trapping. Available evidence indicates wolves are relatively tolerant of anthropogenic disturbance, though weak evidence of avoidance of mines was found in the Alberta Oil Sands Region (Boutin et al. 2015). Wolves have been shown to avoid roads and other forms of human infrastructure, particularly when the density of these disturbances is high or when human activity in the area is high (Thurber et al. 1994; Mech and Boitani 2003; Hebblewhite et al. 2005; Ehlers et al. 2014). Conversely, wolves appear to be capable of adapting to the presence of humans and may select areas closer to human activity (Mech et al. 1995; Thiel et al. 1998; Boitani 2000; Hebblewhite and Merrill 2008). A study by Hebblewhite and Merrill (2008) showed that wolves were constrained into selecting areas closer to human activity as the level of human activity increased within territories, whereas wolves in territories with lower levels of human activity appeared to ignore human activity. In areas with higher levels of human activity, wolves used areas closer to human activity more frequently during nighttime relative to daytime (Hebblewhite and Merrill 2008). These results are consistent with Indigenous Group observations that wolves were seen near existing mining camps (BRDN-JWG 2019b; MN-S-JWG 2019a). Therefore, the relatively low levels of existing anthropogenic disturbance (i.e., linear features and physical footprint of clearings) in the LSA (3.7%) and RSA (0.4%) and associated human activities are not likely affecting existing habitat availability for wolves.

Habitat Suitability

Habitat suitability models were developed for grey wolf for the snow-free period and winter and are described in Appendix 14B. These periods were selected to account for known differences in habitat association patterns that occur throughout the year (Appendix 14B; McLoughlin et al. 2019).

In the Base Case, high, moderate, and low suitability habitats for the snow-free period total 2,396.2 ha (84.6%) and 88,477.4 ha (82.3%) in the LSA and RSA, respectively (Table 14.3-6). Low suitability habitat is the most common type of suitable habitat during the snow-free period, representing 1,660.3 ha (58.6%) and 47,515.9 ha

(44.2%) of the LSA and RSA, respectively (Table 14.3-6). During the snow-free period, mature jack pine represents the majority of high suitability habitat in the LSA (350.5 ha, 71.3%) and RSA (18,875.0 ha, 52.1%).

High, moderate, and low suitability habitats for the winter total 2,045.8 ha (72.2%) and 69.602.5 ha (64.8%) in the LSA and RSA, respectively (Table 14.3-7). Low suitability habitat is the most common type of suitable habitat during the winter, representing 1,660.3 ha (58.6%) and 54,638.4 ha (50.8%) of the LSA and RSA, respectively (Table 14.3-7). Wolves strongly avoid mature jack pine during the winter, which increases the amount of poor suitability habitat during this time of year. Similarly, young or early successional coniferous forest cover represents high suitability habitat for wolves during the snow-free period but low suitability habitat during the winter.

Overall, suitable wolf habitat during the snow-free period and winter is common in the LSA and RSA in the Base Case.

Table 14.3-6: Grey Wolf Habitat Availability in the Local and Regional Study Areas at Base Case during the Snow-Free Period

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	491.3	17.4	36,245.2	33.7
Moderate	244.6	8.6	4,716.3	4.4
Low	1,660.3	58.6	47,515.9	44.2
Poor	435.3	15.4	19,013.4	17.7
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

Table 14.3-7: Grey Wolf Habitat Availability in the Local and Regional Study Areas at Base Case during the Winter

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	302.7	10.7	11,555.4	10.8
Moderate	82.8	2.9	3,408.7	3.2
Low	1,660.3	58.6	54,638.4	50.8
Poor	785.8	27.8	37,888.3	35.2
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.3.2 Habitat Distribution

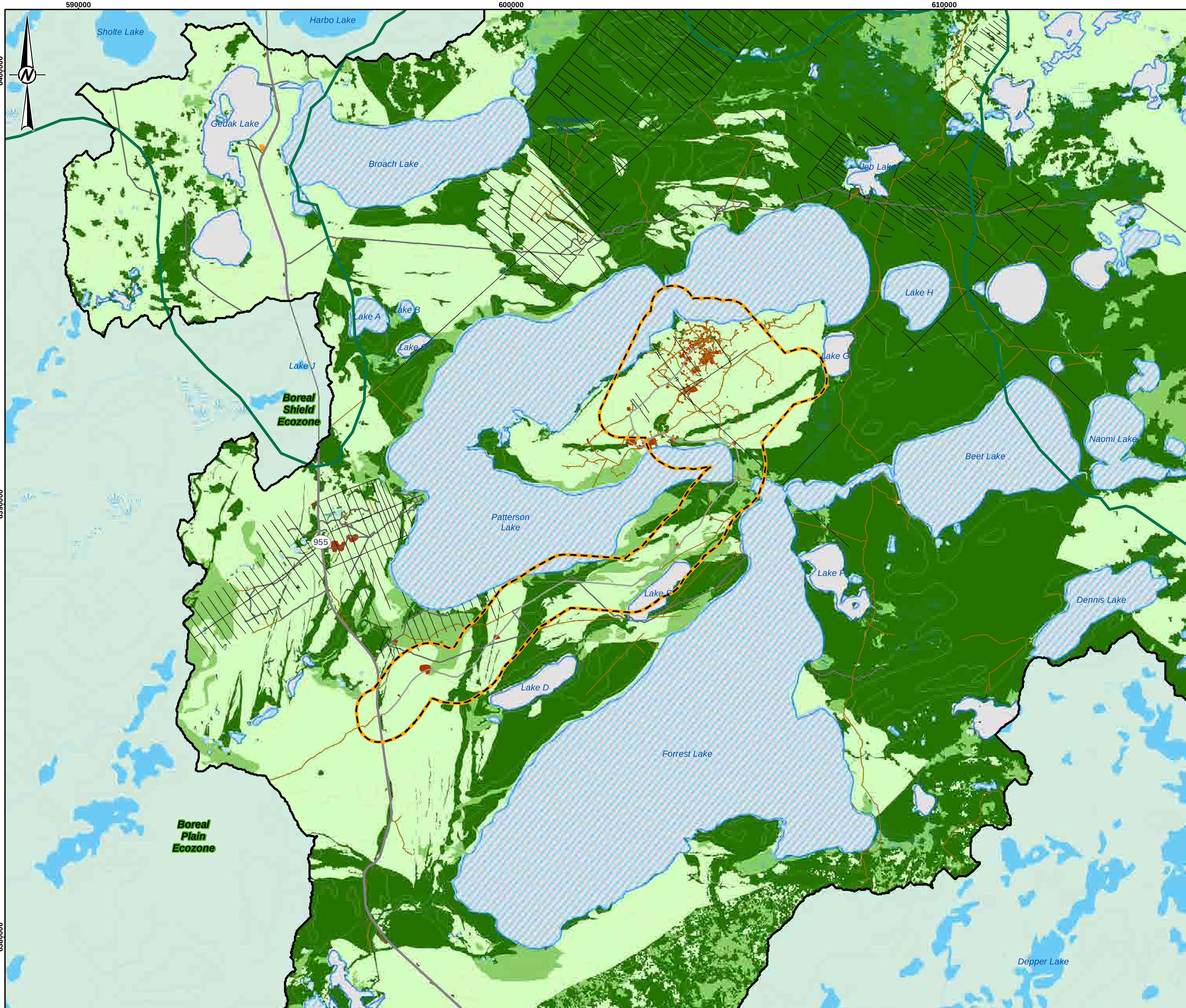
Habitat Arrangement and Connectivity

Grey wolf is a mobile species and will regularly incorporate disturbed or regenerating habitat in the home range. With strong dispersal ability and flexibility in habitat preferences, the species is likely resilient to moderate levels of fragmentation on the landscape (Serrouya et al. 2017). In the Base Case, given the species' generalist habitat selection patterns, suitable habitat for grey wolf is well connected and well distributed in the LSA and RSA during the snow-free period (Figure 14.3-4 and Figure 14.3-6). Patches of high and moderate suitability habitat extend throughout the LSA, interspersed with low suitability habitat (Figure 14.3-4). In the RSA, suitable habitat during the snow-free period is distributed as follows (Figure 14.3-6):

- well-connected high and moderate suitability habitat east of the Patterson and Forrest lakes area associated primarily with a 2017 wildfire and adjacent habitat patches;
- patches of high and moderate suitability habitat in the southwest portion of the RSA;
- large patches of high and moderate suitability habitat in the northeast portion of the RSA;
- large patches of low suitability habitat in the western portion of the RSA;
- large contiguous patch of low suitability habitat that dominates the eastern portion of the RSA; and
- small, scattered patches of high suitability habitat throughout the RSA.

Suitable habitat for grey wolf is limited in the LSA and RSA during winter (Figure 14.3-5 and Figure 14.3-7). Small patches of high suitability winter habitat are distributed throughout the LSA; primarily within the portion of the LSA containing the existing access road from Highway 955 to the Clearwater River (Figure 14.3-5). Most high suitability patches within the LSA are surrounded by low suitability or poor suitability (i.e., unsuitable) habitat (Figure 14.3-5). In the RSA, suitable winter habitat is distributed as follows (Figure 14.3-7):

- patches of high and moderate suitability habitat in the southwest portion of the RSA;
- large, connected areas of low suitability habitat throughout the RSA;
- connected patches of high and moderate suitability habitat in the north, north-central, and central portions of the RSA; and
- small, scattered patches of high suitability habitat throughout the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

GREY WOLF HABITAT IN THE LOCAL STUDY AREA, BASE CASE DURING THE SNOW-FREE PERIOD

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-4**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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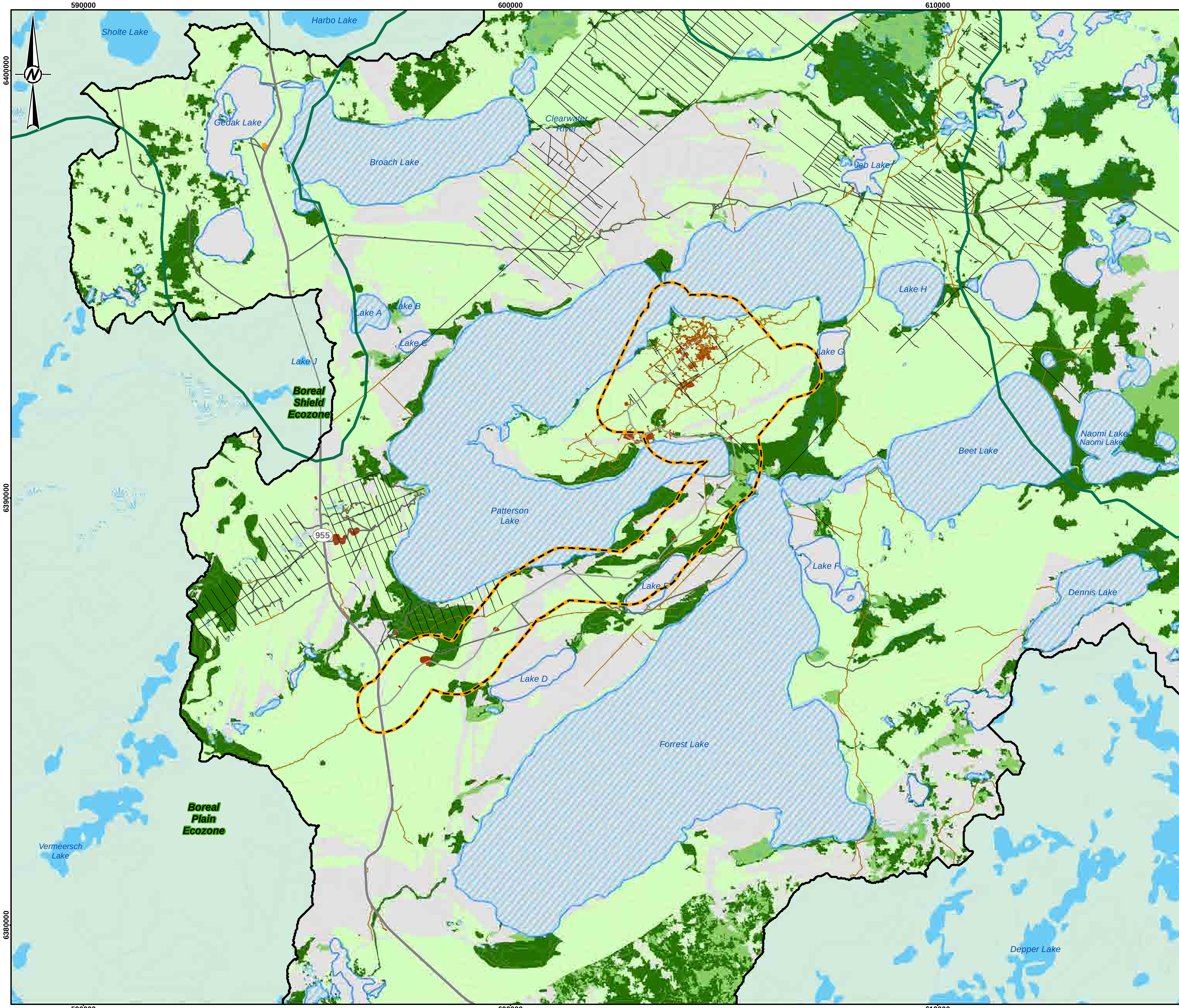


LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

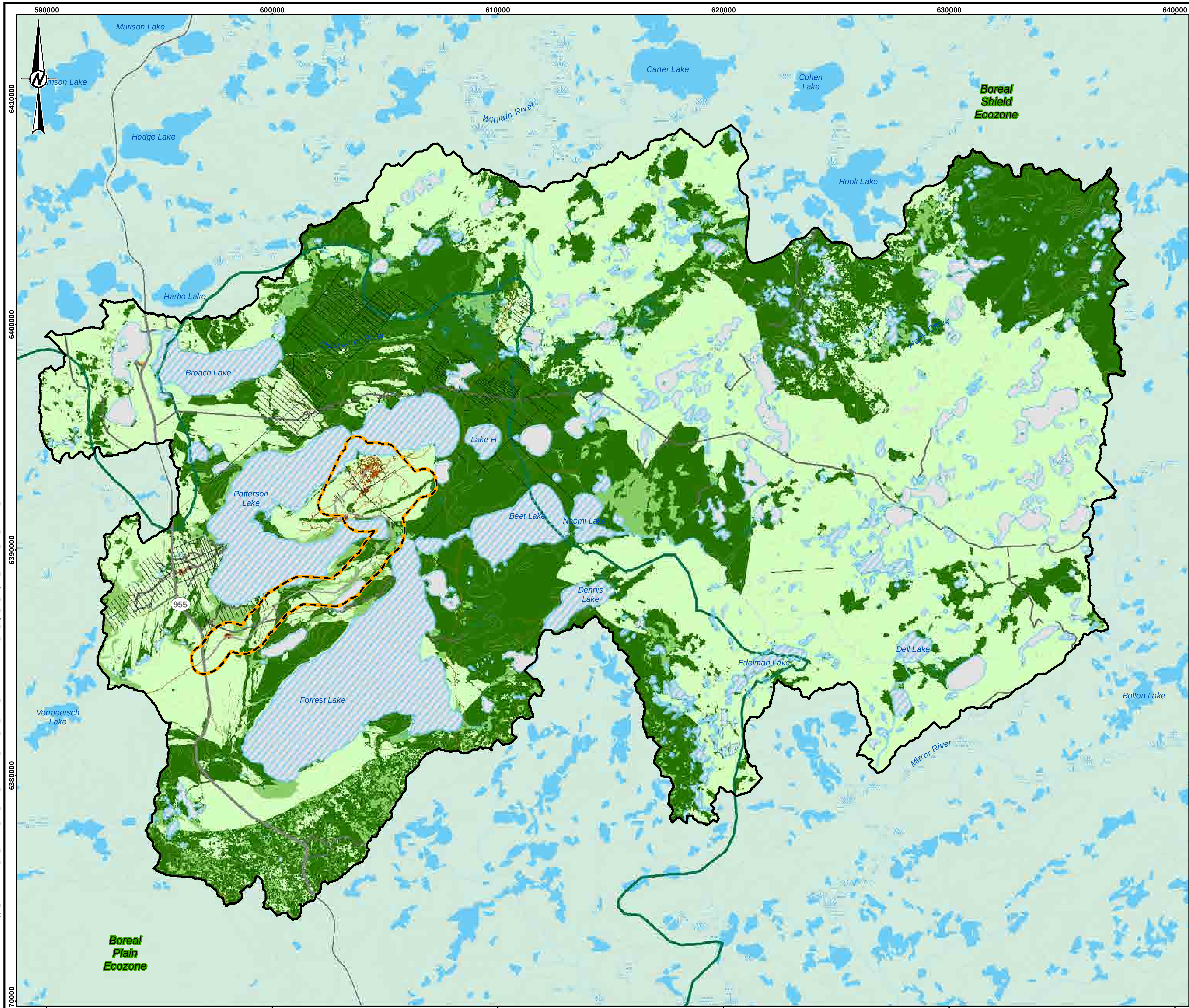
GREY WOLF HABITAT IN THE LOCAL STUDY AREA, BASE CASE DURING WINTER

CONSULTANT

wsp

PROJECT	20144150		PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.3-5	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF LSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:170,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

ROOK I PROJECT

TITLE

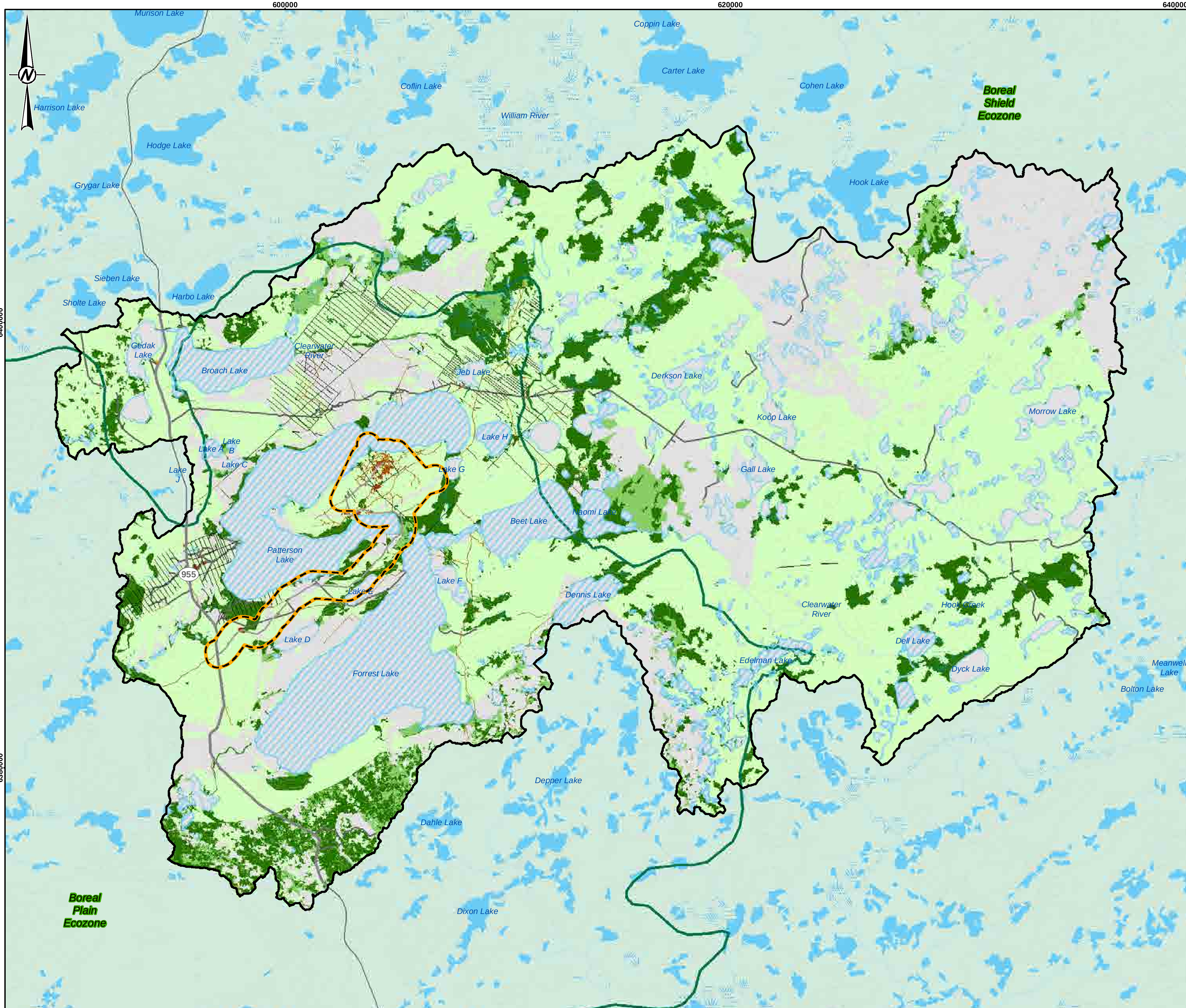
GREY WOLF HABITAT IN THE REGIONAL STUDY AREA, BASE CASE DURING THE SNOW-FREE PERIOD

CONSULTANT

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.3-6	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

GREY WOLF HABITAT IN THE REGIONAL STUDY AREA, BASE CASE DURING WINTER

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.3-7	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Home Range Size

In Saskatchewan, while no formal population surveys have been conducted, wolves typically occur in the forest fringe, forests, and Boreal Shield in the northern part of the province. The wolf population in Saskatchewan has also expanded into southern latitudes in recent years, possibly related to the expansion of moose into agricultural areas (Marr 2016). Grey wolves are considered highly mobile and maintain large home ranges. Wolves tracked by Boutin et al. (2015) in the Alberta Oil Sands Region maintained extensive home ranges (i.e., mean territory size was 861.1 km^2) and travelled large distances through landscapes that had been altered by oil and gas activity, as well as wildfires and forest harvest. In Yukon Flats, Alaska, where moose, the sole ungulate prey, occur at a low density, Lake et al. (2015) found the average winter territory size for five packs of wolves to be 1,433 km^2 (95% adaptive kernel estimator) to 1,608 km^2 (100% minimum convex polygon). McLoughlin et al. (2019) estimated the mean annual core use of the home range (50% kernel density estimator) of resident wolves in the Boreal Shield to be 660 km^2 and the mean annual home range to be 2,865 km^2 (95% minimum convex polygon); wolf home ranges in the Project RSA are likely similar in area, though variation is expected depending on prey availability.

Linear Features

Studies in Alberta have identified that wolves often use habitat near natural linear features such as rivers and creeks because these features represent areas of easier travel and higher prey density (Latham 2009; Latham et al. 2011b; Boutin et al. 2015). Wolves also select human linear features (e.g., seismic lines, trails, pipelines) for travel through the landscape, which increase daily movement rates and distance travelled compared to forested habitat, especially during winter in the presence of deep snow (Paquet and Callaghan 1996; Gurarie et al. 2011; Dickie et al. 2016; Neilson 2017). Covert cameras and backtrailing data from the baseline surveys detected grey wolves using roads and trails in the Project RSA (Annex VIII.1). However, camera and backtrailing study designs were not intended to provide estimates of the magnitude and direction of selection (i.e., preference/avoidance) for roads, trails, or other linear features by wolves and other mammal VCs.

Wolves often use areas of low road density and human activity and travel greater distances more quickly along linear features than when moving through forested habitat (Thurber et al. 1994; Bowman et al. 2010; Houle et al. 2010; Boutin et al. 2015; Dickie et al. 2017). Responses of wolves to linear features was observed to be variable over a range of linear feature densities (i.e., from 0.5 km/km^2 to 15.9 km/km^2) and corridor widths (i.e., from 2 m to 40 m; Dickie et al. 2017). Wolf movement was faster on wider, straight linear features such as railways, transmission lines, and roads; narrow and more sinuous features (e.g., low-impact seismic lines and trails) were less preferred and may not provide a direct path or may hinder line-of-sight (Dickie et al. 2017).

A seasonal trail (i.e., rough road) to the Bolton Lake Wilderness Retreat Resort Lodge extends east–west through the RSA (Tourism Saskatchewan 2021) and may facilitate wolf movement through the RSA and beyond (Figure 14.2-6; Figure 14.3-6). The existing access road from Highway 955 to the NexGen exploration camp was constructed in 2016/2017 and may provide another movement corridor for wolves. Based on Dickie et al.'s (2017) work in Alberta, the existing access road and seasonal trail to Bolton Lake likely allow faster movement rates by wolves and better line-of-sight than other linear features such as trails and seismic lines.

Road densities greater than 0.6 km/km^2 have been reported to negatively affect wolf abundance (Thiel 1985; Jensen et al. 1986; Mech et al. 1988; Mladenoff et al. 1995; Wydeven et al. 2001; Potvin et al. 2005); however, dispersing individuals may travel through areas of high road densities to find suitable habitat (Mech et al. 1995). Anthropogenic linear features such as cutlines, seismic lines, trails, and the seasonal trail to Bolton Lake are not predicted to pose a movement barrier for grey wolf in the RSA and may be preferred travel corridors, especially when snow is compacted relative to forested or more open habitats (Paquet and Callaghan 1996; Gurarie et al. 2011; Dickie et al. 2017). Highway 955 may be a partial barrier to wolf movement during periods of high traffic volume.

The current density of roads (e.g., Highway 955, existing access road, rough road) in the RSA is 0.15 km/km^2. Other linear features (i.e., trails, cutlines, and seismic lines) contribute an additional 0.40 km/km^2 to the RSA with most of these features concentrated in the northwest portion the study area overlapping the LSA (Figure 14.3-6). The density of linear features within the LSA is higher than the RSA with roads (e.g., Highway 955, existing access road, rough road) representing 0.86 km/km^2 and other linear features (i.e., trails, cutlines, and seismic lines) contributing an additional 1.99 km/km^2. Linear features may affect wolf abundance in the LSA, particularly during the period when Patterson and Forrest lakes are not frozen, exploration traffic is higher, and movement is restricted through this corridor between the lakes. However, under existing conditions, the low density of roads in the RSA is not expected to be functionally affecting habitat connectivity or how wolves travel within and beyond the RSA.

14.3.3.3 Survival and Reproduction

Population Density

While no formal surveys of wolf populations in Saskatchewan have been completed, the provincial population of grey wolf was estimated in 2006 using a linear regression model comparing wolf density and ungulate biomass, as well as a habitat model based on densities reported in current literature for habitat types prevalent in Saskatchewan (Government of Saskatchewan 2017). A provincial population estimate of 2,719 individuals was predicted based on the ungulate biomass method and 3,773 individuals based on the habitat method. Predicted densities of wolves for the Boreal Shield including WMZ 75, which contains the RSA, were predicted to be one wolf per 400 km^2 (2.5 wolves per 1,000 km^2) for the ungulate biomass model and 1 wolf per 200 km^2 (five wolves per 1,000 km^2) for the habitat method (Government of Saskatchewan 2017). Wolf density within the Alberta Oil Sands Region, based on confirmed counts, was 5.73 wolves per 1,000 km^2 (Boutin et al. 2015), and pack size and densities were similar to those observed in other portions of the western boreal forest (Kuzyk et al. 2004; Latham et al. 2011b).

Based on the numerical response between wolves and moose following Messier's (1994) study of ungulate population models with predation and on a 2017 aerial survey conducted by the Alberta Biodiversity Monitoring Institute, wolf density was estimated to be between 3.1 wolves per 1,000 km^2 and 3.5 wolves per 1,000 km^2 in the Saskatchewan Boreal Shield (McLoughlin et al. 2016; ABMI 2017; McLoughlin et al. 2019). Similarly, Lake et al. (2015) estimated the average density of wolves as 3.3 wolves per 1,000 km^2 to 3.6 wolves per 1,000 km^2 in the Yukon Flats area of Alaska. Although there are no wolf density estimates available for the RSA, the density of wolves is expected be similar to the studies completed in the Saskatchewan Boreal Shield and range from 3.1 to 3.5 wolves per 1,000 km^2.

Vital Rates

Wolves are long-lived, with an average life expectancy of up to 10 years of age in the wild (Mech 1974). Wolves reach sexual maturity at two years of age but will typically breed at age three (Mech 1974). Mech (1974) found that litters have an average of 6 pups, while Fuller and Keith (1981) found a mean of 3.9 pups in eight litters studied in northeastern Alberta. Survival can be high where prey are abundant and wolves are not intensively trapped (Mech 1974; Fuller and Keith 1981). Collared grey wolves in the Alberta Oil Sands Region maintained pack sizes ranging from four to 11 individuals, and packs produced between five and eight pups each year

(Boutin et al. 2015). Pup survival rate for grey wolves was estimated at 0.66 (Fuller et al. 2003). Average annual adult survival rates for wolf packs studied in the Caribou and Columbia mountains of British Columbia was 0.76 where the majority of deaths (i.e., four out of six individuals) were attributed to hunting and trapping activity (Serrouya et al. 2017).

In general, wolves are considered to have a high reproductive rate and are capable of rapid population growth if the availability of prey is sufficiently high. The species is resilient and adaptable and able to accommodate many threats such as disease, parasites, injuries caused by prey, and exploitation and persecution (i.e., culls) by humans (Mech 1974). Therefore, under existing conditions, the wolf population overlapping the RSA is considered to be healthy, with survival and reproduction rates linked to available prey. Although there are no data on wolf survival and reproduction available for the RSA, it is reasonable to infer from studies conducted in adjacent jurisdictions that the wolf population overlapping the RSA would have similar survival and reproduction rates.

Fur Harvest

In the Fur Conservation Area overlapping the RSA (N-19), the trapping capture rate was 88 individuals between 1985 and 2018, averaging 3.1 individuals per year (Annex VIII.1). No hunting licences for wolves are offered within WMZ 75. A province-wide trapping season for wolves occurs from fall through spring.

Wildlife trapping areas were documented in the RSA by Indigenous Groups. The CRDN documented trapping at Gedak Lake and to the west, at Broach Lake and to the north, at Patterson Lake and between Patterson and Forrest lakes, including within the proposed Project footprint (Figure 4, TSD V.1: CRDN; Figure 20, TSD V.2: CRDN). The MN-S reported trapping at Gedak Lake and a trapline was identified between Broach Lake and Patterson Lake, extending east in the RSA (Figure C; Table 1; TSD IV: MN-S). The Ya'thi Néné Lands and Resources identified the RSA as an important area for furbearers (Figure 10; TSD VI: YNLR).

Indigenous Groups indicated that trapping activities in general have declined due to low fur prices (TSD II: BNDN; TSD III: BRDN; TSD V.2: CRDN), which provides little financial incentive for trapping wolves (BRDN-JWG 2020a; BRDN-JWG 2021b). The MN-S and BRDN reported that wolf populations were increasing in northern Saskatchewan (BRDN-JWG 2020a; BRDN-JWG 2021b; MN-S-JWG 2019a; MN-S-JWG 2020a). In the Base Case, wolf abundance is not expected to be measurably influenced by hunting or trapping.

14.3.4 Black Bear

Black bears are considered habitat generalists and occupy a variety of habitat types throughout the year in response to the shifting availability of forage and prey items (Laufenberg et al. 2018; Tomchuk 2019). Black bear is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021) and is considered a species not at risk by COSEWIC (Government of Canada 2023). Black bear populations in Saskatchewan are monitored through the annual hunter harvest survey, with data supplemented by reports from hunters and ministry staff and by agriculture-related damage (e.g., crop and bee-yard) compensation data (Government of Saskatchewan 2017). Long-term management objectives for black bear include continually defining the provincial range and habitat of black bears, assessing the black bear population trend, monitoring hunter harvest and other related mortality, and creating long-term management units (Government of Saskatchewan 2017). Black bear was identified by Indigenous Groups as a culturally important species that is harvested for their hides and meat (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN-JWG 2020c). The BNDN noted that black bear is an important indicator species (BNDN-JWG 2019a).

The following subsections describe the existing conditions of black bear habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For black bear, habitat availability is described by habitat associations, seasonal diet, natural and anthropogenic disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, home range size and dispersal, and linear features; survival and reproduction are described by population status, vital rates, and harvest.

14.3.4.1 Habitat Availability

Habitat Associations

Black bear is a solitary, omnivorous species that inhabits coniferous, deciduous, and mixedwood forests that provide security cover and abundant forage (Lariviére 2001; McLoughlin et al. 2019). In a study in the Saskatchewan Boreal Shield, which was assumed to be ecologically similar to the RSA, seasonal changes in habitat selection were measured at the home range scale, with black bears avoiding young to mature black spruce habitat in spring and summer but selecting these habitat types during fall (McLoughlin et al. 2019). Black bears selected mixed coniferous-deciduous forests in the spring but strongly avoided it in the fall (McLouglin et al. 2019). Latham et al. (2011a,b) found that collared black bears in east-central Alberta avoided bogs and fens and selected upland habitats of mixed woods and various industrial features. Another study conducted by Bastille-Rousseau et al. (2011) found that black bears in the area of the Laurentides Wildlife Reserve in Quebec displayed significantly stronger selection for habitats with forage-rich vegetation abundance and avoided wet, boggy habitat. Similarly, McLoughlin et al. (2019) found avoidance of black spruce swamp in spring and fall seasons. Early successional stands are neither strongly selected nor avoided during the active season for black bears in the Boreal Shield of Saskatchewan; these younger forest stands were observed to be used by radio-tracked black bears, particularly later in the active seasons (Tomchuk 2019). During baseline pellet group surveys for the Project, black bear pellets were detected most frequently in willow shrubby rich fen (BP25) and tamarack treed fen (BP23; Annex VIII.1).

In winter, black bears require secluded areas for denning and will use a wide variety of den structures such as existing caves or tree cavities, excavated underground chambers, exposed root masses of overturned trees, brush piles, and even above-ground nests (Garshelis et al. 2016). Denning requirements of black bears in the RSA are unknown but expected to be variable. Kolenosky (1987) found that 89% of black bear dens were excavations, of which 41% were under trees or stumps, 23% were under logs, and 36% were dug into the soil. The other 11% of the dens were in hollow logs and trees, in rock caves, or under piles of man-made debris. Neufeld (2018) observed that for 14 black bears denning in the Boreal Shield of Saskatchewan, den sites were more than 100 m from water and at least 14 km from a road. Gantchoff et al. (2019) showed that, with the exception of sows with cubs, black bears selected den locations farther from roads than what would be predicted by availability on the landscape. Investigated dens included southern-facing banks and under a tree, catching snow. Den sites are not expected to be limiting in the RSA (McLoughlin 2021) and are rarely considered limiting for this species. Exceptions are areas that flood (White et al. 2001) or where bears prefer a specific den type (e.g., hollow tree), the abundance of which may be reduced through logging or other human activities (Davis et al. 2012). Fire may also decrease appropriate denning habitat because black bears prefer to den in areas with mature cover and avoid denning in regenerating habitats (Tietje and Ruff 1980). The LSA is expected to contain no to little preferred habitat for denning in the Base Case because of the limited mature forest and the proximity of Highway 955.

Seasonal Diet

Black bears are opportunist omnivores; however, much of the species' diet consists of herbaceous vegetation. Black bears will consume a vast array of food types including roots, buds, fruit, nuts, insects, fish, mammals, carrion, and moose and caribou calves during the calving and post-calving seasons (Garshelis et al. 2016; Schwartz and Franzmann 1990; Bastille-Rousseau et al. 2011; McLoughlin et al. 2019). Snowshoe hares (*Lepus americanus*), adult moose carcasses, and birds and their eggs also make up an important part of spring black bear diet (Schwartz and Franzmann 1990). Later in the spring and throughout the summer, insects become more important staples in black bear diets (Beeman and Pelton 1980; Graber and White 1983; Raine and Kansas 1989). Most of the buildup of fat reserves for winter hibernation comes from berries, which make up the majority of the late summer and fall diet (Beeman and Pelton 1980; Graber and White 1983; Raine and Kansas 1989; Lariviére 2001). A shift in relative selection towards young coniferous stands in the fall was noted by McLoughlin et al. (2019) as bears rely heavily on berries to prepare for winter dormancy through much of North America (Nelson et al. 1983). In the Saskatchewan Boreal Shield, blueberry and lingonberry were more commonly found and with equal or greater cover in young jack pine stands compared to mature stands, and generally, blueberry occurs more commonly in young jack pine stands than it does in any other stand (McLoughlin et al. 2019). Therefore, for existing conditions, it was assumed that black bears use regenerating burn areas in the RSA in the fall for feeding on berries prior to denning.

Bears may also include anthropogenic sources of food in their diets. For example, bears may also be attracted to and consume food garbage (Garshelis et al. 2016) or baits placed during hunting season. In remote areas of northern Saskatchewan, baiting for bears is expected to occur along and adjacent to major roads. In the study area of McLoughlin et al. (2019), every bear was expected to have access to bait during the spring bear hunting season (i.e., mid-April to late June), and baits become a reliable food source at a time when resources are scarce, leading to consistent use by bears throughout the active baiting season (McLoughlin 2021). Similarly, during JWG meetings the MN-S indicated that bears may even come to roads expecting food when they hear vehicles (MN-S-JWG 2019a). Therefore, under existing conditions, it was assumed that black bear use areas near Highway 955 in the RSA in the spring.

Natural and Anthropogenic Disturbance

Black bears have the capacity to adapt and be resilient to existing natural and human-related disturbances and associated variations in habitat availability. Black bears may also benefit from wildfire since berry production and moose densities increase in recently burned areas (Fisher and Wilkinson 2005; Schwartz and Franzmann 1989, 1990). Blueberry (*Vaccinium myrtilloides*) and lingonberry (*Vaccinium vitis-idaea*) were more commonly found in the Saskatchewan Boreal Shield with equal or greater cover in young (i.e., regenerating) jack pine stands than in mature stands (McLoughlin et al. 2019). In the RSA, blueberry was also determined to be abundant in regenerating jack pine ecosites (Section 13.3.4.2, Traditional Use Plant Species Distribution) and assumed to be a food source for black bear.

Despite high sensitivity to disturbance during the winter months (i.e., hibernation), black bears are able to persist in a diversity of habitats and in highly fragmented forested areas in close proximity to humans due to their ability to adjust their diet to the circumstances of their environment (Garshelis et al. 2016). McLoughlin et al. (2019) found that habitat use by black bears increased closer to linear features at the home range scale and that black bears generally selected linear features at all seasons and scales. Cameras deployed during baseline studies for the Project detected black bears more frequently along larger trails (i.e., cleared linear disturbance more than 2 m wide) and roads that support truck traffic compared to smaller trails (i.e., cleared linear disturbance less than 2 m wide; Annex VIII.1). Similarly, the BNDN noted that black bears use habitat adjacent to highways for feeding (BNDN-JWG 2021a). Linear features were highly selected by bears in peatlands and other land covers in northeast British Columbia (DeMars and Boutin 2018). Therefore, for existing conditions, it was assumed that black bear use the trails and roads in the LSA and RSA.

Avoidance effects from sensory disturbance may not be detected during much of the year because black bears can be drawn to attractants associated with anthropogenic disturbance. Although black bears sometimes avoid human activity and development (Vander Heyden and Meslow 1999; Reynolds-Hogland and Mitchell 2007; Simek et al. 2015), suitable habitats that occur adjacent to developments, including active mines, can be used. Results from a five-year remote camera study in the Alberta Oil Sands Region suggested that black bear detection rates were higher at distances farther away from active mines compared to areas closer to mines, but the trend was not statistically significant (Boutin et al. 2015). Black bear habitat selection was not influenced by sensory disturbance in North Carolina (Telesco and Van Manen 2006). Black bears are known to habituate to people and anthropogenic environments, and black bears habituated to human foods may lose their fear of humans (Greenleaf et al. 2009; Lewis et al. 2015).

Although sensory disturbance may not strongly influence black bears during daily activities throughout the active season, bears are highly sensitive to disturbance during winter hibernation and may abandon their dens if disturbance occurs within 1 km of their den site (Linnell et al. 2000). Black bears in North America seem to tolerate disturbance more than 1 km away from den sites (Linnell et al. 2000); however, activity less than 1 km away, and especially within 200 m of dens, caused variable responses (i.e., some dens were abandoned, while other bears tolerated close disturbance). In addition, Gantchoff et al (2019) found that the effects of sensory disturbance on black bear habitat availability are expected to be highest during the winter when animals are denning and thus selecting habitat away from anthropogenic disturbance. Based on this literature review, under existing conditions, it was assumed that black bear use areas around anthropogenic disturbance in the LSA and RSA during most of the year, but denning may be disturbed, and dens potentially abandoned by exploration activities in the winter during hibernation. However, anthropogenic disturbances represent 0.4% of the RSA, is aggregated around Highway 955 in the western portion of study area, and largely consists of trails, cutlines / seismic lines, and rough roads.

Habitat Suitability

Black bear habitat suitability varies seasonally, and therefore habitat suitability models were developed for black bear for spring and fall seasons (Appendix 14B). For example, black bears select for young/mid-successional habitat (i.e., early- and late-stage regeneration) during fall but avoid these habitats during spring (Appendix 14B).

Spring and fall were selected because these seasons represent periods when energetic and nutritional requirements may be limiting for bears (following emergence from the den and prior to entering hibernation). The LSA and RSA have been widely influenced by wildfires occurring between 21 and 40 years ago (i.e., late-stage regeneration; Section 13.2.6.1.4; Table 13.2-6). A total of 1,838.5 ha (64.9%) in the LSA and 50,205.0 ha (46.7%) in the RSA consists of late-stage regeneration ecosites. An additional 4,653.2 ha (4.3%) of the RSA was burned between six years and 20 years ago (i.e., early-stage regeneration; Section 13.2.6.1.4; Table 13.2-6).

In the Base Case during spring, the LSA and RSA contain similar proportions of suitable habitat (Table 14.3-8). High and moderate suitability habitats total 332.6 ha (11.8%) and 11,716.8 ha (10.9%) in the LSA and RSA, respectively. High suitability habitats are dominated by mature mixed coniferous-deciduous forest while open muskeg is the dominant landcover associated with moderate suitability habitat. Low suitability habitat represents approximately 70% of the LSA and RSA (Table 14.3-8) and is associated with mature coniferous forest and young/mid-successional Jack pine (Appendix 14B). High, moderate, and low suitability habitats represent 88,396.4 ha (82.2%) of the RSA.

During fall, similar proportions of suitable habitat are also present in the LSA and RSA (Table 14.3-9). High and moderate suitability habitats total 1,725.1 ha (60.9%) and 54,957.0 ha (51.1%) of the LSA and RSA, respectively, which is largely comprised of high suitability habitat; moderate suitability habitat is uncommon in the LSA and RSA. Late-stage regeneration ecosites are the dominant habitat type, representing 1,641.2 ha (96.8%) and 43,197.5 ha (78.8%) of high suitability habitat in the LSA and RSA, respectively. Low suitability habitat represents 18.0% and 30.0% of the LSA and RSA, respectively, and is largely associated with open muskeg (Appendix 14B). High, moderate, and low suitability habitats represent 87,169.7 ha (81.1%) of the RSA.

Overall, suitable black bear spring and fall habitat is common in the LSA and RSA at Base Case.

Table 14.3-8: Black Bear Habitat Availability in the Local and Regional Study Areas at Base Case during Spring

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	196.9	7.0	1,464.8	1.4
Moderate	135.7	4.8	10,252.0	9.5
Low	2,063.7	72.9	76,679.6	71.3
Poor	435.3	15.4	19,094.3	17.8
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

Table 14.3-9: Black Bear Habitat Availability in the Local and Regional Study Areas at Base Case during Fall

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	1,695.3	59.9	54,795.6	51.0
Moderate	29.9	1.1	161.5	0.2
Low	509.2	18.0	32,212.7	30.0
Poor	597.2	21.1	20,321.0	18.9
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

LSA = local study area; RSA = regional study area.

14.3.4.2 Habitat Distribution

Habitat Arrangement and Connectivity

During spring, large patches of high suitability habitat are located the central (adjacent to Lake E) and southern portions of the LSA and low suitability habitat is distributed throughout the LSA (Figure 14.3-8) High suitability habitat is limited to a few patches in the western and southern portions of the RSA, while low suitability habitat is well distributed throughout the RSA (Figure 14.3-10). Moderate suitability habitat is relative more common and connected in the central and southwestern portions of the RSA.

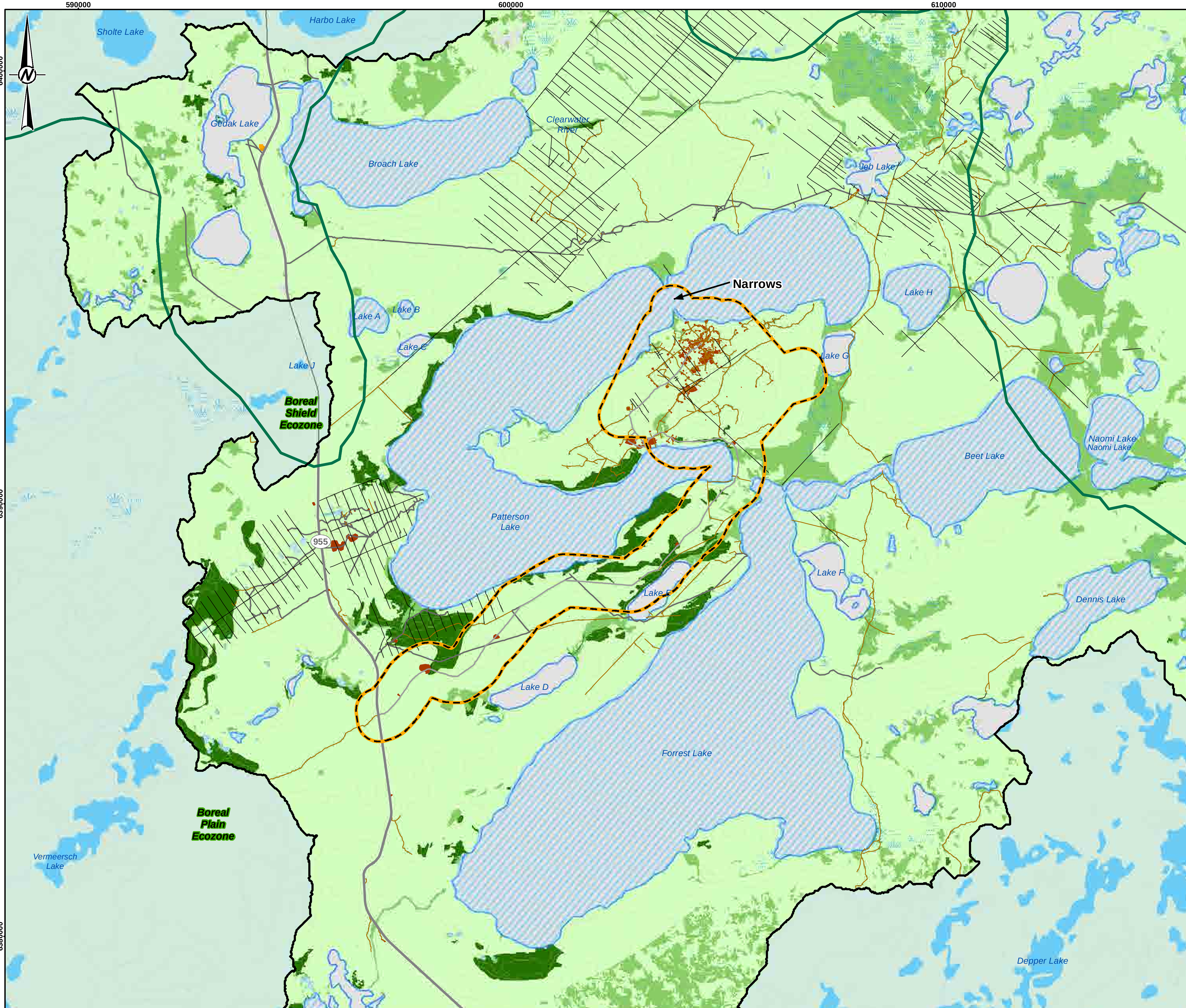
During fall, high suitability habitat is located throughout the LSA and RSA and is well connected (Figure 14.3-9 and Figure 14.3-11). High suitability habitat is interspersed with large patches of low suitability habitat in the northeast, central, and southwest portions of the RSA (Figure 14.3-11). Overall, suitable black bear spring and fall habitat is well distributed and connected across the LSA and RSA under existing conditions.

The movement of black bear through the RSA is likely influenced by waterbodies such as Patterson Lake and Forrest Lake with bears using overland routes, travelling along shorelines, and crossing waterbodies at particular locations. For example, a movement route at the narrows of Patterson Lake North Arm for moose, caribou, and black bear was identified during JWG meetings (BNDN-JWG 2019b). The narrows provides a connection between the north and south shores of the north arm of Patterson Lake (Figure 14.3-8 and Figure 14.3-9).

Home Range and Dispersal

Black bear home range size fluctuates in response to food availability (Koehler and Pierce 2003). As such, bear presence and occupancy within the RSA may be reduced during years of low food abundance. When food availability is low, individual home ranges increase since bears will travel greater distances (i.e., up to 200 km) to obtain adequate amounts of food (Pelchat and Ruff 1986; Garshelis et al. 2016). Mosnier et al. (2008) reported that females with cubs had significantly smaller home ranges than adult females without cubs. In the Saskatchewan Boreal Shield, average annual home range size for adult male and female black bears were reported as 316.5 km^2 and 79.8 km^2, respectively (McLoughlin et al. 2019). These home ranges are larger than average home ranges observed in more productive forests, which suggests that relative density of black bears in the Boreal Shield is low (McLoughlin et al. 2019). Black bear males tend to disperse farther from natal home ranges than females since males travel longer distances to mate with females (Schwartz and Franzmann 1992). Estimated home ranges provided by McLoughlin et al. (2019) are likely representative of individuals occupying the Project RSA, which overlaps the Boreal Shield and has a similar fire regime and likely lower net primary productivity than black bears in more productive forests farther south in the Boreal Plain. Therefore, it was assumed that home range size in the RSA is also 316.5 km^2 for adult male and 79.8 km^2 for adult female black bears.

Black bear dispersal typically occurs in conjunction with mating during the months of May to July and declines towards the fall (Garshelis et al. 2016). Foraging movement is also greater moving into the fall as food abundance begins to increase but may be unevenly distributed across the landscape (Garshelis et al. 2016). It was assumed that these movement patterns also occur in the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE LSA)
- WATERBODY (OUTSIDE OF LSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE LOCAL STUDY AREA, BASE CASE DURING SPRING

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-8**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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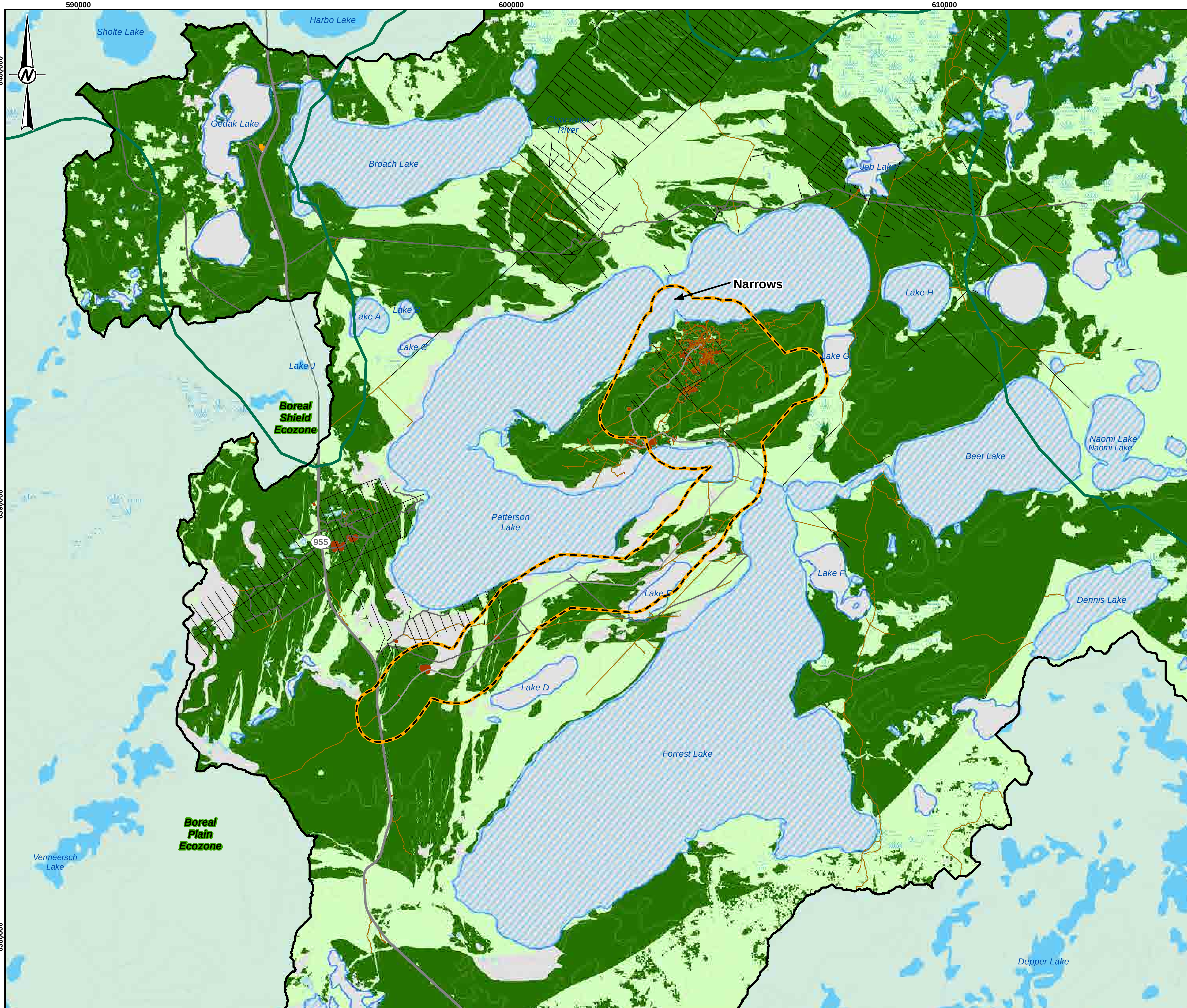

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE LOCAL STUDY AREA, BASE CASE DURING FALL

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-9**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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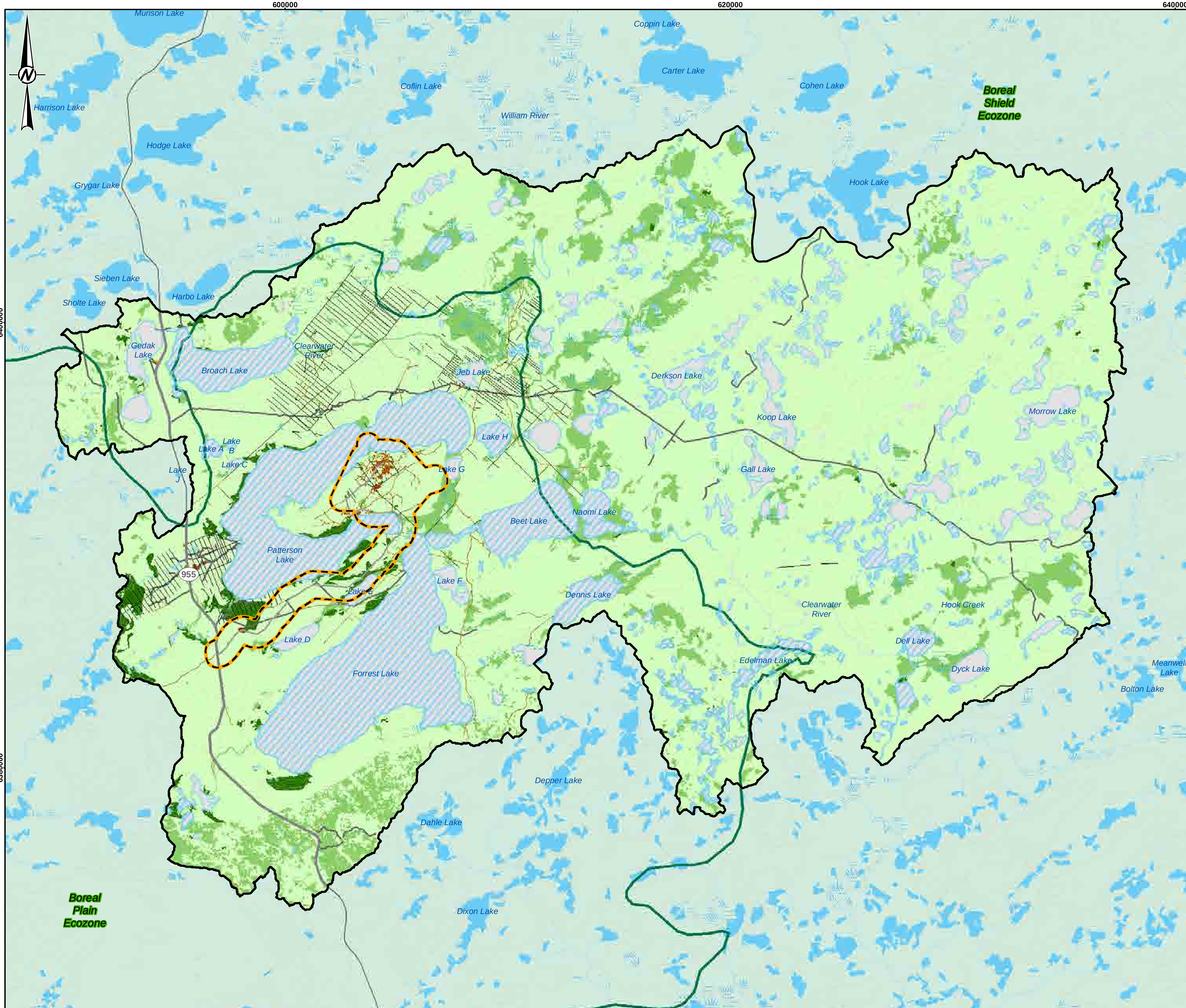

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE REGIONAL STUDY AREA, BASE CASE DURING SPRING

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-10**	
REVIEW	JV	2023-02-09		

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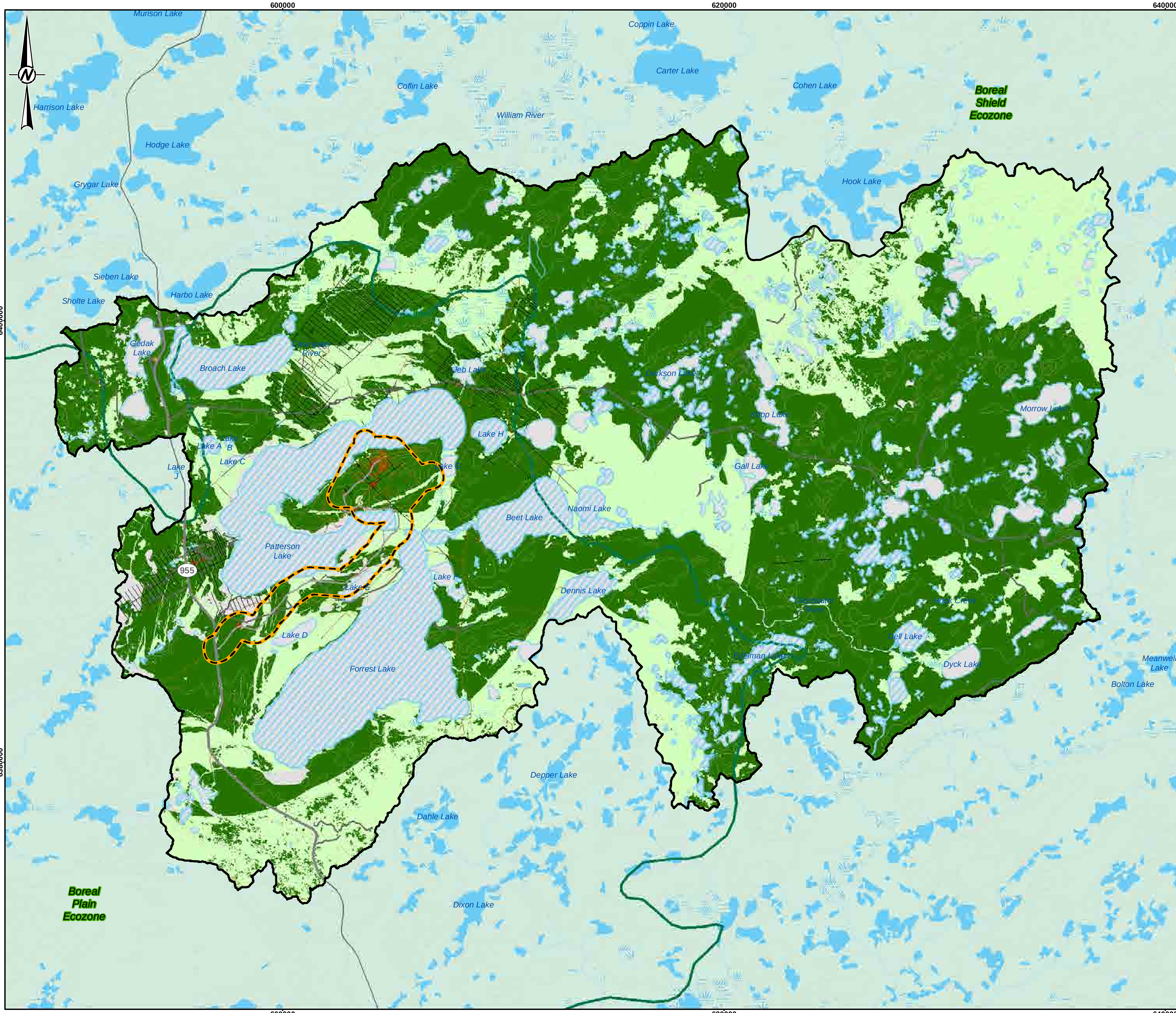

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
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- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE REGIONAL STUDY AREA, BASE CASE DURING FALL

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.3-11	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Linear Features

Existing disturbance in the RSA is low (0.4%) and aggregated in the northwest portion (Figure 14.3-10). A seasonal trail (i.e., rough road) to the Bolton Lake Wilderness Retreat Resort Lodge extends east–west through the RSA, originating from Highway 955 then extending east on the north side of Patterson Lake following the Cree Lake Trail before turning south to extend to the lodge, located outside of the RSA (Figure 14.2-6). Access to the lodge via the rough road occurs during the winter season. While some evidence suggests that black bears may avoid habitat adjacent to roads (Vander Heyden and Meslow 1999; Reynolds-Hogland and Mitchell 2007; Simek et al. 2015), McLoughlin et al. (2019) found that habitat use by black bears increased closer to linear features at the home range scale. Linear features were highly selected by bears in peatlands and other land covers in northeast British Columbia (DeMars and Boutin 2018). Use of linear features (e.g., cutlines / seismic lines, roads, trails) may facilitate movement and habitat connectivity for black bears in and beyond the RSA.

The current density of roads (e.g., Highway 955, existing access road, rough roads) in the RSA is 0.15 km/km^2. Other linear features (i.e., trails, cutlines, and seismic lines) contribute an additional 0.40 km/km^2 to the RSA with most of these features concentrated in the northwest portion the study area overlapping the LSA (Figure 14.3-10). The density of linear features within the LSA is higher than the RSA with roads (i.e., Highway 955, existing access road, and rough roads) representing 0.86 km/km^2 and other linear features (i.e., trails, cutlines, and seismic lines) contributing an additional 1.99 km/km^2. Linear features likely have small negative influence on black bear distribution and facilitate movement in the LSA and RSA.

14.3.4.3 Survival and Reproduction

Population Status

Baseline surveys confirmed black bear occurs within the RSA, but black bear density was not measured. Density in the RSA is predicted to be similar to other populations that inhabit environments with low net primary productivity, frequent fire regimes, and limited availability of mature deciduous and mixed stand ecosites with deciduous shrubs and trees in the understory. While data rely on public reporting and may reflect hunter effort and survey response and not necessarily animal abundance, the anecdotal evidence collected between 2015 and 2017 indicated that black bear populations in Saskatchewan were generally stable or increasing (Government of Saskatchewan 2017), which was supported by observations by Indigenous Groups that black bear populations are generally increasing (BNDN-JWG 2019b; BRDN-JWG 2021b; MN-S-JWG 2019a). It was assumed that the black bear population overlapping the RSA is stable or increasing under existing conditions.

Vital Rates

The mating period for black bears typically occurs in May to July but may be extended in southern latitudes (Garshelis and Hellgren 1994; Spady et al. 2007). Black bears have a gestation period of two months, and females between three years and 10 years of age can give birth every other year; however, in areas where food availability is scarce and consequently growth rate is reduced, the period between births may be three years (Garshelis et al. 2016). The average litter size for black bears varies from two to five cubs in eastern Canada to less than two cubs in western Canada (Alt 1989; Garshelis 1994; Bridges et al. 2011). Generally, black bear cubs separate from their mother between the ages of two and four (Garshelis et al. 2016). Black bears generally do not reuse den sites year to year (Linnell et al. 2000). For existing conditions, it was assumed that black bears in the RSA have similar reproductive life history traits as in the rest of Canada.

Harvest

Results from the Annual Status of Furbearers Survey indicated particularly high bear populations in the Northern Fur Conservation Area in the 2016/2017 trapping season (Government of Saskatchewan 2017). No provincial hunting data specific to the RSA are available; however, Indigenous Groups indicated that they hunt and trap black bears (TSD II: BNDN; TSD III: BRDN; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; CRDN-JWG 2020c).

An open hunting season is available for Saskatchewan and Canadian residents to hunt one black bear, either male or female, during the spring season (i.e., 15 April to 30 June) or fall season (i.e., 25 August to 14 October; ENV 2020b). A second licence is available to Saskatchewan residents for one either-sex black bear during the spring or fall season (ENV 2020b). A total of 5,813 licences were sold for black bear harvest in Saskatchewan in 2020, with an estimated harvest of 1,429 individuals consisting of 1,149 males, 266 females, and 14 young of the year (ENV 2020b). No data specific to WMZ 75, which includes the RSA, were reported.

Saskatchewan recognizes Treaty or Aboriginal Rights, and individuals exercising these rights are able to hunt, fish, and trap for food purposes at all times of the year without a licence. For existing conditions, it was assumed that provincial hunting and trapping licensing is managed in a manner that maintains stable black bear populations in the RSA.

14.3.5 Beaver

Beaver is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021), nor is it a species under consideration by COSEWIC (Government of Canada 2023). Historically, beavers were found in greater numbers and distribution than in the present due to their near extirpation from North America in the early 1900s because of over-harvesting during the fur trade (Havens 2013). Current beaver populations in North America are estimated to range from 6 million to 12 million, whereas the beaver population in North America prior to the arrival of Europeans is estimated to have been between 60 million and 400 million individuals (Havens 2013).

Beaver is a culturally important species that is trapped for its fur and meat by Indigenous Groups (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2019a; BRDN-JWG 2021b; CRDN-JWG 2020b,c). Beaver was also identified by LPA community members as a wildlife species of key interest and concern (NexGen 2019a) and were reported by trappers at the 2021 trapper's workshop to be an important species used for bait to trap other furbearers. The inter-generational transmission of wildlife resources, including beavers is an important aspect of culture and the preservation of knowledge, as noted by a member of the BRDN:

> I want my children to know that out there, if everything else fails, everything else fails in life, I want them to know that there's a place in the bush where they can go to survive . . . . Where they can go to live off the water. Like there's fish. There's muskrats. There's beavers . . . . you can do everything and anything with them. You can do a lot . . . . you can use every part of the animal to benefit . . .your survival. (TSD III: BRDN)

The following subsections describe the existing conditions of beaver habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For beaver, habitat availability is described by habitat associations, anthropogenic disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, home range size and dispersal; survival and reproduction are described by vital rates and threats.

14.3.5.1 Habitat Availability

Habitat Associations

The beaver is a semi-aquatic mammal that inhabits a variety of aquatic habitats such as lakes, ponds, and slow-flowing streams; the species is found across forested regions of Canada (Cassola 2016). Beavers build lodges out of mud, sticks, logs, and debris in areas that are near adequate food sources and building resources, and in a waterbody deep enough that the underwater lodge entrance will not freeze during winter (Boonstra 2013). During LPA community sessions, a community member commented that beavers are “shapeshifters” because of their ability to alter their environment (NexGen 2019a).

Beavers are territorial animals, and the core area of a beaver’s territory is likely to include lodge sites, escape cover, and preferred feeding areas (Havens et al. 2013). During baseline studies for the Project, active beaver lodges were observed more often along creeks than along lake shorelines (Annex VIII.1).

Anthropogenic Disturbance

In the Base Case, disturbances created by human development are unlikely to be negatively affecting habitat availability for beavers in the RSA based on existing literature. Beavers are expected to have the capacity to adapt and be resilient to existing human-related disturbances and associated variations in habitat availability. Beavers are not considered sensitive to anthropogenic disturbance as dams are often created at human-made structures where human activity is common (e.g., culverts under roads; Boyles and Savitzky 2008). A study completed in northeastern British Columbia found no evidence that anthropogenic linear features decreased the likelihood of occurrence or distribution of beaver (Mumma et al. 2018). A recent study in northwestern Alberta showed extensive use of inundated borrow pits (i.e., areas excavated to obtain material for use at another location, and which have since flooded) by beavers for foraging and overwintering (Scrafford et al. 2020). Scrafford et al. (2020) found that borrow pits associated with active beaver lodges were closer to streams, marshes, and swamps, and had more vegetation concealment from adjacent roads. Beaver habitat use in human-altered landscapes is less likely if there is suitable undisturbed habitat near the disturbance. Therefore, the existing exploration activities and Highway 955 are unlikely to be affecting habitat availability in existing conditions.

Habitat Suitability

A habitat suitability model was developed to predict suitable beaver lodge locations, forage, and cover as described in Appendix 14B. In the Base Case, high and moderate suitability habitats total 70.1 ha (2.5%) in the LSA and 3,113.3 ha (2.9%) in the RSA (Table 14.3-10). Low suitability habitat represents 465.5 ha (16.4%) of the LSA and 30,285.8 ha (28.2%) of the RSA. High, moderate, and low suitability lodge habitat represent 33,398.9 ha (31.1%) of the RSA.

The majority of the LSA and RSA contains poor suitability habitat, which is likely related partially to the extent of burned upland forest in the region, which is supported by observations made by the BNDN about beavers not occupying burned habitat: “Beaver is different. With the burnt country, they don’t stay around. They move toward the green area, so the beavers are gone” (TSD II: BNDN). Within the RSA, 1.9% of the total area has been affected by wildfires in the last five years, 4.8% has been burned in the last six to 20 years, and 54.1% has burned in the last 21 to 40 years (Section 13.2.6.1.4; Figure 13.2-5). Large lakes (greater than 8 ha [i.e., open water]) such as Broach, Patterson, Forrest, Beet, and Dennis lakes are also considered poor habitat for beaver (Appendix 14B) and further explain the large amount of poor suitability habitat in the LSA and RSA.

Although beavers may consume young coniferous trees, their preferred food consists of deciduous trees and shrubs that grow adjacent to waterbodies (Jenkins and Busher 1979). Optimal habitat for beavers in the RSA consists of undisturbed mature and late seral stage regenerating deciduous ecosites that contain an understory of green alder and willow (Section 13.3.1.3); however, these ecosites are uncommon in the RSA (Section 13.3.1.1). The understory in the regenerating jack pine ecosites primarily consists of young jack pine trees (Section 13.3.1.3), and undisturbed black spruce ecosites have a prevalence of spruce seedlings in the understory (Section 13.3.2.3); these habitats are generally unsuitable for beavers.

Table 14.3-10: Beaver Lodge Habitat Availability in the Local and Regional Study Areas at Base Case

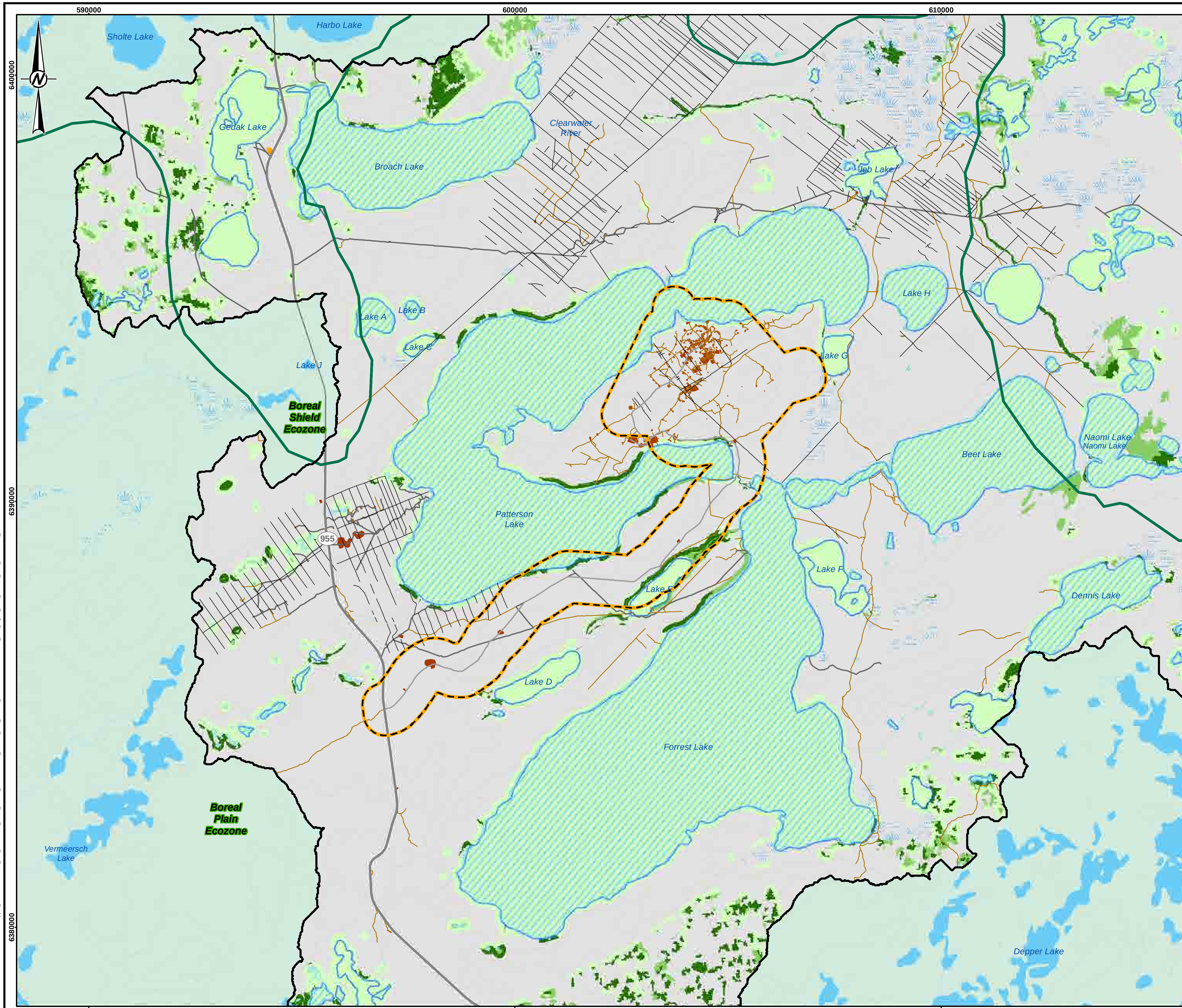
Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	55.8	2.0	1,529.3	1.4
Moderate	14.3	0.5	1,583.8	1.5
Low	465.5	16.4	30,285.8	28.2
Poor	2,296.0	81.1	74,091.9	68.9
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.5.2 Habitat Distribution

Habitat Arrangement and Connectivity

High and moderate suitability habitats identified as beaver forage and cover are limited in the LSA and RSA under existing conditions (Figure 14.3-12 and Figure 14.3-13). In the LSA, suitable beaver habitat is associated with shorelines. Most high and moderate suitability habitat patches in the LSA are distributed along the shores of Patterson Lake and along the shores of Lake E between Patterson Lake and Forrest Lake (Figure 14.3-12). Lake E provides low suitability habitat for beaver. The BNDN identified trapping locations for beaver in, or in the vicinity of the LSA (TSD II: BNDN). Baseline surveys for the Project detected beaver and beaver sign (e.g., runs, feeding sign, active lodges, inactive lodges) along shorelines of waterbodies in the LSA and adjacent RSA (Omnia 2020). Runs and feeding sign were more often detected, followed by inactive lodges and active lodges. Beaver dams were observed at two waterbodies.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE LSA)
- WATERBODY (WITHIN THE LSA)
- WATERBODY (OUTSIDE OF LSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BEAVER LODGE HABITAT IN THE LOCAL STUDY AREA, BASE CASE

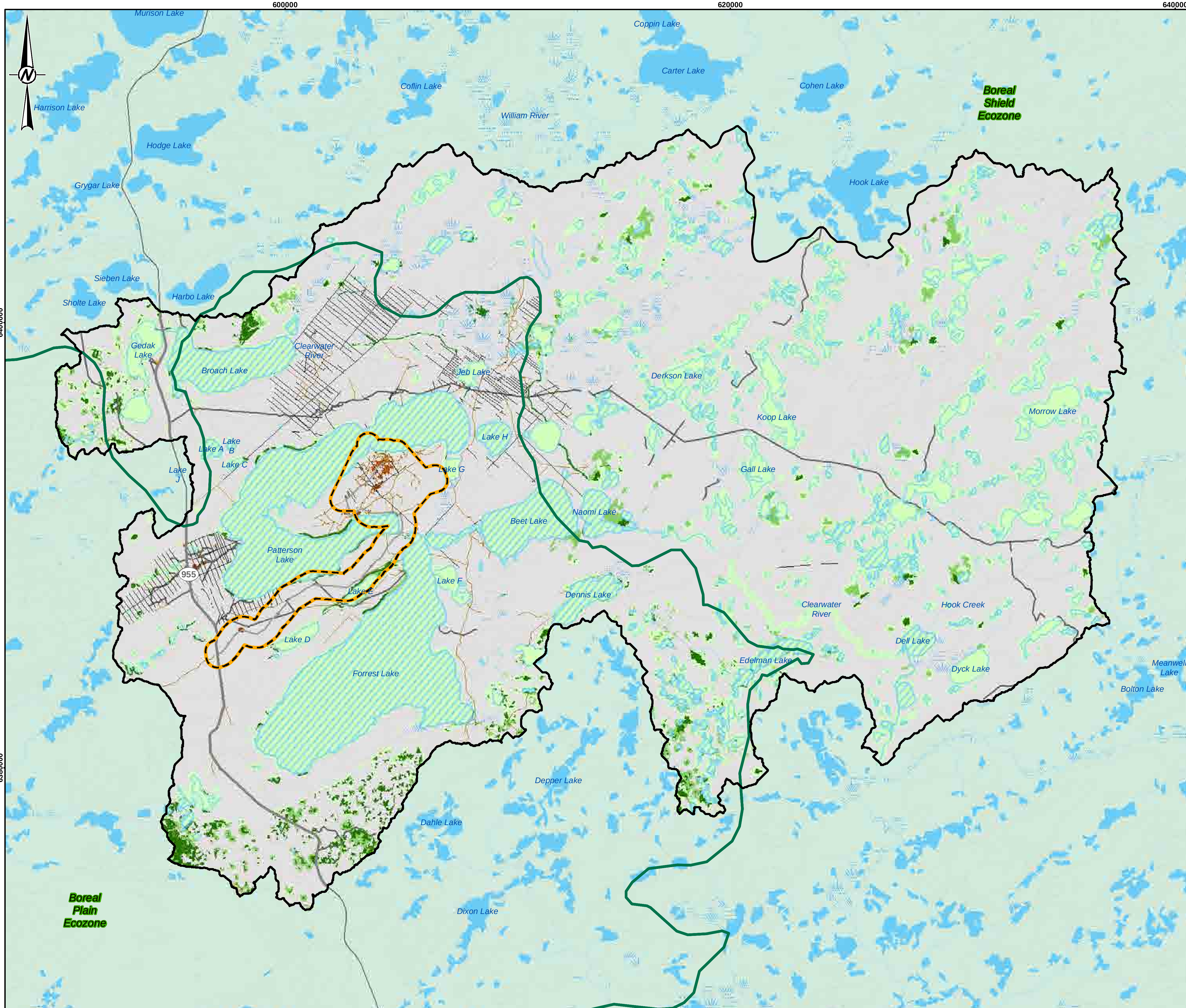
CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-12**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BEAVER LODGE HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.3-13	
REVIEW	JV	2023-02-09		

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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In the RSA, suitable beaver habitat is distributed as follows (Figure 14.3-13):

- high and moderate suitability habitats are concentrated in the southwestern portion of the study area;
- patches of high and moderate suitability habitats in the northwest portion of the RSA, west of Gedak Lake and north of Broach Lake;
- patches of high and moderate suitability habitats in the south-central portion of the RSA, southwest of Dennis Lake;
- patches of high and moderate suitability habitats in the central portion of the RSA, around Naomi Lake and along watercourses north of Naomi Lake; and
- patches of well-connected low suitability habitat scattered throughout the central and eastern portion of the RSA.

The BRDN reported beaver trapping sites within 25 km of the LSA, and noted that the Patterson Lake area supported beaver for trapping in general (TSD III: BRDN). General trapping areas were documented in the RSA by Indigenous Groups. The MN-S reported trapping at Gedak Lake and a trapline was identified between Broach Lake and Patterson Lake, extending east in the RSA (Figure C; Table 1; TSD IV: MN-S). The CRDN documented trapping at Gedak Lake and to the west, at Broach Lake and to the north, at Patterson Lake and between Patterson and Forrest lakes (Figure 4, TSD V.1: CRDN; Figure 20, TSD V.2: CRDN). The Ya'thi Néné Lands and Resources identified the RSA as an important area for furbearers (Figure 10; TSD VI: YNLR).

The prominence of water features (i.e., waterbodies, watercourses, and wetlands) in the LSA and RSA suggests that suitable beaver habitat is well connected at the local and regional scales. Highway 955 may adversely influence the movement and habitat connectivity of beaver during periods of high traffic volume, but movement and connectivity are unlikely constrained by rough roads, trails, and seismic lines / cutlines (Mumma et al. 2018; Scrafford et al. 2020).

Home Range and Dispersal

Average home range size measured for a non-harvested population of beavers in Illinois was 25.5 ha (Bloomquist et al. 2012). A population in the boreal region of Manitoba had an average summer home range of 10.3 ha and an average fall home range of 3.1 ha (Wheatley 1994). Based on this literature, it was assumed that beaver in the RSA have an average annual home range size of 10.3 ha but could vary between 3 ha and 10 ha during the year.

Beavers will generally stay near their lodge sites but have been observed to forage up to 100 m from aquatic habitats (Boyle and Owens 2007). The beaver diet varies seasonally, and the type and abundance of food sources available in an area play an important role in determining beaver distribution (Leary 2012). Beavers have moderate to high mobility, and juveniles will disperse from their natal territories over varying distances. Beavers tend to disperse over longer distances when they have access to free-flowing water (McNew and Woolf 2005), suggesting the important role of surface water networks in enabling travel and maximizing beaver movement potential. For example, a study in Illinois found that on average, beavers dispersed over 5.9 km when they had access to free-flowing water, but dispersal averaged 0.9 km in landlocked colonies (McNew and Woolf 2005).

14.3.5.3 Survival and Reproduction

Vital Rates and Threats

Beavers are monogamous and mate in the winter months of January and February, and kits are generally born in April through June (Hartman 1997; Boyle and Owens 2007). Beavers are strongly territorial animals that live in family groups generally consisting of an adult pair and offspring from one or more breeding seasons (Hartman 1997). Subordinate members of a colony will not become sexually active if a dominant beaver of the same sex is present in the colony (Hartman 1997). Beavers are expected to have the capacity to adapt and be resilient to changes in survival and abundance. The age at first parturition (i.e., birth) varies from two to five years in a typical population, and beavers may respond to population manipulation (i.e., trapping) by becoming sexually mature and dispersing at an earlier age (Nordstrom 1972).

The main limiting factors or threats affecting beaver survival, abundance, and distribution are likely harvest pressure and the availability of suitable habitat. In the Fur Conservation Area overlapping the RSA (N-19), the trapping capture rate was 4,456 individuals between 1985 and 2018, averaging 139.3 individuals per year (Annex VIII.1). Further, many beaver populations across North America have recolonized most areas of their historical range since approaching near extirpation in the early 1900s as a result of over-harvesting during the fur trade (Havens 2013). Indigenous and Local Knowledge about beaver populations varies. The BNDN have noted that beaver populations in the RSA have declined over the past several decades due to forest fires altering their habitat (TSD II: BNDN) and a community member from La Loche; indicated that beavers are fewer now than in the past (NexGen 2019a); however, the MN-S and BRDN commented that beaver populations in general are currently high (TSD III: BRDN; BRDN-JWG 2020a; MN-S-JWG 2020b).

14.3.6 Little Brown Myotis

Little brown myotis is a provincially tracked, secure species as applicable to the breeding and non-breeding population (S4B, S4N) in Saskatchewan (SKCDC 2021; SKCDC 2020). The species is listed as Endangered under Schedule 1 of the federal SARA (Government of Canada 2023). The listing of the species under SARA is due to dramatic population declines caused by white nose syndrome (WNS). White nose syndrome is a deadly fungal disease caused by *Pseudogymnoascus destructans* that affects bats while hibernating and has decimated northeastern North American populations. Prior to the introduction of WNS, little brown myotis was a common bat in Canada and is still common in areas not affected by WNS, such as in northwestern Saskatchewan (Environment Canada 2018). Where hibernacula are infected, WNS has reduced populations by more than 75% (Frick et al. 2010). Mortality rates at infected sites in eastern Ontario were 92% after two years of exposure (COSEWIC 2012). White nose syndrome has been estimated to travel at an average rate of 200 to 400 km per year (COSEWIC 2012). It is anticipated that the entire Canadian population of little brown myotis will be affected by the disease within 11 to 22 years, or possibly sooner based on the recent confirmation of WNS in Washington State (USGS 2016). Little brown myotis is predicted to be functionally extirpated (i.e., less than 1% of existing population remaining) in Canada and the United States by 2030 or sooner (COSEWIC 2012) due to WNS, which is within the lifespan of the Project.

Anthropogenic activities have little control over the spread and potential for extirpation of this species from WNS; therefore, this assessment focuses on effects on little brown myotis mainly from habitat changes and disturbance, which is also a potential threat identified in the recovery strategy for little brown myotis and northern myotis (Environment Canada 2018).

The following subsections describe the existing conditions of little brown myotis habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For little brown myotis, habitat availability is described by habitat associations, natural and sensory disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, and linear disturbance; survival and reproduction are described by home range, vital rates, and disease.

14.3.6.1 Habitat Availability

Habitat Associations

All Canadian bat species have four primary habitat requirements: maternity roosts, foraging areas, swarming sites, and hibernacula (i.e., winter hibernation sites). Maternity roost sites and, especially, hibernacula are considered to be the main limiting habitat features for little brown myotis within their range (COSEWIC 2013).

Little brown myotis is an Endangered species under SARA, and as such, destruction of legally defined critical habitat is prohibited under Section 58(1) of SARA. Critical habitat for little brown myotis has only been partially identified for hibernacula. Critical habitat for maternity roosts, and summer habitat for roosting and foraging, has not yet been formally identified and will be the focus of future research efforts by ECCC (Environment Canada 2018).

Maternity Roosts and Foraging Habitat

Maternity roost sites for little brown myotis are typically in buildings, under bridges, in rock crevices, or in cavities in tall, large-diameter trees that are in the early to middle stages of decay; however, habitat characteristics may differ as knowledge of the biophysical attributes of maternity roosts in western Canada is limited (COSEWIC 2013; Environment Canada 2018). In the LSA and RSA, deciduous trees such as trembling aspen and birch (*Betula* spp.) are the primary species that provide sufficiently large cavities required by females with pre-volant (i.e., not yet able to fly) young (Psyllakis and Brigham 2006; Willis et al. 2006; Park and Broders 2012).

There is contradictory evidence regarding preferred foraging habitat for little brown myotis. Some studies suggest the species preferentially use edge habitat for foraging (COSEWIC 2013), while other studies suggest little brown myotis prefer areas with dense vegetation (i.e., cluttered canopies; Kalcounis and Brigham 1995). The size of the clearing, as well the size of the bat, may influence the use of edge habitat for foraging. Large clearings have more wind and may inhibit efficient foraging by small bats. Large clearings also have different aerial prey species and lower prey abundance than in the forest interior (Kalcounis and Brigham 1995). Other studies have found edges may not be used by little brown myotis as foraging habitat but instead may be used as travel corridors between roosting sites and foraging areas (Kalcounis-Ruepell et al. 2013).

Baseline bat surveys for the Project were completed between late May and early October 2018, and between early May and late September 2020. The group of bat species with high frequency echolocation signals (Eastern red bat, Northern myotis, little brown myotis; Vonhof 2017) and *Myotis* species group (Northern myotis and little brown myotis) were detected most frequently in creek and bog habitats (Annex VIII.3, Wildlife Baseline Report 3 [Bird Migration and Bats]). The high frequency bat species group and *Myotis* species group were also recorded in coniferous forest (Annex VIII.3). The high frequency echolocation signals are expected to primarily be little brown myotis based on known species ranges, abundance, call characteristics, and habitat preferences. Based on these data, it was assumed that creek, bog, and coniferous forest habitat are used for foraging in the RSA.

Hibernacula

In winter, little brown myotis hibernate in caves or abandoned mines where the open and accessible space extends below the frost line, and above 0°C temperatures and high humidity are relatively constant throughout the winter. In northern Saskatchewan, low survey effort and remote conditions have introduced a knowledge gap about hibernacula locations, though known hibernacula occur as far north as the NWT (COSEWIC 2013). Within the Athabasca Basin in northern Saskatchewan, bats have been found within abandoned uranium mine satellite sites being reclaimed by the Saskatchewan Research Council and bats may use these sites as hibernacula (SRC 2019). These abandoned mines are fitted with special gates allowing bats to occupy the inner mine areas while restricting public access (SRC 2019).

Natural hibernacula features, such as rock cliffs, may provide minor hibernacula in the RSA. Minor hibernacula that harbour smaller concentrations of bats are poorly understood but have the potential to play a critical role in the recovery of the population from WNS. A total of 192 hibernacula have been identified in Canada as critical habitat required for the survival and recovery of the species, recognizing that this likely represents a small fraction of all occupied hibernacula (Environment Canada 2018). A map of known hibernacula has been created by ECCC and is included in the Recovery Strategy (Environment Canada 2018). No known hibernacula identified by ECCC are within Saskatchewan; however, this represents a data gap rather than a documented absence of features (Environment Canada 2018).

Terrain in the majority (79%) of the LSA consists of an undulating to hummocky upland landscape with high relief and a dominant surface stoniness class of “very stony” (i.e., 3% to 15% of ground surface covered; Section 12.3.1, Surficial Material Distribution). The LSA is dominated by soils that are classified as having predominantly sand or loamy sand textures (Section 12.3.2, Terrain and Slope Stability). Given the physical properties of the LSA, it has low potential to harbour natural features such as caves or rock cliffs that could provide suitable sites for hibernacula. The LSA does not contain underground mines, which are also used as hibernacula.

Most of the known hibernating bats of a region are typically found in only a few hibernacula. Industrial activities in close proximity to hibernacula can degrade habitat quality by altering its microclimatic characteristics (USFWS 2007). Because of the aggregation (i.e., grouping) nature of this species, disturbance of hibernacula can have a disproportionately high effect on local populations.

Little brown myotis and northern myotis mate during a late summer or fall “swarming period” prior to hibernation (COSEWIC 2013). No bat detectors recorded a spike indicative of the swarming period prior to hibernation (COSEWIC 2013); detecting such an activity pattern could indicate the presence of a nearby hibernaculum. Therefore, given the low potential for caves in the LSA, the likelihood of hibernacula near the Project was assumed to be currently low, though this is not certain since there is the potential for between year variability in the use of hibernacula.

Natural and Sensory Disturbance

Foraging (i.e., edge) habitat for little brown myotis is common in the boreal forest, and roosting habitat is therefore considered the most limiting factor for bats in the LSA and RSA during the non-hibernation period. Forest fire in the RSA has likely led to changes in the amount of potential foraging and roosting habitat for little brown myotis. A total of 1,838.5 ha (64.9%) of the LSA and 61,996.5 ha (57.7%) of the RSA has been burned within the past 40 years (Section 13.2.6.1.4; Figure 13.2-5). Loss of mature forest habitat generally leads to negative effects on many bat species, and little brown myotis was found to be more abundant in old versus young forest types in Alberta and central Ontario (Jung et al. 1999; COSEWIC 2013). The addition of human infrastructure such as bridges and buildings would likely have added some potential roosting opportunities in the RSA.

Sensory disturbance from existing developments may temporarily result in avoidance of maternity roosting habitat by little brown myotis. Noise frequencies that overlap with the little brown myotis echolocation frequency range (i.e., approximately 40 kHz to 70 kHz) are expected to have the greatest effect on this species. Harrison (1965) found that little brown myotis did not respond to frequencies above 40 kHz when in torpor (i.e., while roosting). A study by Luo et al. (2014) found bats were more sensitive to noise when it occurred closer to sunset as opposed to earlier in the daily roosting period. Bats also responded least to traffic noise and most to vegetation noise (e.g., rustling of leaves), possibly because traffic noise was at a lower frequency than the range of hearing in bats. Bats may rapidly become habituated to repeated and prolonged noise exposure (e.g., bats roosting under bridges; Luo et al. 2014).

Noise has been found to negatively affect foraging by passive-listening bat species (i.e., bats that rely on listening for prey-produced sounds to find food [e.g., *Myotis myotis*]; Schaub et al. 2008), especially when noise frequencies occur at the same frequency as prey noises (Jones 2008; Schaub et al. 2008; Siemers and Schaub 2011). Consequently, passive-listening bats have been found to avoid areas with high noise levels (e.g., adjacent to highways; Schaub et al. 2008). However, echolocating species, such as little brown myotis, have been found to adapt the amplitude and duration of their calls to the ambient noise level of an environment (Luo and Wiegrebe 2016). Based on the literature, it was predicted that in the Base Case in the LSA, little brown myotis are periodically disturbed from foraging and roosting by irregular disturbance associated with exploration activities.

Habitat Suitability

Suitable roosting habitat was identified and mapped at Base Case as per the methods detailed in Appendix 14B. The mapping included potential effects from sensory disturbance (e.g., noise, presence of people) on habitat quality by applying a ZOI to disturbances with expected high activity levels (i.e., Highway 955, existing access road for the Project, exploration activities). The resulting habitat suitability model suggests that the LSA and RSA contain limited suitable roosting habitat. The LSA has no high suitability roosting habitat, 16.9 ha (0.6%) of moderate suitability roosting habitat, and 11.2 ha of low suitability habitat (Table 14.3-11). In the RSA, high and moderate suitability roosting habitat are estimated at 127.8 ha (0.1%) and 989.5 ha (0.9%), respectively (Table 14.3-11). Low suitability roosting habitat represents 21,087.7 ha or 19.6% of the RSA. High, moderate, and low suitability lodge habitat represent 22,198.0 ha (20.7%) of the RSA in the Base Case.

The majority of the LSA and RSA consist of poor suitability roosting habitat under existing conditions. The small amount of suitable roosting habitat is primarily a result of over half of upland vegetation ecosites in the LSA and RSA having been burned by forest fires in the last 40 years. Burned uplands cover 63.7% of the LSA and 51.8% of the RSA (Section 13.3.1.1). Further, there is a limited amount of mature deciduous and mixed forest in the LSA and RSA (Section 13.3.1.1, Table 13.3-1).

Table 14.3-11: Little Brown Myotis Roosting Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	0.0	0.0	127.8	0.1
Moderate	16.9	0.6	989.5	0.9
Low	318.4	11.2	21,080.7	19.6
Poor	2,496.2	88.2	85,292.7	79.3
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.6.2 Habitat Distribution

Habitat Arrangement and Connectivity

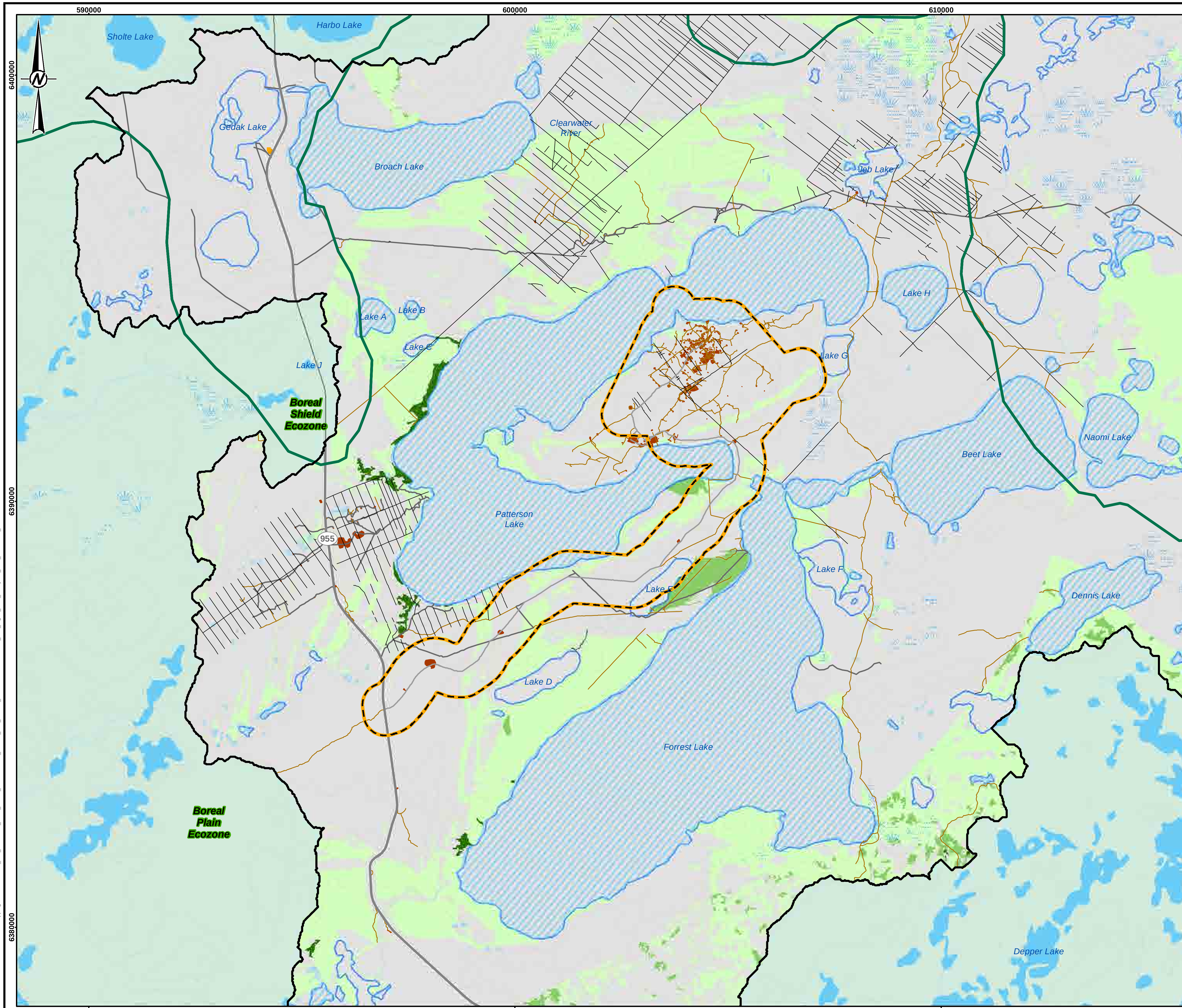
Little brown myotis occurs in every province and territory in Canada (except Nunavut) and approximately 50% of the species' global range is within Canada (Environment Canada 2018). In Saskatchewan, little brown myotis range extends across the province and as far north as Reindeer Lake in the northeast and Lake Athabasca in the northwest. Little brown myotis is a regional migrant and can move hundreds of kilometres between summer and winter areas (Fenton 1969; Kurta and Murray 2002; Norquay et al. 2013).

In the Base Case, suitable roosting habitat for little brown myotis is limited in the LSA and RSA (Figure 14.3-14 and Figure 14.3-15). In the LSA, moderate suitability habitat includes a small patch of mature pine-dominant mixed forest (BP04) south of Patterson Lake South Arm (Figure 14.3-14). Low suitability habitat is distributed as patches of connected mature coniferous forest and treed wetlands in the southern and central portions of the LSA and an isolated narrow strip west of Lake G. Small patches unconnected low suitability habitat are also located along the south shore of the Patterson Lake North Arm.

In the RSA, suitable little brown myotis roosting habitat is distributed as follows (Figure 14.3-15):

- a few patches of high suitability roosting habitat in the western portion of the RSA, west of Patterson Lake and East of Highway 955;
- very small patches of high suitability roosting habitat in the northeast portion of the RSA;
- large patches of moderate suitability roosting habitat near the LSA, by Forrest and Patterson lakes;
- patchy occurrences of moderate suitability roosting habitat along the southwestern and south-central boundaries of the RSA;
- large, connected patches of low suitability roosting habitat in the northeastern portion of the RSA;
- a large contiguous patch of low suitability habitat in the central portion of the RSA east of Naomi Lake;
- a large patch of low suitability habitat between Broach and Patterson lakes and a large patch north of these lakes; and
- moderate-sized patches of low suitability roosting habitat along the west, south, and east shores of Forrest Lake.

It is assumed that suitable habitat is mostly connected in the RSA as little brown myotis are highly mobile and can fly through poor suitability burned habitat that is interspersed among patches of low suitability and high suitability habitats (Figure 14.3-15).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

LITTLE BROWN MYOTIS ROOSTING HABITAT IN THE LOCAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-14**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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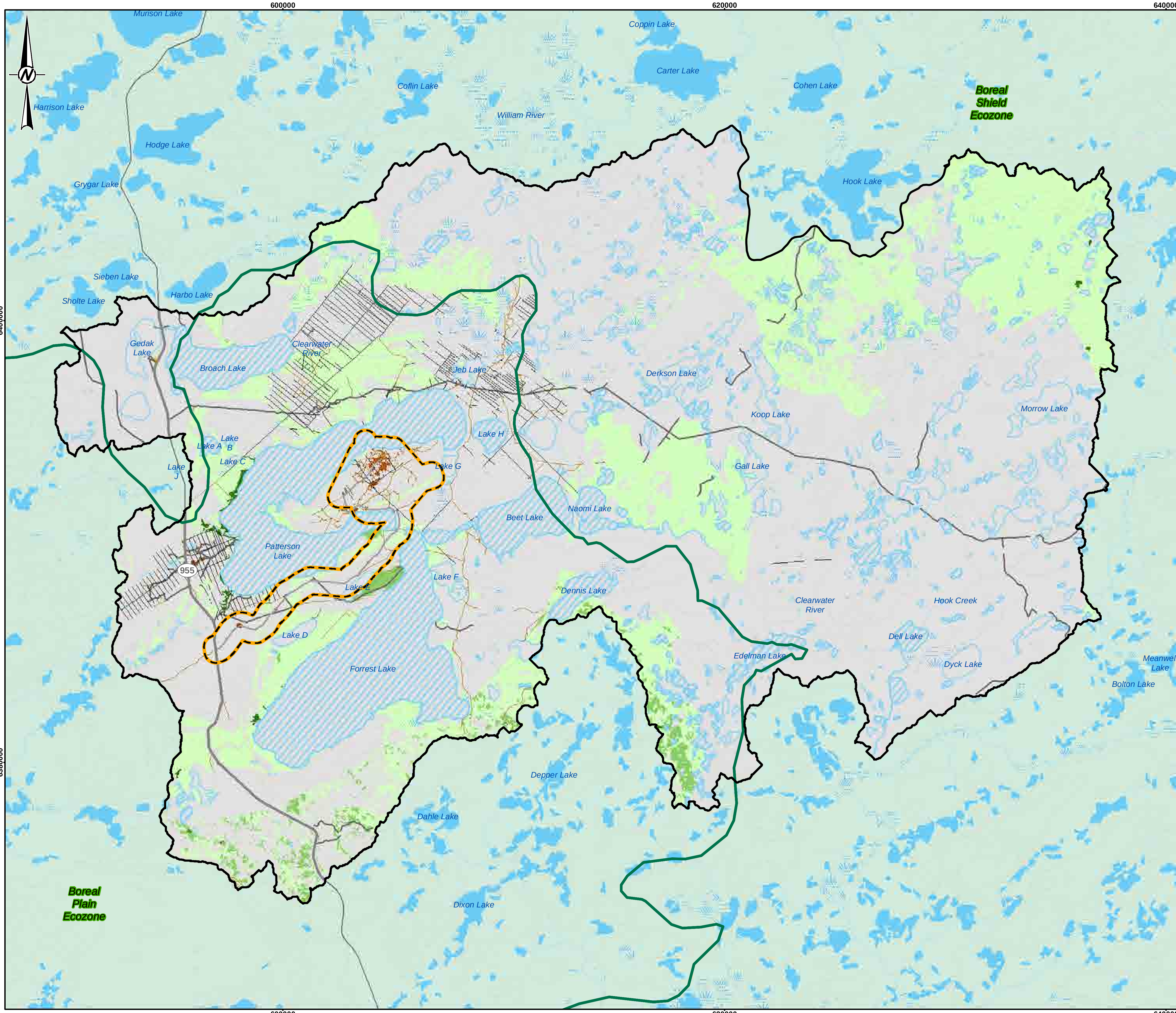

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
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- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

LITTLE BROWN MYOTIS ROOSTING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-15**	
REVIEW	JV	2023-02-09		

25mm

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Linear Features

Bats have been found to avoid areas of high sensory disturbance (e.g., roads, facilities) because it can interfere with echolocation (Jones 2008; Schaub et al. 2008). Areas of high sensory disturbance can influence bat movement patterns and disrupt or alter migratory or foraging movements (Fensome and Mathews 2016). However, bats have also been found to follow linear forest features for commuting and foraging, and little brown myotis are tolerant of linear disturbance, even when associated with noise (e.g., traffic on roads; Abbott et al. 2012). The effects of edges and corridors on little brown myotis are unclear but a number of studies suggest that forest fragmentation may be beneficial for little brown myotis (Broders and Forbes 2004; Broders et al. 2006; Ethier and Fahrig 2011; Jantzen and Fenton 2013; Segers and Broders 2014). Other studies have found that little brown myotis prefer closed and cluttered canopy areas and avoid edges (Kalcounis and Brigham 1995; Jung et al. 1999; Morris et al. 2010).

Linear disturbance features may act as barriers to bats because some species are reluctant to cross open ground and some species avoid areas with lights such as roads (Altringham and Berthinussen n.d.). Bats that forage in open air space, such as little brown myotis, appear to be less sensitive to barrier effects from linear disturbances than species that glean prey from vegetation (Kerth and Melber 2009; Fensome and Mathews 2016). Studies in Alberta found little brown myotis travelled 2 to 2.5 times less in the centre of forested habitat than through the forest edges or along retained stands of trees within a clearcut block (COSEWIC 2013). Roads are thought to have greater barrier effects on bats than other linear disturbance such as rail lines and transmission lines because roads are usually wider and have higher vehicle traffic volume (Altringham and Berthinussen n.d.).

Existing anthropogenic disturbance is aggregated in the northwest portion of the RSA, overlapping the LSA, and includes infrastructure and activities such as Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. In the Base Case, Highway 955 may adversely influence movement of little brown myotis, particularly during periods of high traffic volume. Other linear features in the LSA and RSA have little activity and likely do not function as dispersal barriers for this species because bats are highly mobile and can travel long distances each night. The existing trails, seismic lines, and cutlines in the RSA may also be providing commuting and foraging habitat for little brown myotis.

14.3.6.3 Survival and Reproduction

Home Range

The average home range for little brown myotis is unknown in northern Saskatchewan; however, Owen et al. (2003) recorded mean female northern myotis home ranges of 65 ha in a population in West Virginia. Henry et al. (2002) found that home range size in pregnant little brown myotis in Quebec was 30.1 ha (±15 ha standard deviation), and 17.6 ha (±9.1 ha standard deviation) for lactating females. Since bat species are known to share roosting trees and home ranges, each home range would theoretically contain several individuals if the habitat is fully occupied. Home range size of little brown myotis in the RSA was assumed to be between 17 ha and 65 ha.

Vital Rates

Little brown myotis are long-lived but only give birth to one pup per year (Fenton and Barclay 1980; Kunz and Reichard 2010), making their populations sensitive to increases in adult mortality and slow to recover when the population size is small. Females may be reproductively active during their first year of life and reproductive rate (i.e., proportion of females in breeding condition) was high in a study conducted in New Hampshire (87% to 99%;

Frick et al. 2010). Individuals of this species have been recorded to live over 30 years (Fenton and Barclay 1980), though the average life span is thought to be shorter (COSEWIC 2013). Reproductive rates seem to decline with increasing latitude; a reproductive rate of more than 96% was recorded in the eastern United States, with lower rates of 42% to 57% in British Columbia (COSEWIC 2013). Survival rates are lowest in the first year of age because juveniles often lack sufficient fat reserves needed for hibernation (COSEWIC 2013).

Disturbances to little brown myotis during hibernation can be caused by industrial activities. Noise and vibration from industrial activities have the potential to disturb hibernating bats, or to otherwise interfere with their behaviour by masking echolocation and hearing (Schaub et al. 2008, Siemers and Schaub 2011). Echolocating species, such as little brown myotis, may be less sensitive to sensory disturbance during foraging than passive-listening species as echolocating species can adjust the amplitude and duration of their calls to the ambient noise level of an environment (Luo and Wiegrebe 2016). Sensory disturbance can disrupt bat commuting behaviour, which can increase flight time and stress; increase predation risk; reduce foraging time; and reduce growth and survival of juveniles because of the increase in time that the mother is away from the roost for foraging (Tuttle 1976; Papadatou et al. 2011). Survival and reproduction in bats can decline if the bats are disrupted by noise or light disturbance during hibernation or during the rearing of pups (Thomas 1995; Boldogh et al. 2007; McCracken 2011). In the Base Case, it was assumed that sensory disturbance could be having some minor effects on survival and reproduction of little brown myotis in the western portion of the RSA where there is more anthropogenic disturbance.

Little brown myotis are also vulnerable to persecution because of their tendency to use anthropogenic structures, such as buildings (Environment Canada 2018). This was expected to be less of a factor affecting little brown myotis survival in the RSA in the Base Case, as the density of anthropogenic structures is low.

Disease

If the spread of WNS continues at its current rate, the entire Canadian range of little brown myotis is expected to be affected by WNS between 2025 and 2028 (COSEWIC 2013). Little brown myotis is predicted to be functionally extirpated (i.e., less than 1% of existing population or 65,000 individuals) in the northeastern United States within 15 years (Frick et al. 2010), though low numbers of individuals have been recently found to survive the infection, and survival rates are increasing in areas of previous infection (Environment Canada 2018). A positive population growth trend as a result of these increased rates of survival is not predicted (Maslo et al. 2015). Because WNS results in substantial declines in bat survival once a colony is infected, the resiliency of little brown myotis populations in the RSA is expected to be very low once the disease has spread to the area. Should WNS spread to Saskatchewan and the RSA, little brown myotis is expected to rapidly exceed its limits of resilience and adaptability. As of 15 September 2021, the fungus that causes WNS in bats had been detected in eastern Saskatchewan, suggesting that the disease could be soon affecting Saskatchewan populations (Global News 2021).

14.3.7 Olive-Sided Flycatcher

The status of olive-sided flycatcher under Schedule 1 of the SARA was recently updated from Threatened to Special Concern (Government of Canada 2023) and was previously down-listed to Special Concern by COSEWIC in recognition that population declines have slowed in recent decades (COSEWIC 2018). The species is a provincially tracked S4B, S4M species, indicating that breeding and migratory populations are apparently secure. The population objective for olive-sided flycatcher identified in the federal recovery strategy is to halt the national decline by 2025, with no more than a 10% decline during this time, and to provide a 10-year positive population trend thereafter (Environment Canada 2016). An estimated 900,000 individuals breed in

Canada, which is considered adequate to sustain the Canadian population or increase species abundance with the implementation of appropriate conservation measures (Environment Canada 2016). Olive-sided flycatcher is listed as a priority species under the federal Bird Conservation Strategy for the Bird Conservation Region 6: Boreal Taiga Plains (BCR 6), which covers the RSA, due to the species being listed under the SARA and assessed by COSEWIC and national/continental conservation concerns (Environment Canada 2013b; Environment Canada 2014). The population objective for the region is consistent with the recovery objective for the species (Environment Canada 2013b; Environment Canada 2014).

The following subsections describe the existing conditions of olive-sided flycatcher habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For olive-sided flycatcher, habitat availability is described by habitat associations, natural and anthropogenic disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, and linear features; survival and reproduction are described by breeding territory and population status, and vital rates and threats.

14.3.7.1 Habitat Availability

Habitat Associations

Olive-sided flycatchers prefer tall trees and snags adjacent to open areas, which provide individuals with perches from which they hunt flying insects (COSEWIC 2018). Olive-sided flycatchers nest in forested stands but, because of their foraging behaviour, are associated with high contrast habitats including burned forests, logged areas, and natural forest openings such as gaps, meadows, rivers, and wetlands (Altman and Sallabanks 2012). As a result, the abundance of olive-sided flycatcher is correlated with landscapes containing fragmented late seral forest with high-contrast edges (Altman and Sallabanks 2020).

During baseline surveys for the Project, 13 olive-sided flycatchers were detected at 12 locations, with most (10 of 12 locations) near large waterbodies (Patterson Lake and Forrest Lake) or along creeks and bogs with sparse vegetation in the adjacent uplands (Annex VIII.2). Habitat types known to have the potential to support olive-sided flycatchers were fairly common and widespread in the LSA and areas surrounding Patterson Lake (Annex VIII.2).

Natural and Anthropogenic Disturbance

Decades of fire suppression in northern Canada have resulted in longer fire intervals and less availability of high-quality burned habitat for olive-sided flycatcher (COSEWIC 2018). However, the wildfire regime in the RSA is more characteristic of the fire regime in the Boreal Shield, where wildfires are the dominant agent of disturbance, than in the Boreal Plain (Boulanger et al. 2014; Boucher et al. 2018; McLoughlin et al. 2019). A total of 1,838.5 ha (64.9%) of the LSA and 61,996.5 ha (57.7%) of the RSA has been burned within the past 40 years (Section 13.2.6.1.4; Figure 13.2-5). In fire-dependent ecosystems, olive-sided flycatcher abundance is often higher in early post-fire communities than in other habitat types (Hutto and Young 1999; Robertson and Hutto 2007; Altman and Sallabanks 2012; Environment Canada 2016; COSEWIC 2018). In western Canada, olive-sided flycatchers are often associated with early to mid-successional post-disturbance coniferous forest with tall snags and residual live trees, mixed forests with canopy openings, and old growth forests (Schieck and Song 2006; COSEWIC 2018).

A study of olive-sided flycatcher in the Peace River region of British Columbia found that small forest clearings of less than 10 ha within mature forest were preferred; however, the species was found to occur in clearings up to 284 ha in size where tall, standing snags were available (Norris et al. 2021). In Saskatchewan, olive-sided flycatcher was found to be more abundant in burned forests than in unburned forests (Morissette et al. 2002).

Olive-sided flycatcher was found to be positively influenced by fire in a study completed in the boreal forest of the NWT (Knaggs et al. 2020). Generally, the net effects of natural disturbance can result in more suitable habitat than was historically available for olive-sided flycatcher because recent burn openings in the RSA are expected to provide suitable contrast habitat adjacent to mature forest. However, burned areas greater than 284 ha in size, typical of those found in the RSA, are generally considered lower suitability than smaller burn openings.

Anthropogenic disturbances can result in positive and negative changes to olive-sided flycatcher habitat. Vegetation clearing can improve habitat around the disturbance perimeter by creating edge habitats that are positively associated with flycatcher abundance (McGarigal and McComb 1995).

Existing sensory disturbance from traffic along Highway 955, traffic on the existing access road, and exploration activities were assumed to be causing indirect habitat loss in the Base Case. Bayne et al. (2008) found that noise from compressor stations had negative effects on boreal songbird abundance within 300 m of the noise source. McClure et al. (2013) found that during fall migration, road noise between 37 dBA and 57 dBA resulted in adjacent habitat avoidance by multiple bird species. The ENV Activity Restriction Guidelines for Sensitive Species (ENV 2017) recommends a 50 m to 300 m setback distance (dependent on the activity type), which indicates there is a 50 m to 300 m zone of influence (depending on the type of disturbance) where habitat is less suitable for olive-side flycatcher because of anthropogenic activity. The setback distances were used to categorize habitat suitability for mapping nesting habitat (Appendix 14B) and the habitat in the zones of influence was reduced to poor suitability so that effects were not underestimated. However, the areas within the zones of influence are not considered to be impermeable barriers to movement, or to never be occupied, by olive-sided flycatcher. Therefore, for the Base Case, it was assumed that olive-sided flycatcher avoid high disturbance activities by 300 m (e.g., Highway 955 and the existing access road) and medium disturbance activities by 150 m (e.g., exploration activities) or 50 m (e.g., trails, cutlines / seismic lines) (Appendix 14B; ENV 2017).

Habitat Suitability

Suitable olive-sided flycatcher nesting habitat was identified and mapped at Base Case as per the methods detailed in Appendix 14B. The mapping included potential effects from sensory disturbance (e.g., noise, presence of people) on habitat quality by applying ZOIs to disturbances with expected high and moderate activity levels (i.e., Highway 955, existing access road, cutlines / seismic lines, rough roads, trails). The LSA has an estimated 23.1 ha (0.8%) of high suitability nesting habitat, 173.8 ha (6.1%) of moderate suitability nesting habitat, and 852.1 ha (30.1%) of low suitability nesting habitat (Table 14.3-12). The RSA has similar relative proportions of high, moderate, and low suitability habitat. (Table 14.3-12). High, moderate, and low suitability nesting habitat represent 69,685.2 ha (64.8%) of the RSA. Early (young) and late-stage (immature) regeneration ecosites comprise the majority of high and low suitability habitat within the LSA and RSA for olive-sided flycatcher. Suitable olive-sided flycatcher nesting habitat appears to be common in the RSA and relatively less abundant in the LSA.

Table 14.3-12: Olive-sided Flycatcher Nesting Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	23.1	0.8	3,750.6	3.5
Moderate	173.8	6.1	20,896.1	19.4
Low	852.1	30.1	45,038.5	41.9
Poor	1,782.6	63.0	37,805.5	35.2
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

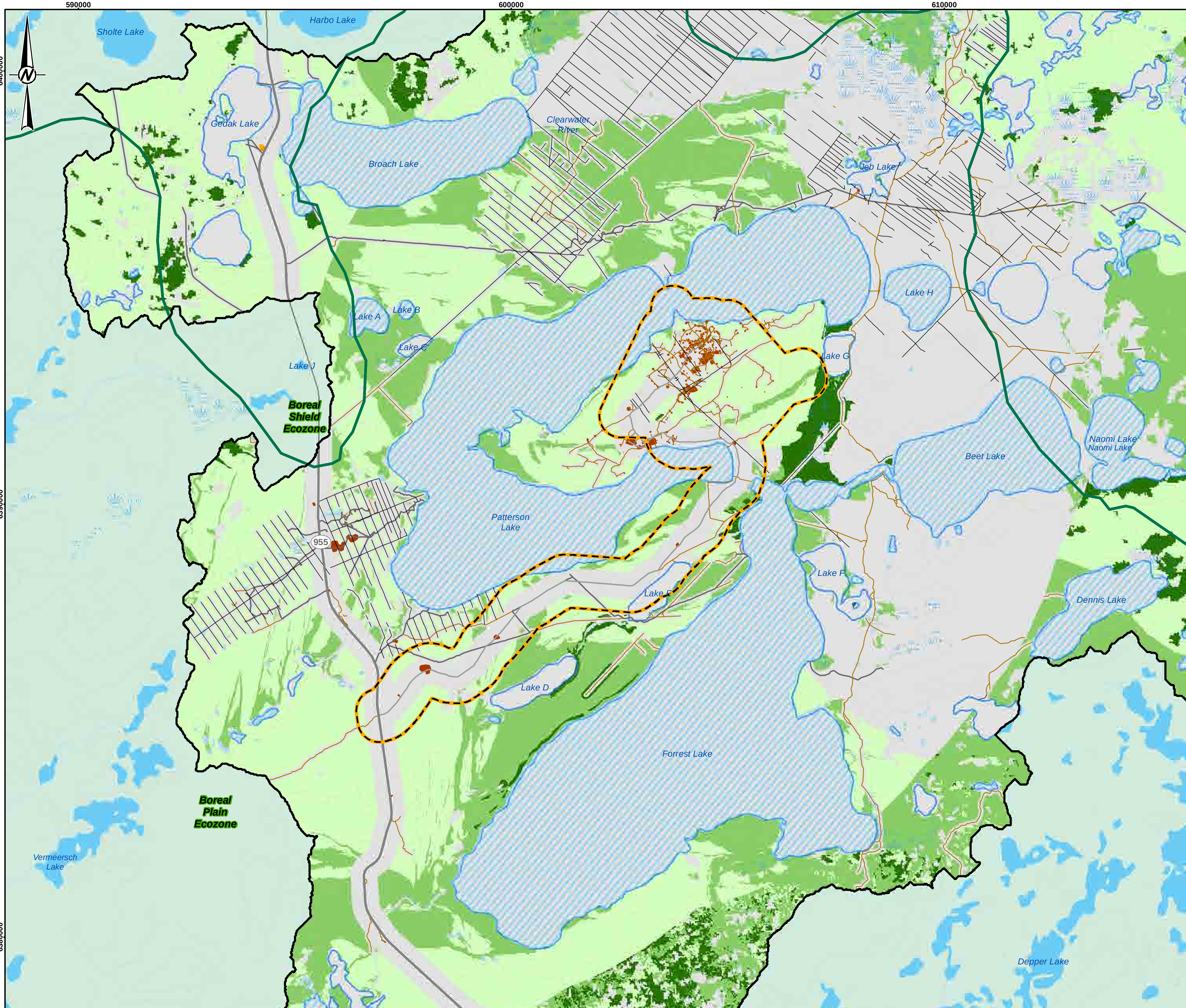
14.3.7.2 Habitat Distribution

Habitat Arrangement and Connectivity

Olive-sided flycatcher is a common summer resident of the Boreal Shield of Saskatchewan (Smith 1996), though locally and patchily distributed, and is generally found at low densities throughout its range in Canada (COSEWIC 2018). The importance of habitat distribution and connectivity for olive-sided flycatcher is largely unknown (Environment Canada 2016). McGarigal and McComb (1995) found that olive-sided flycatcher abundance is positively associated with forest edge and fragmentation. Similarly, point count data collected across Canada indicate that mature conifer stands within patchy landscapes support the highest densities of the species (Environment Canada 2016). A review of the status of land birds in the Boreal Plains Ecozone of Alberta determined that the abundance of olive-sided flycatcher peaked in landscapes with a human footprint of approximately 40% (ABMI 2012).

As an edge-adapted species, olive-sided flycatcher is thought to benefit from habitat fragmentation. Studies report positive numerical response to some types of harvested forest (Altman and Sallabanks 2012). However, Haché et al. (2014) found that roadside surveys overestimate olive-sided flycatcher density supporting the association of this species with edge habitat. Olive-sided flycatchers may perceive large forest clearings, such as those associated with larger developments, as a barrier to movement (Desrochers and Hannon 1997; St. Clair et al. 1998).

Moderate and high suitability olive-sided flycatcher nesting habitat is limited to very small patches within the LSA under existing conditions (Figure 14.3-16). Small areas of high suitability habitat are patchily distributed throughout the RSA, with a more prominent patch associated with moderate suitability habitat patches located in the southwest portion of the RSA (Figure 14.3-17). Larger tracts of moderate suitability habitat are found in the northeast and central portions of the RSA, with additional patches located throughout the western portion of the RSA (Figure 14.3-17). Low suitability is continuous around the shore of Patterson Lake and northeastern portion of the LSA (Figure 14.3-16), and common and well distributed in the RSA (Figure 14.3-17). Poor suitability habitat is concentrated on the west side of the RSA; a recent burn associated with a 2017 wildfire that extends east of Patterson and Forrest lakes also represents poor suitability habitat (Figure 14.3-17).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

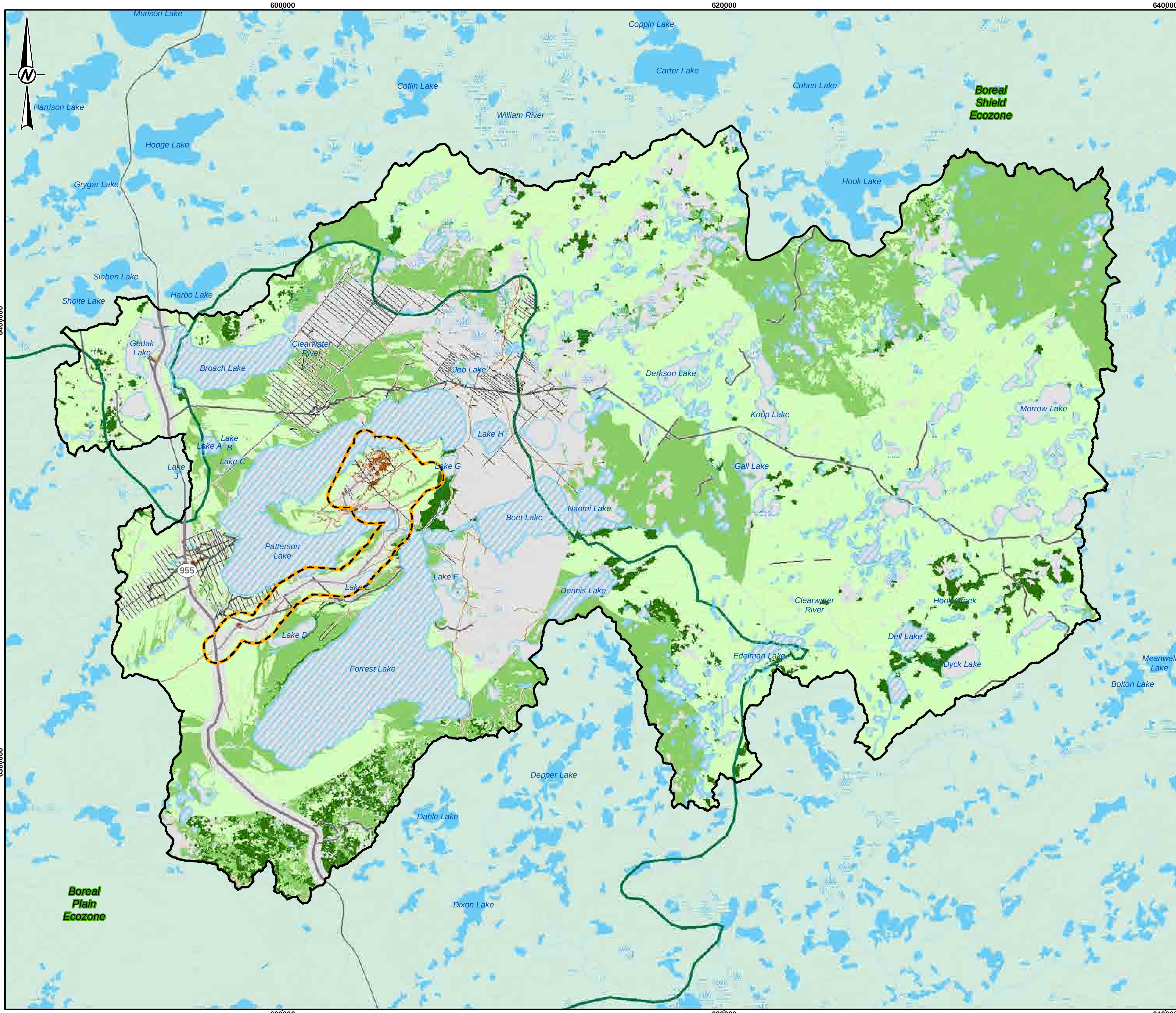
OLIVE-SIDED FLYCATCHER NESTING HABITAT IN THE LOCAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.3-16	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
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- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

OLIVE-SIDED FLYCATCHER NESTING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-17**	
REVIEW	JV	2023-02-09		

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Linear Features

Discrete, isolated disturbances (i.e., poor suitability habitat) are not believed to represent major barriers to movement since olive-sided flycatcher are highly mobile and can fly around or over these areas. Haché et al. (2014) found olive-sided flycatchers to be negatively affected by linear disturbances but the mechanism underlying this response was unclear. Linear disturbances may also influence songbird territory establishment and delineation (Machtans 2006; Ashenhurst and Hannon 2008). Other studies have shown that narrow linear disturbances such as cutlines / seismic lines, trails, and access roads generally do not represent barriers to bird movement (Desrochers and Hannon 1997; St. Clair et al. 1998). The Bolton Lake Wilderness Retreat Resort Lodge trail (i.e., rough road traversing the RSA east–west) is expected to be used primarily during the non-breeding period (i.e., winter season; Bolton Lake Wilderness Retreat 2021) and would likely not influence the movements of olive-sided flycatcher in the RSA (Figure 14.3-17). Highway 955 may adversely influence of the movement and habitat connectivity of olive-sided flycatcher, particularly during periods of high traffic volume. Based on these studies, it was assumed that movements of olive-sided flycatcher are locally influenced by the existing access road and exploration disturbance in the LSA. Overall, existing anthropogenic disturbance is low (0.4%) in the RSA and aggregated in the northwest portion of the study area; it was assumed that most linear features in the RSA (i.e., trails, rough roads, and seismic / cutlines) do not functionally affect the movement and habitat connectivity of olive-sided flycatcher in the Base Case.

14.3.7.3 Survival and Reproduction

Breeding Territory and Population Status

Territory size for olive-sided flycatcher breeding pairs ranges from 10 ha to 45 ha with an average value of approximately 15 ha (Altman and Sallabanks 2020). Breeding territory size typically increases with decreasing habitat quality, such as food abundance (Haché et al. 2013). Under existing conditions, low suitability habitat comprises 65% of suitable nesting habitat in the RSA; moderate and high suitability habitat represent 30% and 5% of nesting habitat, respectively (Table 14.3-11; Section 14.3.7.1, Habitat Availability). In the Base Case, it was assumed that olive-sided flycatcher breeding territory size approaches the upper value reported by Altman and Sallabanks (2020; i.e., 45 ha).

Olive-sided flycatchers have high breeding-site fidelity (i.e., individuals nest in the same area year after year; Altman and Sallabanks 2012) and the loss of potential suitable habitat may affect reproductive success if individuals are displaced into lower quality habitat or if there is a large decrease in the amount of suitable habitat. The effects of sensory disturbance on olive-sided flycatcher are largely unknown, but sensory disturbance may potentially affect reproductive success and survival of some individuals as a result of reduced abundance and pairing success (Habib et al. 2007; Bayne et al. 2008).

The BNDN and BRDN have noted a decrease in the populations of birds in general (TSD II: BNDN; TSD III: BRDN). An analysis of breeding bird survey data indicated an annual rate of decline in olive-sided flycatcher population size in Canada of approximately 1.94% between 1970 and 2019 (Smith et al. 2020). A 1.9% annual rate of decline corresponds to an approximate 61.6% decline in the Canadian population since 1970 (Smith et al. 2020). However, the magnitude in the decrease has lessened in recent years (Government of Canada 2015a; Smith et al. 2020). A decrease in magnitude of population declines is consistent with analyses completed by the Boreal Avian Monitoring Project, which found no evidence for a decline in olive-sided flycatcher density across Canada between 1997 and 2013 (Haché et al. 2014). Therefore, it was assumed that the population of olive-sided flycatcher in the RSA is likely stable in the Base Case.

Vital Rates and Threats

Noise levels above 48 dBA have been shown to result in reduced abundance and pairing success of some other songbird species (Habib et al. 2007; Bayne et al. 2008), and the effects of noise on olive-sided flycatcher are likely similar. The ECCC (ECCC 2019) indicate that noise levels more than 50 dBA or 10 dBA above ambient (i.e., background) noise can negatively affect birds. Other potential effects from noise could include interference with communication (e.g., reducing ability to hear approaching predators or intraspecific vocalizations; Ortega 2012). Average existing ambient nighttime and daytime noise levels in the noise RSA (which covers the wildlife LSA and extends into the RSA) ranged from 21 dBA during the night to 42 dBA during the day (Section 7.3.3). Therefore, for the Base Case, it was assumed that noise levels of existing activities are likely having little to no influence on olive-sided flycatcher abundance.

The main threats to olive-sided flycatcher populations include habitat loss or degradation, fire suppression, and reduced availability of insect prey (Environment Canada 2016). Fire suppression is understood to be limited in the RSA and was not predicted to be a threat to olive-sided flycatcher habitat and populations in the RSA based on the existing fire regime (Section 14.3.7.1). It is currently unknown whether availability of breeding habitat is a limiting factor for this species (Environment Canada 2016). However, olive-sided flycatcher was detected throughout the LSA and surrounding area around Patterson Lake with 13 observations at 12 survey sites during the breeding bird survey (Annex VIII.2).

Some studies suggest that deforestation on tropical wintering grounds may be a key factor in the historical decline of this species (Petit et al. 1993; Altman and Sallabanks 2012). Other factors may be affecting olive-sided flycatcher on their migration routes. A decline in aerial insect abundance from habitat loss, pesticide use, and climate-induced changes to the timing of insect emergence on olive-sided flycatcher breeding grounds may also contribute to the abundance of the species (Environment Canada 2016). Olive-sided flycatcher may be particularly susceptible to these factors because the species has low reproductive potential compared to other passerines and the longest migration distance of all flycatchers (Environment Canada 2016). In the Base Case, it was assumed that olive-sided flycatcher survival and reproduction likely support a stable population given the current change in status from Threatened to Special Concern (COSEWIC 2018; Government of Canada 2023), the availability of suitable nesting habitat in the RSA (Figure 14.3-17), and the results of the baseline surveys.

14.3.8 Rusty Blackbird

Rusty blackbird is a federally listed species under Schedule 1 of the SARA as Special Concern and is a provincially tracked S3B, SUN, S3M species, indicating that the species’ breeding and migratory populations are vulnerable/rare to uncommon but there is uncertainty in the non-breeding population status (Government of Canada 2023; SKCDC 2021; SKCDC 2020). The Canadian population of rusty blackbird is estimated at approximately 4.4 million individuals, which represents approximately 86% of the global breeding population (COSEWIC 2017).

The following subsections describe the existing conditions of rusty blackbird habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For rusty blackbird, habitat availability is described by habitat associations, anthropogenic and natural disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, and non-linear and linear features; survival and reproduction are described by breeding territory, population status, and vital rates.

14.3.8.1 Habitat Availability

Habitat Associations

Rusty blackbirds usually select wooded wetlands for breeding habitat, preferring peat bogs, treed fens, swamps, sedge meadows, and marshes (COSEWIC 2017; Avery 2020). Rusty blackbirds breed in isolated, low-elevation wetlands in coniferous and mixed forest habitats across the boreal region to the northern edge of the tundra. The species will also use shrubby riparian areas along the edges of lakes, beaver impoundments, rivers, and other watercourses in coniferous and mixed forests, as well as early successional habitats created by natural disturbances such as fire (COSEWIC 2017; Avery 2020). In Saskatchewan, rusty blackbirds are a common summer resident in bogs and fens (Smith 1996).

During baseline surveys for the Project, four rusty blackbirds were detected among three locations (Annex VIII.2). One location was in a mixture of young and mature upland coniferous forest within 150 m of a wetland (shrubby bog; one observation). Another location was at the intersection of mature coniferous forest and a late-stage regenerating wetland (treed bog) adjacent to Patterson Lake (two observations). The third location was in mature upland coniferous forest adjacent to Forrest Lake (one observation).

Rusty blackbirds predominately feed on aquatic insect larvae, crustaceans, snails, and occasionally salamanders and small fish (COSEWIC 2017). Open water may be important for foraging, and nests are typically built near or over water in the branches of living or dead trees or among emergent vegetation (Kennard 1920; Shaw 2006; Deming 2009; Avery 2020). Breeding habitat requirements of rusty blackbird are consistent across the species' range in western North America (COSEWIC 2017; Avery 2020) and were assumed to be the similar in the RSA.

Anthropogenic and Natural Disturbance

Clearing of forested habitat in the summer breeding range of the rusty blackbird is identified as one of the main threats to the species (Greenberg et al. 2011; Environment Canada 2015c). Anthropogenic disturbance in the RSA may have decreased and altered potential rusty blackbird habitat under existing conditions. However, the amount of disturbance is low (i.e., 0.4% of RSA) and most of the vegetation loss is not due to large clearings but rather from narrow linear features such as trails and seismic lines / cutlines (Section 13.2.6.1.5; Figure 13.2-6). Thus, physical removal of vegetation from anthropogenic activities has likely resulted in negligible changes to rusty blackbird habitat availability in the RSA. It is possible that sensory disturbance created by human activities has also reduced the quality of habitat (i.e., functional loss of habitat) for rusty blackbird, particularly in areas where noise may occur during the breeding season (e.g., Highway 955, existing exploration camp).

Recent fires (i.e., 17BN-Vision fire in 2017, 16BN-Koop and 16BN-Brian fires in 2016; Section 13.2.6.1.4; Figure 13.2-5) may have affected rusty blackbird habitat in the RSA. In the past 40 years, 64.9% of the LSA and 57.7% of the RSA has been disturbed by wildfire. Fires that burned through treed wetlands would have removed mature trees and branches that provide potential nesting habitat for the species; however, the species will breed in recent burns if wildfires open gaps in the forest near a waterbody or flooded area (COSEWIC 2017; Avery 2020).

Habitat Suitability

Suitable nesting habitat was identified and mapped in the Base Case per the methods detailed in Appendix 14B. The mapping included potential effects from sensory disturbance (e.g., noise, presence of people) on habitat quality by applying a ZOI to disturbances with expected high and moderate activity levels (i.e., Highway 955, existing access road, exploration activities, cutlines / seismic lines, rough roads, and trails). Limited availability of treed and shrubby (i.e., willow) wetlands (Section 13.3.2.1, Ecosystem Availability) with adequate open water and large areas of burned and non-burned upland forest not adjacent to wetlands resulted in a small amount of high and moderate quality nesting habitat in the LSA and RSA. A total of 2.1 ha (0.1%) of the LSA contains high and moderate suitability habitat, 85.2 ha (3.0%) of low suitability habitat (Table 14.3-13). In the RSA, high and moderate suitability habitat are estimated at 403.2 ha (0.4%) and 516.5 ha (0.5%), respectively (Table 14.3-13).

Low suitability habitat represents 13,559.2 ha or 12.6% of the RSA. The majority of the LSA and RSA contains poor suitability habitat. It was assumed that rusty blackbirds inhabiting the RSA have adapted to the existing fire regime and low suitability habitats (e.g., more open and shrubby wetlands, late-stage regenerating wetlands) provide successful nesting habitat for the species in the Base Case. The assumption is supported by baseline surveys, which recorded rusty blackbird in low suitability (and poor suitability) habitats during the nesting period (Appendix 14B). No detections of rusty blackbird were recorded in the assessment LSA.

Table 14.3-13: Rusty Blackbird Nesting Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	1.3	<0.1	403.2	0.4
Moderate	0.8	<0.1	516.5	0.5
Low	85.2	3.0	13,559.2	12.6
Poor	2,744.3	96.9	93,011.7	86.5
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than; LSA = local study area; RSA = regional study area.

14.3.8.2 Habitat Distribution

Habitat Arrangement and Connectivity

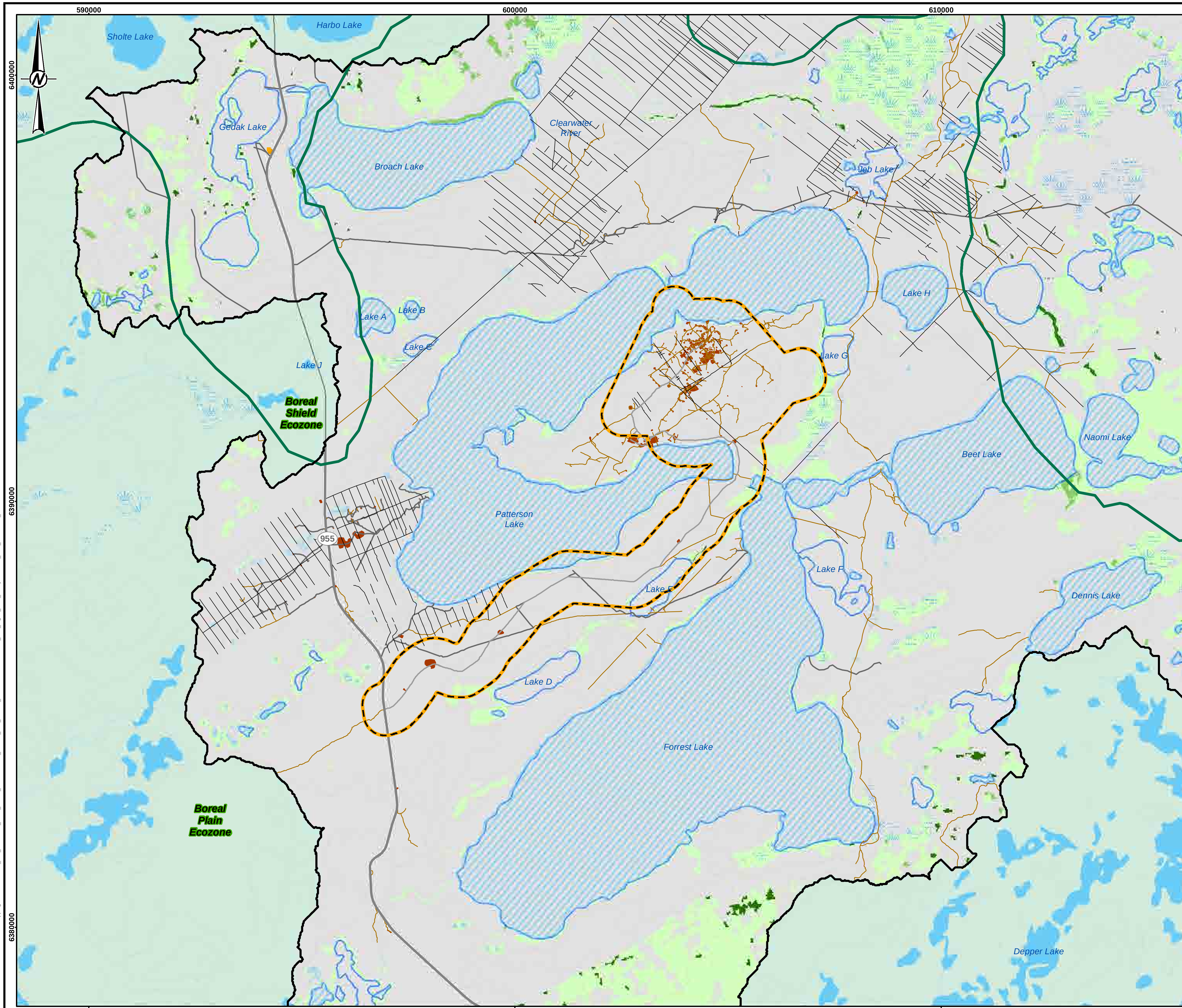
Approximately 86% of the global breeding range of rusty blackbird is in Canada (Nordell and Bayne 2017). In Saskatchewan, the species is generally confined to the northern half of the province, extending south to the Turtle Lake, Montreal Lake, and Hudson Bay areas as a fairly common but diminishing summer resident (Smith et al. 2019). There is evidence that rusty blackbird populations in Canada have been reduced along the southern margin of the breeding range because of habitat loss (Environment Canada 2015c).

Suitable nesting habitat for rusty blackbird is limited in the LSA (Figure 14.3-18). One small patch of high suitability habitat is located between Lake G and Patterson Lake, one patch of high suitability habitat is along the drainage connecting Patterson Lake and Forrest Lake, and one patch of moderate suitability habitat is along the drainage connecting Lake E with Forrest Lake. Low suitability habitat is distributed as follows:

- small patches along the south shore of Patterson Lake and adjacent to Lake G in northern portion of LSA;
- one patch at the north end of Forrest Lake; and
- several patches near Lake D in the southern portion of the LSA.

In the RSA, suitable rusty blackbird habitat is more common and connected and is distributed as follows (Figure 14.3-19):

- a few small, concentrated patches of high suitability nesting habitat in the southwestern portion of the RSA;
- very small patches of high suitability nesting habitat in the south-central portion of the RSA;
- very small patches of high suitability nesting habitat in the central portion of the RSA;
- small, scattered and small patches of high and moderate suitability habitat throughout the RSA;
- large patches of low suitability habitat in the southwestern portion of the RSA;
- large patches of low suitability habitat in the midwestern portion of the RSA (i.e., west, north, and east of the LSA); and
- scattered small to larger patches in the remainder of the RSA, particularly near Hook Lake, Hook Creek, and Dell Lake.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

RUSTY BLACKBIRD NESTING HABITAT IN THE LOCAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-18**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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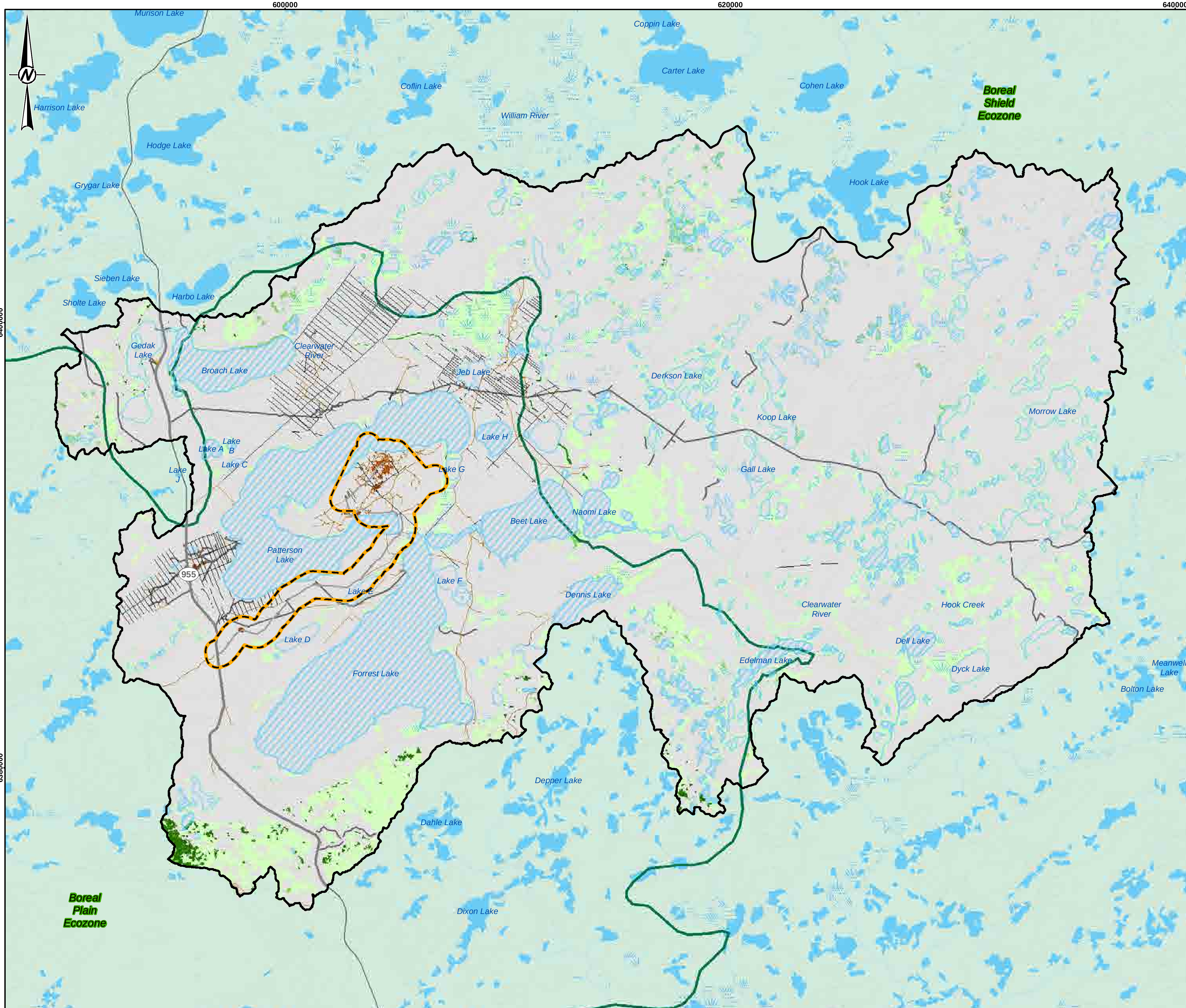

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

RUSTY BLACKBIRD NESTING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-19**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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Non-linear and Linear Features

There is currently a lack of information on the effect of non-linear disturbances (e.g., burns, clearcuts) on rusty blackbirds. Studies have suggested that some bird species will readily cross non-linear disturbances, though the response to habitat fragmentation among songbird species is variable (Desrochers and Hannon 1997; Bayne and Hobson 2001). Forest bird species have been found to forage more than 150 m, and up to 1 km, from their nest site (Norris and Stutchbury 2001; Fraser and Stutchbury 2004; MacIntosh et al. 2011). St. Clair et al. (1998) found that some forest birds were reluctant to cross gaps greater than 50 m but would cross gaps of 200 m when no other choice existed. Other studies have found that non-linear disturbances (e.g., clearcuts) affect movement patterns and habitat connectivity for many boreal songbird species (Desrochers and Hannon 1997; Robichaud et al. 2002; Mitchell et al. 2009; Villard and Haché 2012). In the Base Case, large patches of open land cover associated with recent burns and early-stage regenerating ecosites in the LSA and RSA may affect movements of rusty blackbirds. However, the magnitude of the effect is uncertain as adult rusty blackbirds often forage in multiple unconnected wetlands within their home range (Powell et al. 2010a).

A study in the boreal forest of the NWT found that some passerine bird species move their territories away from human linear disturbance features as little as 6 m in width (Machtans 2006). Studies of boreal songbirds have also shown that most species do not perceive seismic lines that are less than 8 m wide as barriers to movement and incorporate these linear disturbances into their territories (Rich et al. 1994; Machtans 2006). The Bolton Lake Wilderness Retreat Resort Lodge trail (a rough road) is expected to be used primarily during the non-breeding period (i.e., winter season; Bolton Lake Wilderness Retreat 2021; Figure 14.3-19) and is not expected to be affecting migratory birds. In addition, the current level and frequency of activity associated with narrow linear features in the RSA is not known. Thus, the effect of sensory disturbance on rusty blackbird habitat quality from trails, rough roads, and seismic lines / cutlines in the RSA may be lower than assumed in the habitat suitability index models (Section 14.3.8.1, Habitat Availability).

Highway 955 may adversely influence of the movement and habitat connectivity of rusty blackbird in the southwest portion of the RSA, particularly during periods of high traffic volume. Existing anthropogenic disturbance is low (0.4%) in the RSA and aggregated in the northwest portion of the study area, and most linear features consist of existing access road, trails, rough roads, and seismic lines / cutlines, which are not predicted to functionally affect the movement and habitat connectivity of rusty blackbird. Therefore, existing anthropogenic disturbances in the LSA and RSA do not likely function as movement barriers for rusty blackbird given the high mobility and patchy distribution of the species.

14.3.8.3 Survival and Reproduction

Breeding Territory and Population Status

Based on a study by Avery (2020), territory size for breeding pairs has been reported as 37.5 ha and nest density was found to be 3.4 nests per km^2. This territory size and nest density were assumed to be reasonable estimates for the RSA under existing conditions.

Rusty blackbird has been declining throughout its range over the last century and has suffered one of the steepest population declines of any bird in North America (Greenberg and Droege 1999; COSEWIC 2017; Avery 2020). The BNDN and BRDN have noted a decrease in the populations of birds in general (TSD II: BNDN; TSD III: BRDN). An analysis of breeding bird survey data indicated an annual rate of decline in rusty blackbird population size in Canada of approximately 3.6% between 1970 and 2019 (Smith et al. 2020). A 3.6% annual rate of decline corresponds to an approximate 82.9% decline in the Canadian population since 1970 (Smith et al. 2020). Christmas Bird Count data show a similar negative population trend, with an annual rate of decline of 1.6% in North America corresponding to an approximate 53% decrease in the continental population since approximately 1970 (Government of Canada 2015b). The management objective for the rusty blackbird in Canada is to stop the national decline by 2025 and demonstrate a 10-year sustained population increase thereafter (Government of Canada 2015b).

Although the causes of the declines observed since the 1960s are poorly understood, current threats to the species include conversion of wetlands in its winter range (i.e., the United States), forest clearing in its summer and winter ranges, mercury contamination and wetland acidification, and use of agricultural pesticides (Environment Canada 2015c). An increase in the density of roads or other infrastructure can have negative effects on rusty blackbird populations because areas with higher densities of roads and anthropogenic disturbance are often associated with higher densities of predator species or competitor species (e.g., American crow [*Corvus brachyrhynchos*]) that use similar resources (Buckley 2013).

Vital Rates

Limited information is available on survival rates of adult rusty blackbirds (COSEWIC 2017). The species' low reproductive rate and nestling success, and vulnerabilities to predation make rusty blackbird susceptible to disturbance, particularly disturbances that increase the risk of predation in their breeding grounds. Exploration or other activity near breeding grounds has the potential to increase nest predation for rusty blackbirds (Powell et al. 2010b) and could decrease the quality of wetland nesting habitat, depending on the frequency, level, and timing of activities.

Noise levels above 48 dBA have been shown to result in reduced abundance and pairing success of some other songbird species (Habib et al. 2007; Bayne et al. 2008), and the effects of noise on rusty blackbird are likely similar. The ECCC (ECCC 2019) indicate that noise levels more than 50 dBA or 10 dBA above ambient (i.e., background) noise can negatively affect birds. Other potential effects from noise could include interference with communication (e.g., reducing ability to hear approaching predators or intraspecific vocalizations; Ortega 2012). Average existing ambient nighttime and daytime noise levels in the noise RSA (which covers the wildlife LSA and extends into the RSA) ranged from 21 dBA during the night to 42 dBA during the day (Section 7.3.3). Therefore, for the Base Case, it was assumed that noise levels of existing activities are likely having little to no influence on rusty blackbird abundance.

The amount and frequency of fire in the past 40 years has likely limited the availability of high and moderate suitability breeding habitat for rusty blackbird in the RSA (i.e., 58% of the RSA has burned from 1981 to 2020). Although fire and forest harvesting represent different mechanisms of disturbance, some studies have shown reduced nesting success (i.e., the percentage of nests that hatch at least one egg) in regenerating harvest areas (Greenberg and Matsuoka 2010; Powell et al. 2010b). In contrast, the amount of anthropogenic disturbance is low in the RSA (0.4%) and expected to have had a negligible influence on rusty blackbird survival and reproduction and nesting habitat availability. Rusty blackbirds breeding in the RSA have likely adapted to the existing wildfire regime and are assumed to survive and successfully reproduce in low suitability nesting habitat (Section 14.3.8.1).

14.3.9 Common Goldeneye

Common goldeneye is not a federally listed or provincially tracked species (Government of Canada 2023; SKCDC 2021), nor is it a species under consideration by COSEWIC (Government of Canada 2023). Waterfowl are managed by the Government of Saskatchewan at the scale of Game Bird Management Units, which are combined into the North or South Game Bird Districts. The RSA is located within the North Game Bird District. Long-term management objectives include confirming that waterfowl are managed within sustainable and socially acceptable levels and promoting a strong commitment to waterfowl habitat retention and improvement through the North American Waterfowl Management Plan (Government of Saskatchewan 2017).

Indigenous Groups and LPA community members reported that ducks in general are important species that are harvested that contribute to traditional diets (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2021b; CRDN-JWG 2020b; NexGen 2019a). Ducks are a preferred food during the fall moose hunting season (TSD V.2: CRDN) and generally hunted during the fall and spring (BNDN-JWG 2021b; BRDN-JWG 2021b). The BRDN also collect duck eggs during the spring (BRDN-JWG 2021b). The MN-S reported that goldeneye is preferred to mallard because they are tastier and are generally harvested during the fall (MN-S-JWG 2019a).

The following subsections describe the existing conditions of common goldeneye habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For common goldeneye, habitat availability is described by habitat associations, sensory disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, and linear features; survival and reproduction are described by breeding territory and population status, vital rates, and harvesting.

14.3.9.1 Habitat Availability

Habitat Associations

Common goldeneye is a species of duck that breeds in trees mature enough to provide suitable nest cavities along wetlands, lakes, and rivers. Rock cavities have been used in northern portions of the breeding range (e.g., Newfoundland: Palmer 1976; Bellrose 1980). The species preferentially nests in trees in open stands near water or solitary trees on the edges of marshes rather than in trees in dense stands to increase the ease of entry when flying to the nest (Johnsgard 1978, Madge and Burn 1988). The species also nests in artificial nest boxes (del Hoyo et al. 1992). In general, common goldeneye prefer clear, open lakes lacking fish and abundant emergent or submerged vegetation (Nummi and Pöysä 1993; Wayland and McNicol 1994), though emergent bulrush (*Scirpus* spp*.)* may be important areas for foraging (Zicus et al. 1995). In Ontario and Quebec, oligotrophic lakes and lakes with surface areas between 1.5 ha and 20 ha are extensively used by common goldeneye (DesGranges and Darveau 1985; McNicol et al. 1987); however, in some areas, much larger lakes have been observed to form primary habitat for this species (Zicus et al. 1995). A total of eight pairs of common goldeneye were observed during the July baseline waterfowl survey and 16 individuals were observed during the June migration survey for the Project (Annex VIII.1; Annex VIII.3). All observations of common goldeneye in the July survey occurred around waterbodies less than 10 ha in size (Annex VIII.1).

Common goldeneye has been found to nest in both coniferous and deciduous trees and does not appear to show a preference for the type of forest stand surrounding the breeding site waterbody (Bellrose 1980). Some studies have shown that the species prefers open tree stands (Johnsgard 1978; Madge and Burn 1988). Other research concluded there was no association between nest box preference and attributes of the surrounding habitat including habitat type, species of tree to which the nest box was attached, number of branches around the entrance hole and flight path into the entrance hole, and visibility of nest boxes (Dow and Fredga 1985; Pöysä et al. 1999). These studies suggest that nesting habitat may not be a primary limiting factor for the species. Common goldeneye nests may be located up to 1.3 km away from water (Eadie et al. 2020) though preference for nesting along the shoreline has been found (Pöysä et al. 1999).

During the breeding season, the availability of abundant invertebrate species appears to influence habitat selection for common goldeneye (Wayland and McNicol 1994). Fish-bearing lakes are less than ideal habitat for common goldeneye, as some fish species (e.g., yellow perch [*Perca flavescens*]) compete with common goldeneye for invertebrate food sources. As such, common goldeneye tend to avoid lakes that contain fish (Eriksson 1979; Eadie and Keast 1982; Blancher et al. 1992; McNicol and Wayland 1992).

Sensory Disturbance

Literature on the effect of sensory disturbance on common goldeneye is limited; however, waterbirds in general are considered sensitive to disturbance and react negatively to anthropogenic noise or motion (Rodgers and Burger 1981; Bélanger and Bédard 1990; Dahlgren and Korschgen 1992). Noise levels above 63 dBA may negatively affect some waterbird species (Conomy et al. 1998), though other species have been reported to tolerate noise levels of 55 to 100 dBA (Black et al. 1984). Common goldeneye appear moderately tolerant of noise; for example, occupying narrow treed bands in areas of intensive agricultural activities (i.e., livestock grazing and cropping; Corrigan et al. 2011). Average existing ambient nighttime and daytime noise levels in the noise RSA (which covers the wildlife LSA and extends into the RSA) ranged from 21 dBA to 42 dBA (Section 7.3.3). In the Base Case, it was assumed that existing activities in the RSA, which are largely low activity such as trails and seismic / cutlines, may occasionally disturb common goldeneye but have a negligible effect on habitat availability.

Habitat Suitability

Common goldeneye are migratory birds that overwinter outside of Canada. As a result, the assessment of habitat suitability for common goldeneye was focused on defining nesting habitat during the breeding period. The model predicted nesting habitat suitability to be highest at shoreline but available up to 1.3 km from the edge of open water and that common goldeneye primarily use waterbodies between 1.5 ha and 20 ha in size.

Habitat suitability rankings of land cover types and ecosites for common goldeneye nesting habitat were characterized as a function of distance from the shoreline of suitable waterbodies (1.5 ha to 20 ha). Ecosites within the LSA and RSA were classified as either “suitable” or “not suitable” based on the ability to support common goldeneye nesting habitat. Habitat suitability rankings of land cover types and ecosites for common goldeneye nesting habitat in the RSA, which includes the LSA, are provided in Table 14.3-13.

Literature on ZOIs (e.g., areas of habitat avoidance due to sensory disturbance) for common goldeneye is lacking, and there are no federal or provincial minimum setback distance guidelines for this species. However, waterbirds can be sensitive to disturbance and react negatively to anthropogenic noise or motion (Rodgers and Burger 1981; Bélanger and Bédard 1990; Dahlgren and Korschgen 1992). Although ECCC has removed reference to the buffer sizes for particular nesting birds, waterfowl and shorebirds previously had a recommended minimum 100 m setback. The effects of anthropogenic noise on common goldeneye nesting habitat were considered within a 100 m buffer of human developments with high levels of activity (e.g., Highway 955, exploration, existing access road); habitats within the 100 m buffer were assigned a suitability rank of not suitable (Table 14.3-14).

Table 14.3-14: Suitability of Land Cover Types and Ecosites for Common Goldeneye Nesting Habitat

Land Cover Type	Ecosite[(a)]	Suitability[(b)]
Mature upland forest	BP02; BP03; BP04; BP06; BP07; BP11; BP12; BP14; BP16; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13; BS14; BS15	Suitable
Mature treed wetland	BP18; BP19; BP23; BS17; BS21	
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)	Not suitable
Young upland forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Immature upland forest	BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	
Young or immature treed wetland	BP18(BU/E); BP19(BU/E); BP23(BU/E); BS17(BU/E); BS21(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BS16(BU/L); BS17(BU/L); BS21(BU/L)	
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Open water	Water	

a) Refer to Attachment 14B1, Ecological Land Classification Units.
b) Within 1,300 m of waterbodies between 1.5 ha and 20 ha.

In the Base Case, the LSA contains 13 ha (0.5%) of suitable common goldeneye nesting habitat and 2,818.6 ha (99.5%) of not suitable habitat (Table 14.3-15). Suitable nesting habitat for common goldeneye is uncommon in the LSA due to recent fires and the presence of large fish-bearing lakes (i.e., waterbodies greater than 20 ha; Patterson Lake, Forrest Lake). The RSA contains 13,103.9 ha (12.2%) of suitable nesting habitat and 94,386.8 ha (87.8%) of not suitable nesting habitat (Table 14.3-15). Availability of suitable is greater in RSA but limited due to the existing spatial extent and frequency of fires. Recent fires (i.e., 17B still N-Vision fire in 2017, 16BN-Koop and 16BN-Brian fires in 2016; Section 13.2.6.1.4) may have affected common goldeneye habitat in the RSA because the fires would have burned through treed wetlands, removing or degrading mature coniferous and deciduous tree species that provide potential nesting habitat for the species. As a result, mature upland forest and mature treed wetland ecosites are limited in the Base Case (Section 13.3.1.1 and Section 13.3.2.1).

Table 14.3-15: Common Goldeneye Nesting Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Suitable	13.0	0.5	13,103.9	12.2
Not suitable	2,818.6	99.5	94,386.8	87.8
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.9.2 Habitat Distribution

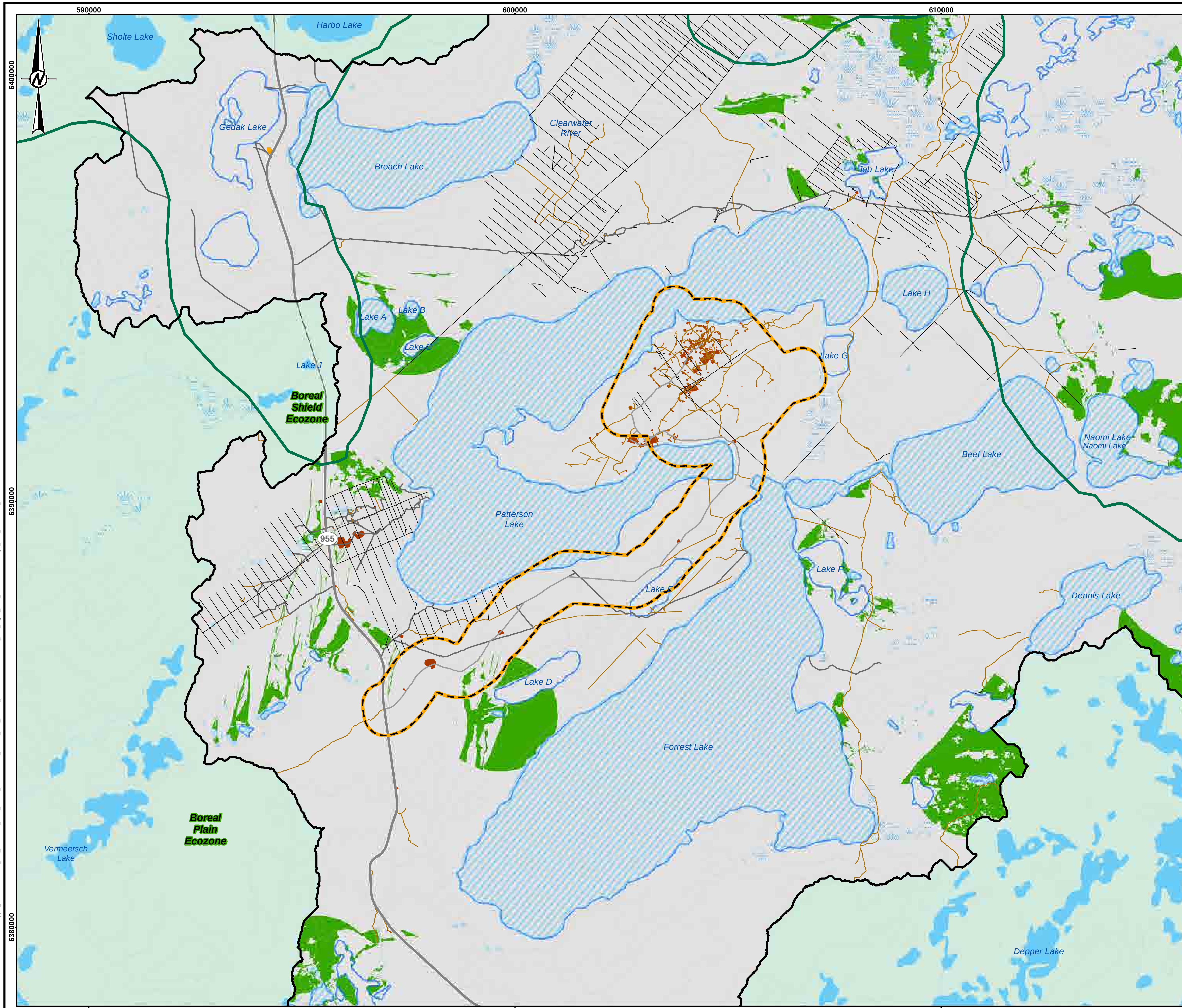
Habitat Arrangement and Connectivity

Common goldeneye is a cavity-nesting species that is found throughout most of North American forests during the breeding season and is a common summer resident of the lakes of the boreal forest in Saskatchewan (Smith 1996; Eadie et al. 2020). In North America, the species breeds almost exclusively within the boreal forest tree line from Alaska to Newfoundland (Adamus 1987; Smith et al. 2020). While common goldeneye wintering range is extensive, spanning from the Pacific coast to the eastern provinces and south to northern Mexico, common goldeneye may occur anywhere there is open water, and have been recorded as far north as La Ronge in Saskatchewan during winter, though rare (Smith 1996; Smith et al. 2020).

In the LSA, suitable habitat for common goldeneye is associated with mature upland forest within 1.3 km of a suitable waterbody and is limited to 13 ha (0.5%) and is found at the southwest portion of the existing access road, northwest of Lake D and (Figure 14.3-20). In the RSA, suitable habitat is concentrated in the northeast portion of the RSA, with additional patches located in the following areas (Figure 14.3-21):

- the central portion of the RSA, between Naomi and Gall lakes;
- the south-central portion of the RSA, southwest and southeast of Dennis Lake; and
- scattered patches throughout the east portion of the RSA.

The CRDN identified Beet Lake and Naomi Lake as important duck hunting sites (TSD V.2: CRDN), while general wildlife hunting locations were reported at Patterson and Forrest lakes (TSD V.2: CRDN) and Gedak, Dennis, Derkson, Koop, and Gall lakes (TSD IV: MN-S).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

COMMON GOLDENEYE NESTING HABITAT IN THE LOCAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-20**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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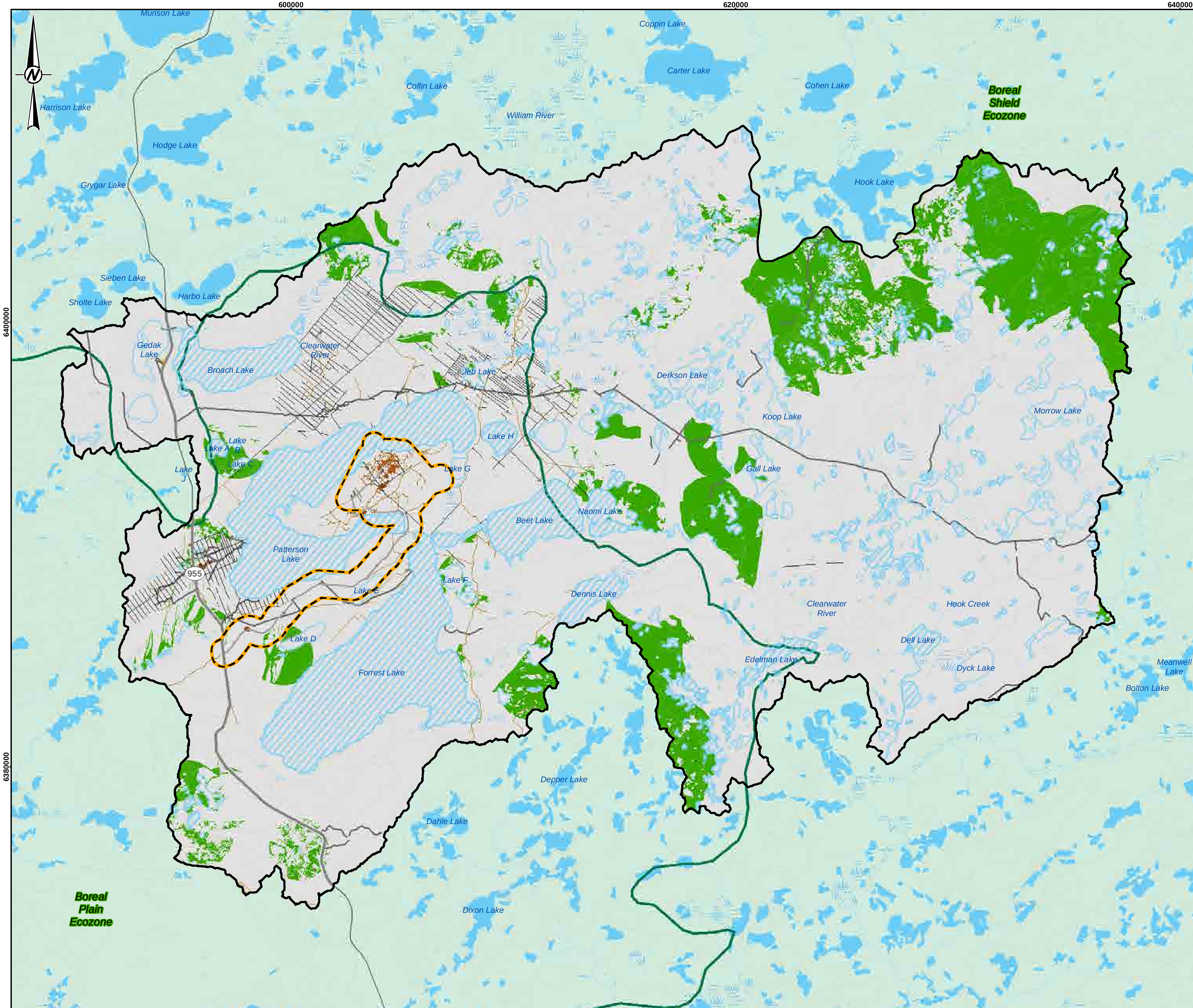

LEGEND

ELEVATION CONTOUR (20 m INTERVAL)
WATERCOURSE
OPEN WATER (WITHIN THE RSA)
WATERBODY (WITHIN THE RSA)
WATERBODY (OUTSIDE OF RSA)
WETLAND
WOODED AREA
ECOZONE BOUNDARY
LOCAL STUDY AREA
REGIONAL STUDY AREA

DISTURBANCE CLASS

ACCESS ROAD
CUTLINE/SEISMIC
SECONDARY HIGHWAY
ROUGH ROAD
TRAIL
NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

SUITABLE
NOT SUITABLE

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
COMMON GOLDENEYE NESTING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
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CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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Linear Features

Existing anthropogenic disturbance is low (0.4%) and aggregated in the northwest portion of the RSA, overlapping the LSA, and includes infrastructure and activities such as Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. In the Base Case, Highway 955 may adversely influence the movement of common goldeneye, particularly during periods of high traffic volume. Other linear features in the LSA and RSA have little activity and likely do not function as movement barriers for this species because the species is highly mobile and travels long distances annually between wintering and breeding grounds. For example, Saskatchewan populations move toward the Oregon and Californian Pacific Coast to winter (Eadie et al 2020). Thus, common goldeneye is predicted to fly over roads, trails, and cutlines with little change to movement and distribution. Although likely not affecting the overall migration routes for the species, fire has resulted in a large amount of unsuitable habitat in the RSA and likely influences the movement and distribution of birds in localized areas.

14.3.9.3 Survival and Reproduction

Breeding Territory and Population Status

Breeding individuals in British Columbia establish nesting territories at a density of 0.09 pairs/ha (Eadie et al. 2020). The species shows high breeding site fidelity (Eadie et al. 2020) but reaches a plateau in breeding success based on density, which may indicate that nesting habitat is not the primary limiting factor constraining the population (BirdLife International 2018). Noise disturbance may be affecting common goldeneye reproduction in the LSA if it results in nesting females deserting their clutches, which research indicates can happen if the disturbance is during the first two weeks of incubation (Eadie et al. 2020). However, in the Base Case, the existing levels of noise disturbance in the LSA are considered low (i.e., low to moderate ongoing human activity). In the Base Case, it was assumed that nesting territories in the RSA are at a density of 0.09 pairs/ha and that disturbance to nesting is negligible.

Common goldeneye populations remain relatively stable despite threats from hunting, pesticides and contaminants, and degradation of habitat (Eadie et al. 2020). Common goldeneye populations in the Canadian Western Boreal Region appear to be stable in both the short-term (2015 to 2019) and longer timeframe (1970 to 2019; CWS Waterfowl Committee 2020). An analysis of breeding bird survey data indicated an annual rate of increase in common goldeneye population size in Canada of approximately 0.2% between 1970 and 2019 (Smith et al. 2020). A 0.25% annual rate of increase corresponds to an approximate 7.7% increase in the Canadian population since 1970 (Smith et al. 2020). In Saskatchewan, an annual rate of increase in common goldeneye population size of approximately 1.1% corresponds to an approximate 68% increase in the Saskatchewan population since 1970 (Smith et al. 2020). Breeding populations in the Canadian Western Boreal Region in 2019 were estimated at approximately 475,000 birds (CWS Waterfowl Committee 2020). In the Base Case, it was assumed that the common goldeneye population overlapping the RSA is likely stable.

Vital Rates

Common goldeneye females breed in their second year and make one nesting attempt a year (Eadie et al. 2020). In a study of 14 nest boxes conducted at Emma Lake, SK, 13 clutches averaged 9.2 eggs per clutch of which 11 clutches were successful, hatching 9.3 young per successful nest (Rever and Miller 1973). However, brood survival has been found to be low with brood size decreasing from 8.7 at hatching to 3.1 near fledging and complete loss of broods (18% to 34%) is high (Eadie et al. 2020). Paasivaara and Pöysä (2008) also found juvenile mortality to be high (58% to 77%) with up to 56% of duckling losses during the first week of life. Common causes of death are rain and cold weather after hatching, predation, and infanticide by common goldeneye females, red-necked grebes (*Podilymbus podiceps),* and common loons (Eadie et al. 2020). In the Base Case, it was assumed that the survival rates and threats to survival for common goldeneye in the RSA are similar to those presented in the literature.

Harvest

Common goldeneye is hunted throughout Canada, though the largest numbers are traditionally harvested in Ontario and harvests have decreased since the 1980s, averaging approximately 17,000 individuals per year (CWS Waterfowl Committee 2020). In Saskatchewan, between 17,000 and 22,000 permits to hunt waterfowl are sold annually, and each hunter can harvest up to eight ducks per day between 1 September and 16 December (Government of Saskatchewan 2021a). However, the waterfowl harvest in the province is not considered significant for common goldeneye. The MN-S and BRDN have noted that duck populations in general have declined (TSD III: BRDN; TSD IV: MN-S; MN-S-JWG 2019a; MN-S-JWG 2020a). In the Base Case, harvest of common goldeneye in the RSA likely varies, but the effect of harvest on the population is unknown.

14.3.10 Mallard

Mallard is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021), nor is it a species under consideration by COSEWIC (Government of Canada 2023). Waterfowl are managed by the Government of Saskatchewan at the scale of Game Bird Management Units, which are combined into the North or South Game Bird Districts. The RSA is located within the North Game Bird District. Long-term management objectives include confirming that waterfowl are managed within sustainable and socially acceptable levels and promoting a strong commitment to waterfowl habitat retention and improvement through the North American Waterfowl Management Plan.

Indigenous Groups and LPA community members identified ducks in general as important species that are hunted and a key part of traditional diets (TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; TSD VI: YNLR; BNDN-JWG 2021b; BRDN-JWG 2021b; CRDN-JWG 2020a,b; NexGen 2019a). The BRDN specifically noted that mallard is harvested for food (BRDN-JWG 2019a). The CRDN reported that ducks are regularly harvested in season and are considered a preferred food during fall moose hunting (TSD V.2: CRDN). The BNDN reported hunting ducks during the spring and fall (BNDN-JWG 2021b) while the BRDN reported that ducks are hunted, and their eggs are collected during the spring (BRDN-JWG 2021b). An MN-S member estimated that 50% of his diet consists of Traditional Foods, in which duck is a key component (TSD IV: MN-S).

The following subsections describe the existing conditions of mallard habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For mallard, habitat availability is described by habitat associations, sensory disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, and linear features; survival and reproduction are described by vital rates and population status, threats to survival, and harvest.

14.3.10.1 Habitat Availability

Habitat Associations

Mallard is the most abundant duck species in North America, and can be found on almost any waterbody habitat, from lakes to ephemeral wetlands (Drilling et al. 2020). Although mallards prefer shallow and calm waterbodies and will generally avoid fast-flowing, oligotrophic waters (i.e., waters low in nutrients) and unvegetated areas such as rocky ground and sand dunes, the species has few requirements such as a readily available food supply and small areas of open water for roosting and nesting (Drilling et al. 2020). Breeding mallards in the boreal forest prefer wetlands with some open water that are more vegetated, such as shorelines with emergent vegetation, bog mats, or seasonal wetlands and bogs (Merendino and Ankney 1994).

Mallards construct their nests over water, usually in densely vegetated wetlands or in upland habitat close to water, including in marshes, bogs, shrubland, and forests, with the largest proportion of upland nests being within 150 m of water (Drilling et al. 2020; Sowls 1955; Dzus and Clark 1997; Clark and Shutler 1999; Arnold et al. 1993). During the breeding season, mallards mainly eat invertebrate species such as aquatic insect larvae, worms, snails, freshwater shrimp, and native wetland plants (del Hoyo et al. 1992; Drilling et al. 2020). In Saskatchewan, habitat selection and breeding distribution is widespread and, although mallard is less numerous in the boreal forest than in the parkland regions, it is still considered a common species in northern Saskatchewan (Smith 1996). Mallards do not typically maintain or defend structured breeding territories; territories often overlap with adjacent breeding pairs, and nests can at times be as close as 1 m from other nests (Drilling et al. 2020). During baseline studies for the Project, 61 mallard individuals were detected and were the fourth most common waterfowl species observed (Annex VIII.1).

Sensory Disturbance

Mallards occur in a variety of human-modified habitats and are considered relatively tolerant of anthropogenic disturbance compared to most other species of waterfowl and other birds (Tuite 1981; Rodrigues and Fabião 1995; Ludlow and Davis 2018). Studies on the effect of oil and gas infrastructure on mallard nesting placement have shown that the species is somewhat resilient to anthropogenic disturbance on the landscape and will place nests within 100 m of noise-producing oil wells and roads (Ludlow and Davis 2018). Similarly, in a North Dakota study, several duck species, including mallard, were shown to have higher nest densities in areas closer to primary and secondary roads compared to areas farther from roads (Skaggs et al. 2020). Noise levels greater than 63 dBA may negatively affect some waterbird species (Conomy et al. 1998), though other species have been reported to tolerate noise levels of 55 dBA to 100 dBA (Black et al. 1984). Average existing ambient nighttime and daytime noise levels in the noise RSA (which covers the wildlife LSA and extends into the RSA) ranged from 21 dBA during the night to 42 dBA during the day (Section 7.3.3). In the Base Case, it was assumed that existing activities in the RSA may occasionally disturb mallard but have a negligible effect on habitat availability.

Habitat Suitability

Suitable nesting habitat was identified and mapped in the Base Case per the methods detailed in Appendix 14B. The mapping included potential effects from sensory disturbance (e.g., noise, presence of people) on habitat quality by applying a ZOI to disturbances with expected high and moderate activity levels (e.g., Highway 955, existing access road, exploration activities, cutlines / seismic lines). The LSA has an estimated 416.8 ha (14.7%) of high suitability nesting habitat, no moderate suitability habitat, and 393.1 ha (13.9%) of low suitability nesting habitat (Table 14.3-16). In the RSA, high, moderate, and low suitability nesting habitat are estimated at 53,633.3 ha (49.9%; Table 14.3-16). The moderate amount of suitable mallard habitat available at Base Case suggests that habitat availability is not limiting for this species in the LSA and RSA.

Table 14.3-16: Mallard Nesting Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
High	416.8	14.7	29,103.9	27.1
Moderate	0.0	0.0	96.8	0.1
Low	393.1	13.9	24,432.6	22.7
Poor	2,021.7	71.4	53,857.4	50.1
Total	**2,831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.10.2 Habitat Distribution

Habitat Arrangement and Connectivity

During the breeding season, mallards range from California to Alaska and across the central plains to the Atlantic coast, nesting in wetlands, croplands, forests, urban areas, and artificial nesting boxes (Krapu et al. 1979). Mallards can be found wintering as far north as conditions permit (Drilling et al. 2020). In Saskatchewan, the species' breeding range extends throughout the province and is considered common in the parklands and less numerous but still common in the boreal forest (Smith 1996; Smith et al. 2019). Mallards do not exhibit strong breeding site fidelity, and their use of the LSA and RSA is likely dependent on seasonal water levels and food availability.

Suitable nesting habitat for mallard in the LSA is patchily distributed, with high suitability habitat associated with wetland habitat or areas within 150 m of open water (Figure 14.3-22). Low suitability nesting habitat is found on open water in the LSA including Patterson Lake, Lake E, and a small portion of the northern extent of Forrest Lake (Figure 14.3-22).

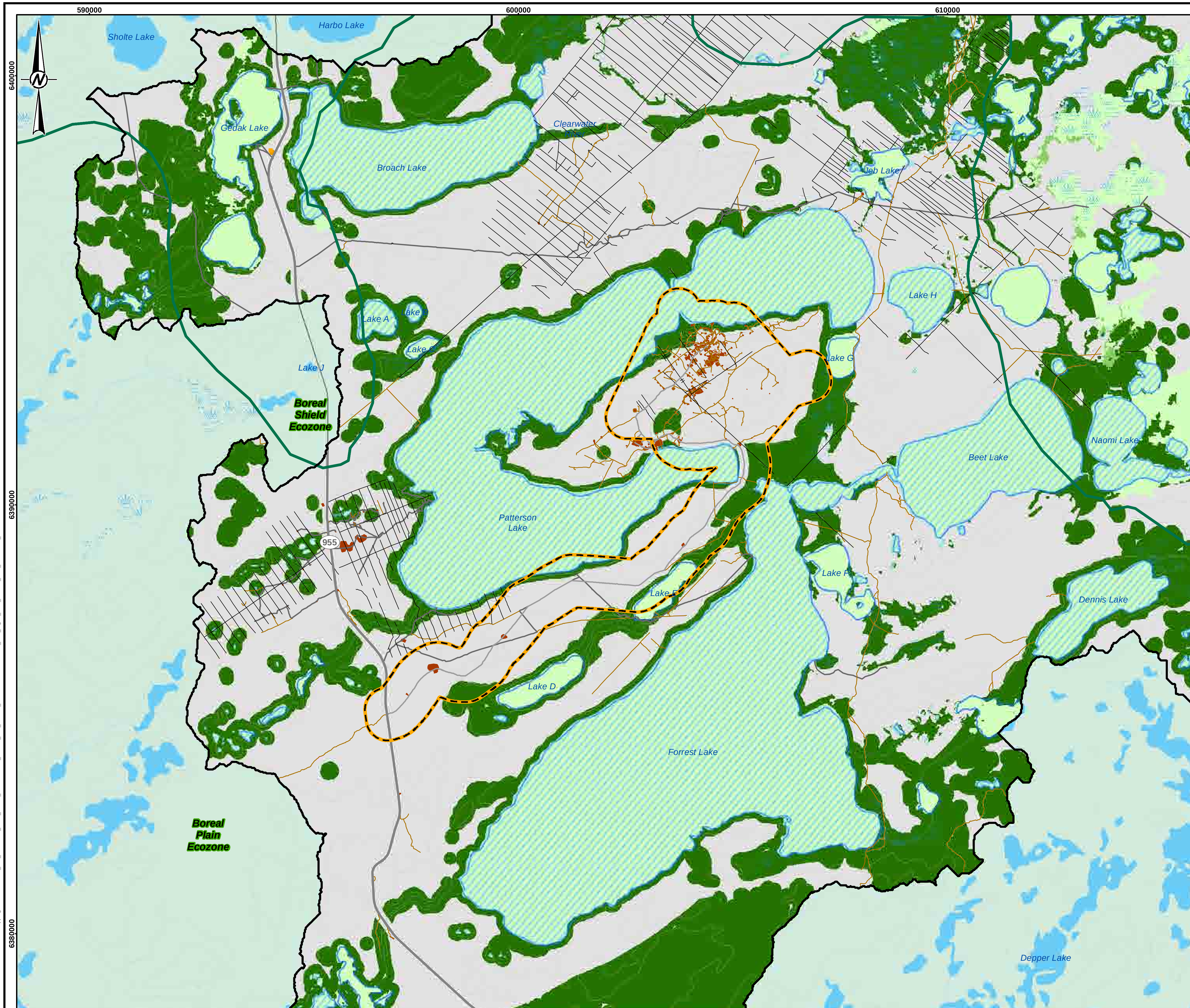
Moderate suitability mallard nesting habitat is limited; however, high and low suitability habitat are well distributed throughout the RSA (Figure 14.3-23). Additional larger patches of high suitability habitat are located in the RSA as follows (Figure 14.3-23):

- southwest portion of the RSA, southwest of Forrest Lake;
- south-central portion of the RSA, southeast of Dennis Lake;
- northwest portion of the RSA, west of Gedak Lake and north of Broach Lake; and
- north of Jeb Lake in the north-central portion of the RSA.

The CRDN identified Beet Lake and Naomi Lake as important duck hunting sites (TSD V.2: CRDN), while general wildlife hunting locations were reported at Patterson and Forrest lakes (TSD V.2: CRDN) and Gedak, Dennis, Derkson, Koop, and Gall lakes (TSD IV: MN-S).

Linear Features

Existing anthropogenic disturbance is low (0.4%) and aggregated in the northwest portion of the RSA, overlapping the LSA, and includes infrastructure and activities such as Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. In the Base Case, Highway 955 may adversely influence the movement of mallard, particularly during periods of high traffic volume. Other linear features in the LSA and RSA have little activity and likely do not function as movement barriers for this species because birds are highly mobile and travel long distances annually between wintering and breeding grounds. Thus, mallards are predicted to fly over roads, trails, and cutlines with little change to movement and distribution.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MALLARD NESTING HABITAT IN THE LOCAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.3-22	
REVIEW	JV	2023-02-09		

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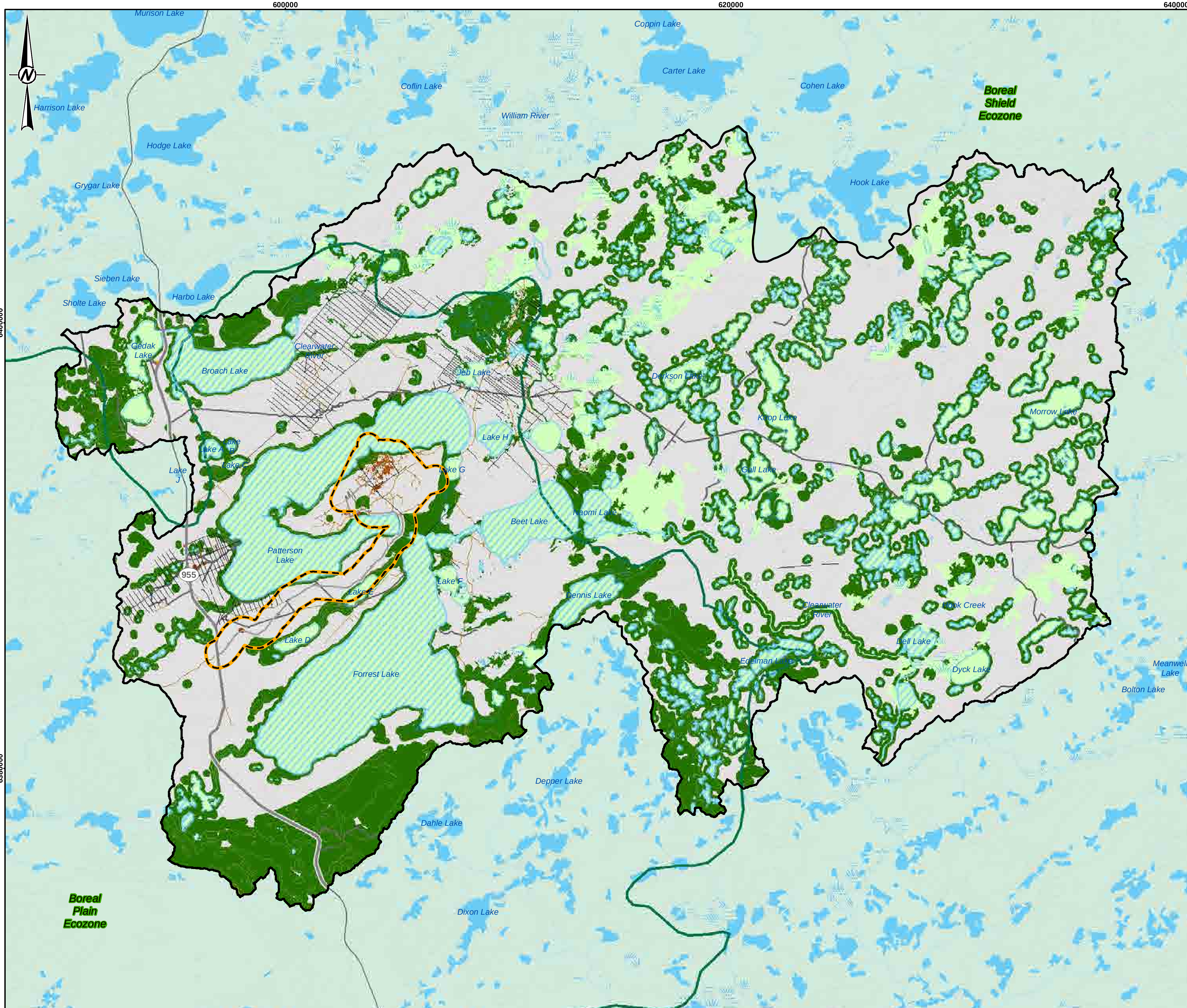

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
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- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MALLARD NESTING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.3-23**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

14.3.10.3 Survival and Reproduction

Vital Rates and Population Status

Mallard is a highly successful species due to adaptability to varied habitats, hardiness in cold climates, and tolerance to human activities (Drilling et al. 2020). However, hybridization (mixing of genes between species) with other ducks is a potential threat to the species (Drilling et al. 2020). Mallards are known to mate with species such as the gadwall (*Mareca Strepera*), northern pintail (*Anas acuta*), cinnamon teal (*Spatula cyanoptera*), green-winged teal (*Anas crecca*), and canvasback (*Aythya valisineria*; Ehrlich et al. 1988).

Mallards typically lay up to 12 eggs, and the incubation period lasts approximately one month (Palmer 1976; Pehrsson 1991; Alisauskas and Ankney 1992). Mallard nesting success was estimated at between 9% and 14% over a three-year study in North Dakota (Skaggs et al. 2020). Mallards will re-nest if the initial nest fails (Sowls 1955; Coulter and Miller 1968). Survival rate varies between life stages and sex; adults survive at a significantly higher rate than juveniles, and adult males survive at higher rates than adult females (Drilling et al. 2020). Annual survival ranges from 54% to 59% for females and from 62% to 68% for males.

Population data appear to be variable. An analysis of breeding bird survey data indicated an annual rate of decrease in mallard population size in Canada of approximately 0.2% between 1970 and 2019 (Smith et al. 2020). A 0.2% annual rate of decrease corresponds to an approximate 9.6% decrease in the Canadian population since 1970 (Smith et al. 2020). However, the Canadian Wildlife Service Waterfowl Committee (2020) reported that the population appears to be stable across a longer timeframe (1970 to 2019). Mallard populations in the Canadian Western Boreal Region experienced short-term declines between 2015 and 2019 (CWS Waterfowl Committee 2020). Breeding population estimates for mallard in the province of Saskatchewan increased between 2007 (8.4 million birds) and 2016 (11.8 million birds; Government of Saskatchewan 2017). The MN-S and BRDN have noted that duck populations in general have declined (TSD III: BRDN; TSD IV: MN-S; MN-S-JWG 2019a; MN-S-JWG 2020a). Based on the available information it was assumed that the population in the RSA may be decreasing in the Base Case.

Threats to Survival

When faced with the perceived risk of predation created by anthropogenic disturbance, ducks spend less time foraging and more time in alert behaviours and may initiate escape flights, which are energetically expensive (Zimmer et al. 2010; 2011). Mallards that are consistently disturbed by human activity demonstrate reduced food consumption and reduced body mass or condition (Zimmer et al. 2010). Sustained or repeated disturbance of waterfowl nesting sites by humans can lead to reduced clutch size, increased egg mortality, increased predation risk, and nest abandonment (Dahlgren and Korschgen 1992), all of which would result in reduced reproductive output. Displacement from more productive nesting or foraging habitats into less productive habitats may also lead to declines in reproduction and survival in waterbirds (Mathers and Montgomery 1997). On the other hand, Skaggs et al. (2020) found that oil and gas well density on the landscape did not have a measurable effect on duck nest survival in an expansive study area in North Dakota.

Other threats to mallards, and to other waterfowl species, include wetland habitat degradation and loss from pesticides and pollution (Kwon et al. 2004; Grishanov 2006); wetland drainage and management practices (e.g., burning, mowing, cultivation; Grishanov 2006); lead shot ingestion (Mateo et al. 1998); and outbreaks of disease such as avian botulism (Rocke 2006) and avian influenza (Melville and Shortridge 2006). However, mallard may be able to withstand acute losses from disease due to high reproductive potential (Rocke 2006). Wetland loss and degradation have not had large effects on mallard habitat in the RSA because there is no agriculture in the area. Outbreaks of disease could affect the population in the RSA. Based on the literature and low level of existing disturbance, it was assumed that there are negligible threats to mallard survival and reproduction in the RSA in the Base Case.

Harvest

Mallard is the most heavily hunted duck species in North America and its populations and habitats are often managed for the continued benefit of sport hunting (Bregnballe et al. 2004). Hunting pressure is an important factor in determining mallard survival throughout North America (Drilling et al. 2020). In Saskatchewan, between 17,000 and 22,000 permits to hunt waterfowl are sold annually, and each hunter can harvest up to eight ducks per day between 1 September and 16 December (Government of Saskatchewan 2021a). The number of mallards harvested annually in Saskatchewan between 2008 and 2017 ranged from approximately 126,000 to 194,000 individuals (Government of Saskatchewan 2017). In the Base Case, it was assumed that there is likely some hunting pressure on the mallard population in the RSA.

14.3.11 Canadian Toad

Canadian toad is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021) and is considered Not at Risk by COSEWIC (Government of Canada 2023). Little information is available on the current population size of Canadian toad in Canada or in Saskatchewan because of limited province-wide monitoring efforts and the species' cryptic nature (i.e., difficult to detect; Hamilton et al. 1998). Anecdotal observations of populations over the past several decades in Alberta have indicated that the species has experienced considerable declines since the 1980s (Hamilton et al. 1998).

The following subsections describe the existing conditions of Canadian toad habitat availability, habitat distribution, and survival and reproduction in the LSA and RSA. For Canadian toad, habitat availability is described by habitat associations, sensory disturbance, and habitat suitability; habitat distribution is described by habitat arrangement and connectivity, and linear features; survival and reproduction are described by vital rates, threats to survival, and disease.

14.3.11.1 Habitat Availability

Canadian toad habitat requirements can be separated into overwintering/dispersal habitat and breeding habitat. Canadian toad typically occupies boreal forests and aspen parkland in central and northern Saskatchewan (Russell and Bauer 2000). The species is considered a habitat generalist as individuals select a variety of wetlands and waterbodies for breeding and occupy many types of upland habitat during the active season and hibernation period (Russell and Bauer 2000).

Overwintering and Dispersal Habitats

The primary limiting factor affecting Canadian toad distribution is believed to be the availability of suitable overwintering habitat on the landscape (Hamilton et al. 1998). Canadian toads are intolerant to freezing and must seek refuge during the winter months in Saskatchewan, hibernating below the frostline (Hamilton et al. 1998; Russell and Bauer 2000). Hibernation sites (i.e., hibernacula) are communal burrows located at depths of up to 1.2 m below the surface (Breckenridge and Tester 1961; Tester and Breckenridge 1964). Canadian toads require loose, coarse-textured soils (e.g., sand with gravel) to excavate their hibernacula because they are poor burrowers (Breckenridge and Tester 1961; Hamilton et al. 1998).

Hibernation habitat is generally confined to well-drained, sandy, upland areas (Hamilton et al. 1998). Well-drained, upland habitat is common in the LSA where the vast majority of soil types are within the sandy or sandy loam classifications (Section 12.3.3, Soil Quantity and Distribution). The dominant land cover types in the LSA are regenerating jack pine-dominated forest (58.0% of total LSA area) that was burned within the past 40 years and undisturbed jack pine-dominated forest (11.8% of total LSA area; Section 13.3.1.1). These land cover types are associated with dry, well-drained upland habitats that would potentially provide suitable hibernation habitat for Canadian toad. Therefore, suitable hibernation habitat is not expected to be limiting in the LSA in the Base Case.

Most reports have found Canadian toads within 100 m of open water; however, they have been recorded up to 1,500 m away from breeding areas (Roberts and Lewin 1979; Kuyt 1991; Constible et al. 2010). Movement through the landscape (i.e., habitat connectivity) is important for Canadian toads to connect breeding populations, promote gene flow between breeding units, and access the various types of habitat that they rely on as a part of their life history (Compton et al 2007; Semlitsch 2008; Todd et al. 2009; Annich et al. 2019). Many species of amphibians, including toads, rely on a network of wetlands, small ponds, or flooded areas to move through the landscape during migratory or dispersal movements (Semlitsch 2008; Bull 2009; Todd et al. 2009). Recent studies have indicated that the species may be more terrestrial and will occupy forested habitat more often during the summer months than previously believed (Annich et al. 2019). The extent of upland habitat immediately adjacent to waterbodies and wetlands has been shown to be an important factor in determining the presence of breeding Canadian toads on the landscape in boreal ecosystems (Annich et al. 2019).

In the Base Case, wetland habitats are well distributed and connected in certain portions of the RSA, but not in others, which is associated with the location of recent fire activity (Section 14.3.11.2, Habitat Distribution).

Breeding Habitat

Canadian toads breed in a variety of waterbody types, including natural and constructed ponds, streams, and lakes with shallow margins, fens, rivers, and ephemeral (i.e., temporary) waterbodies (Roberts and Lewin 1979; Russell and Bauer 2000; Westworth and Associates 2002). A recent study of male calling sites in northeast Alberta indicated that Canadian toads were most likely to be detected in habitats dominated by lakes or smaller waterbodies and that the species was more commonly detected in wetland types associated with lower vegetation heights (i.e., shrubby or grassy fens and marshes) than treed wetlands (Annich et al. 2019). Studies have indicated that beavers are important habitat engineers for amphibians and will create breeding ponds for several species of amphibians (Stevens et al. 2007; Anderson et al. 2015). Given the apparent importance of small wetlands to Canadian toads, beaver activity on a landscape likely has an effect on the availability of Canadian toad breeding habitat.

Canadian toads are known to typically leave wet areas to forage in uplands following breeding. Proximity of the breeding pond to suitable upland foraging habitat was identified as an important factor in describing Canadian toad occurrence in northeastern Alberta (Annich et al. 2019). Canadian toads will often use disturbed areas of standing water as breeding habitat, including pools of standing water at the edge of well pads, along the ditches of roads, or in borrow pits (Russel and Bauer 2000; Stevens et al. 2006). In Saskatchewan, Canadian toads have been observed as far north as Lake Athabasca (Eaton et al. 2005).

Canadian toads may perceive the use of ephemeral waterbodies as a trade-off between the risk of desiccation prior to metamorphosis (i.e., change from tadpole to juvenile toad) in temporary waterbodies and the risk of predation at established, permanent waterbodies (Hamilton et al. 1998). However, breeding success may be higher in permanent waterbodies (Stevens et al. 2006). Canadian toads do not exhibit strong selection of waterbody type for breeding, but breeding success is predicted to be higher in permanent waterbodies. In the boreal forest, Canadian toad breeding behaviour begins in late May or early June (Tester and Breckenridge 1964). Male toads tend to stay close to breeding areas for two months while females only stay long enough to lay eggs (Breckenridge and Tester 1961; Roberts and Lewin 1979). After breeding, Canadian toads migrate to upland areas where they remain until the following breeding season (Hamilton et al. 1998). Canadian toads will often return to breeding wetland habitats throughout the active season since prey species are abundant and the opportunities for osmoregulation (i.e., maintaining salt and water balance within their cells) are higher than in upland habitat (Constible et al. 2010).

Canadian toads, like many pond-breeding amphibians, show strong site fidelity to their breeding ponds (i.e., individuals return year after year to the same location to breed), so direct removal of breeding habitat can have considerable effects on a population if additional breeding sites are not accessible on the landscape (Hamilton et al. 1998).

Canadian toads were detected during baseline surveys carried out in May and June (i.e., breeding season) for the Project. Canadian toad vocalizations were detected in the LSA on seven occasions, and two individuals were observed incidentally in amplexus (i.e., breeding posture) on the shores of Naomi Lake (Annex VIII.2). Canadian toad detections occurred in seven different ecosite / vegetation cover types in the LSA, including open water, late-stage regeneration upland, late-stage regeneration wetland, recent burn upland, jack pine/lichen, Labrador tea shrubby bog, and willow shrubby rich fen.

In the Base Case, existing anthropogenic disturbance in wetland and pond habitat is limited and is likely having a negligible effect on Canadian toad breeding habitat. Canadian toads often select breeding sites near human-disturbed water features (Russell and Bauer 2000; Stevens et al. 2006).

Sensory Disturbance

Anthropogenic disturbance on the landscape could potentially lead to a decline in the quality of Canadian toad breeding habitat occurring in proximity to noise sources (Bee and Swanson 2007; Annich 2017). Sensory disturbance would, however, vary in its effect on species, depending on their adaptability. Recent habitat modelling in northeastern Alberta showed a non-significant effect of noise-producing industry infrastructure on Canadian toad occupancy (Annich 2017).

Literature on ZOIs (e.g., areas of habitat avoidance due to sensory disturbance) for Canadian toad is limited. However, the ENV Activity Restriction Guidelines for Sensitive Species recommend minimum setback distances from various levels of disturbance for Canadian toad and these distances were applied as ZOI buffers in the habitat suitability model. The guidelines recommend a 90 m setback from high and medium disturbance activities (ENV 2017).

Habitat Suitability

The descriptions of breeding habitat and disturbance effects from the literature were used to support the habitat suitability modelling. Characterizing habitat suitability for Canadian toad was focused on defining breeding habitat because it was not possible to measure site-specific soil conditions required for overwintering at the scales of the LSA and RSA (i.e., soil map units were not mapped for the entirety of the RSA). Each ecosite type within LSA and RSA was classified as either "suitable" or "not suitable" based on the ability to support Canadian toad breeding habitat. Habitat suitability rankings of land cover types and ecosites for Canadian toad breeding habitat in the RSA, which includes the LSA, are provided in Table 14.3-17.

Breeding habitats within 90 m of human developments with high and moderate levels of activity (i.e., Highway 955, existing access road, exploration activities, cutlines / seismic lines, rough roads, trails) were determined to be "not suitable" (Table 14.3-17).

Table 14.3-17: Suitability of Land Cover Types and Ecosites for Canadian Toad Breeding Habitat

Land Cover Type	Ecosite[(a)]	Suitability[(b)]
Graminoid wetland	BP21; BP26; BP28; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS24(BU/L)	Suitable
Immature or young treed wetland	BP18(BU/E); BP19(BU/E); BP23(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BS16(BU/L)	
Mature treed wetland	BP18; BP19; BP23	
Open wetland	BP22; BP27; BS25; BS25(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS22; BS23; BP20(BU/E); BP25(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS22(BU/L); BS23(BU/L)	
Open water	Water	
Graminoid wetland	BS19; BS19(BU/L)	
Immature or young treed wetland	BS17(BU/E); BS21(BU/E); BS17(BU/L); BS21(BU/L)	
Mature treed wetland	BS17; BS21	
Open wetland	BS20; BS20(BU/E); BS20(BU/L)	
Shrubby wetland	BS18; BS18(BU/E); BS18(BU/L)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Recent burn wetland	Recent burn (wetland)	
Immature upland forest	BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	Not suitable
Young upland forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Mature upland forest	BP02; BP03; BP04; BP06; BP07; BP11; BP12; BP14; BP16; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13; BS14; BS15	
Recent burn upland	Recent burn (upland)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Existing disturbance	Cutlines / seismic lines; trail; existing access road; Highway 955; rough road; clearing; NexGen non-linear development; historical oil and gas activities; exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Appendix 14B, Attachment 14B-1.
b) Within 1,300 m of waterbodies between 1.5 ha and 20 ha.

In the Base Case, the LSA contains 134.5 ha (4.8%) of suitable breeding habitat for Canadian toad (Table 14.3-18). Existing disturbances such as trails, cutlines, and seismic lines decrease the availability of suitable habitat, but the magnitude may be overestimated as the current level and frequency of activity associated with many of these features is not known. The availability of suitable breeding habitat increases in the RSA to 15,325.8 ha (14.3%; Table 14.3-18) but is limited by the amount of open wetland ecosites. The majority of the RSA is covered by small patches of undisturbed wetland habitats, including open water, which make up 30% of the total area of the RSA; however, the vast majority of wetland habitat is dominated by black spruce treed bog (Section 13.3.2.1). Open and graminoid wetland types (i.e., dominated by undifferentiated grass-like plants) preferred by Canadian toads for breeding are patchy and relatively uncommon in the RSA compared to the presence of treed bog wetlands.

Table 14.3-18: Canadian Toad Breeding Habitat Availability in the Local and Regional Study Areas at Base Case

Habitat Suitability	LSA		RSA	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Suitable	134.5	4.8	15,325.8	14.3
Not suitable	2696.9	95.2	92,164.9	85.7
Total	**2831.6**	**100.0**	**107,490.7**	**100.0**

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
LSA = local study area; RSA = regional study area.

14.3.11.2 Habitat Distribution

Habitat Arrangement and Connectivity

Connectivity between wetland breeding habitats and upland habitat types used for foraging and overwintering is important for most amphibians, including Canadian toad (Russell and Bauer 2000). Movement through the landscape (i.e., habitat connectivity) is important for Canadian toads to connect breeding populations, promote gene flow between breeding units, and access the various types of habitats that they rely on as a part of their life history (Compton et al. 2007; Semlitsch 2008; Todd et al. 2009; Annich et al. 2019). Most studies have found Canadian toads within 100 m of open water; however, they have been found up to 1,500 m away from breeding areas (Kuyt 1991; Roberts and Lewin 1979; Constible et al. 2010). Amphibians, including Canadian toad, are at risk of predation and desiccation in open habitat, and therefore rely on a network of wetlands, small ponds, or flooded areas to move through the landscape during migratory or dispersal movements (Semlitsch 2008; Bull 2009; Todd et al. 2009).

In general, pond-breeding amphibians are considered intolerant of habitat fragmentation because they rely on good habitat connectivity on the landscape to link their breeding grounds to the habitat they occupy during the active season (Rittenhouse et al. 2008; Rittenhouse et al. 2009). Fragmentation on the landscape has been shown to adversely affect dispersal success and juvenile survivorship, both of which can have important effects on the health of a breeding population (Cushman 2006). Altering the configuration of forested and wetland habitat on the landscape can also lead to isolation of breeding ponds and reduce the suitability of some terrestrial habitats, which Canadian toads would potentially use for dispersal or hibernation (Rittenhouse et al. 2008; Todd et al. 2009).

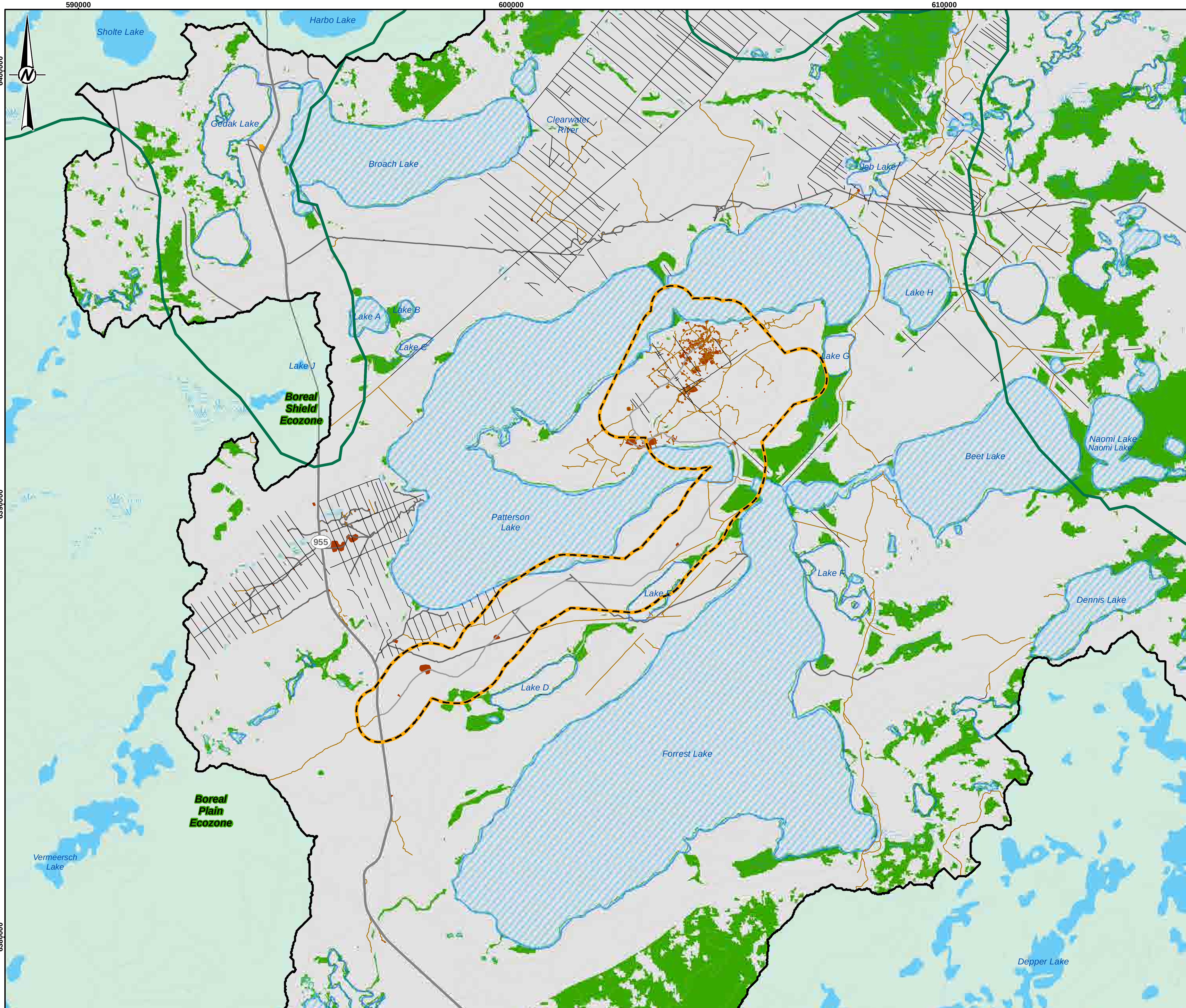
The limited amount of suitable breeding habitat that occurs in the central portion of the RSA between Forrest Lake and Beet Lake and north of Beet Lake is surrounded by recently burned upland habitat. Habitat connectivity in this portion of the RSA is expected to be low in the Base Case as toads are less likely to occupy upland habitats with low overhead cover due to the risk desiccation (Semlitsch 2008).

In the eastern half of the RSA, breeding habitat appears to be well connected in the southeast near Dyck Lake and in the north along Hook Creek (Figure 14.3-25). Much of the wetland habitat that occurs along Hook Creek is surrounded by burned jack pine/blueberry/lichen (BS03[BU]) forest cover (Section 13.3.1.3). This landcover type is associated with some overhead cover in the form of regenerating jack pines (Section 13.3.1.3); therefore, the BS03(BU) would presumably be more suitable for Canadian toad than the recently burned habitat present elsewhere in the RSA.

Linear Features

In the Base Case, suitable breeding habitat for Canadian toad in the LSA is restricted to a few patches adjacent to Lake D, Lake E, Forrest Lake, Lake G, and Patterson Lake (Figure 14.3-24). Most of the suitable breeding habitat for Canadian toads in the LSA is surrounded by either large waterbodies or burned pine-dominated upland habitat. Canadian toad movement is relatively localized (i.e., within 2 km of breeding areas) on the landscape, and Canadian toads do not disperse great distances relative to other wildlife VCs. This suggests that in the Base Case, breeding habitat is well-connected on the landscape to habitats that the species would use outside of the breeding season (i.e., for foraging, dispersal, and hibernation). Existing anthropogenic disturbances may restrict movements of Canadian toads in the LSA, particularly the existing access road and cleared open areas; however, studies have shown that adult western toads (*Anaxyrus boreas*) will enter and disperse through clearcuts and along roads during the active season (Deguise and Richardson 2009). The current density of linear features in the RSA (0.6 km/km^2) is likely causing negligible adverse effects on Canadian toad.

Suitable breeding habitat is more common and connected in the western half of the RSA (Figure 14.3-25). The largest patches of suitable breeding habitat for Canadian toad occur in the southwest and central portions of the RSA. These large patches of suitable breeding habitat are surrounded by areas of either intact or regenerating forest habitat, which are relatively unfragmented by anthropogenic disturbance, apart from Highway 955. Highway 955 is likely a partial barrier to toad movement and dispersal, particularly during periods of high traffic volume.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

CANADIAN TOAD BREEDING HABITAT IN THE LOCAL STUDY AREA, BASE CASE

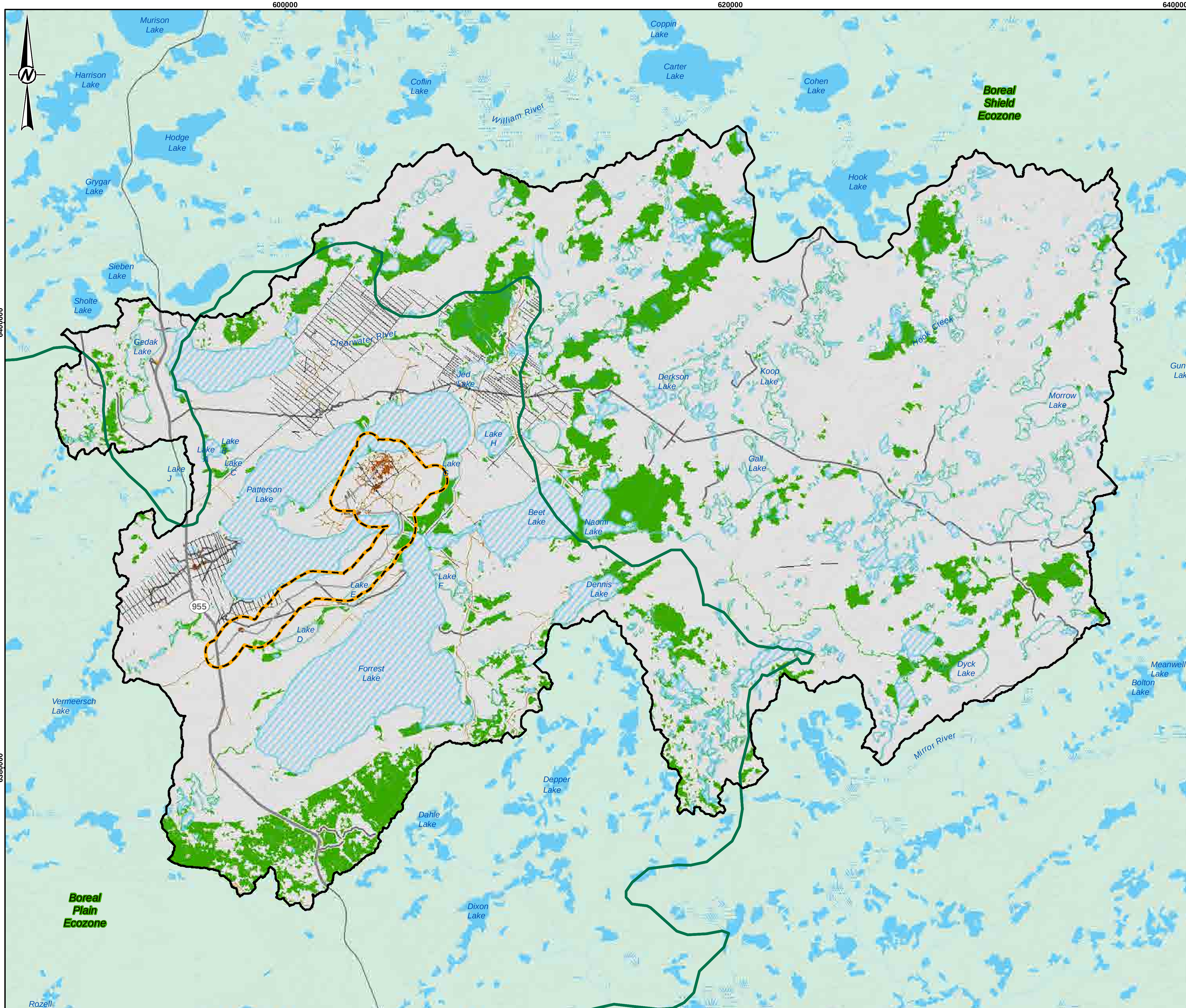
CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.3-24**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

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ROOK I PROJECT

TITLE

CANADIAN TOAD BREEDING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.3-25	
REVIEW	JV	2023-02-09		

14.3.11.3 Survival and Reproduction

Vital Rates

Canadian toads mature quickly, with males beginning to breed at one year of age and females becoming reproductively active at two years (Eaton et al. 2005). Canadian toads have high fecundity, with each female capable of producing several thousand eggs during the breeding season (Eaton et al. 2005). Because of the high fecundity and long lifespan of adults, populations are expected to be capable of surviving short-term environmental disturbances if breeding habitat remains available on the landscape (Eaton et al. 2005). In the Base Case, existing human activities in the LSA and RSA are expected to have little influence on reproductive success.

Canadian toad populations in Alberta have declined over the past several decades due to habitat loss from industrial activity (Eaton et al. 2005). Studies of Canadian toad populations in Saskatchewan have been limited, particularly in the boreal forest. However, the amount of existing anthropogenic disturbance in the RSA is low (0.4%) and expected to have had little influence on Canadian toad populations. Fires have also created open habitats, but given the high fecundity and ability of Canadian toads to travel through wetlands and adjacent vegetated upland habitats, the species is anticipated to be resilient to existing levels of natural disturbance in the RSA.

Threats to Survival

Threats to survival include predation and desiccation. Survival rates among toad tadpoles and young-of-the-year is low as the early life stages are targeted by a variety of predator species (Eaton et al. 2005). Canadian toads are also vulnerable to desiccation and predation during their annual migratory movements between breeding ponds and the upland habitats they use for foraging or for hibernation (Rittenhouse et al. 2008; Todd et al. 2009; Hamilton et al. 1998; Semlitsch 2008). In the Base Case, existing development activities and associated open/disturbed habitats in the LSA and RSA are not expected to be affecting predation or desiccation risk for Canadian toads.

Disease

Amphibian populations are also vulnerable to viral and fungal infection, which can be introduced by human activity and can spread rapidly through populations, leading to significant declines in survival among individuals (Stevens et al. 2012; Earl et al. 2016). Pathogens introduced into amphibian populations can cause direct mortality in individuals but can also affect fecundity rates and predator avoidance, thus reducing survival and reproductive rates (Lesbarrères et al. 2014).

An inventory in Alberta between 2006 and 2020 detected chytrid fungus (*Batrachochytrium dendrobatidis*) in several areas and amphibian populations, including sites in the boreal region (Stevens et al. 2012). Ranavirus has also been identified in amphibian populations in central and southern Saskatchewan (Schock et al. 2008). The presence of disease in the RSA in the Base Case is unknown; however, disease and pathogens are a possible risk to Canadian toad populations in the RSA.

14.4 Project Interactions and Mitigations

The pathway analysis identified potential adverse effects of the Project on wildlife VCs, identified practicable mitigation for these potential effects, and determined whether any of the potential effects could be sufficiently mitigated such that they are not expected to cause a residual adverse effect. As described in Section 14.2.7, Project Interactions and Mitigations, the pathway analysis assigned each potential effect as:

- no pathway (i.e., mitigation results in no effect on wildlife VCs);
- secondary pathway (i.e., mitigation results in a negligible effect on wildlife VCs); or
- primary pathway (i.e., effect that is greater than negligible and carried forward for further assessment).

The pathway analysis is summarized in Table 14.4-1. The subsections following the table provide the rationale used to assign potential effects to the no pathway and secondary pathway categories and list primary pathways. Each Project interaction identified as a primary pathway was carried forward for detailed assessment in Section 14.5. Effects pathways apply to all Project phases and wildlife VCs unless otherwise noted.

The environmental design features and mitigations in Table 14.4-1 represent the list of key actions used to inform the pathway analysis as part of preparing the EIS. In addition to this list of key actions, NexGen would implement the Environmental Protection Program, which would describe the processes required to monitor and characterize effects from Project facilities and activities. This program would be used to periodically evaluate mitigation performance and identify additional mitigation, where required, and prompt potential adaptive management measures (Section 14.7). Where relevant, adaptive management measures may also be proposed to address uncertainties associated with effects predictions and mitigation. The process for determining when, how, and where to use adaptive management would be described within the Integrated Management System Manual.

Potential accidents and malfunctions that have the capability to influence biophysical or human environments are discussed in Section 21, Accidents and Malfunctions.

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-01	Project components/activities that contribute to the Project footprint during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ process plant ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ handling and storage of waste rock, special waste rock, and ore ▪ sewage treatment plant and water storage and effluent monitoring ponds ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Habitat loss:** ▪ Direct removal or alteration of soil and vegetation can cause loss of wildlife habitat and affect wildlife abundance and distribution	▪ **Site access road** between gatehouse and mine terrace realigned during Project design **to avoid a wetland** ▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing the use of cleared areas for Project activity o using existing road infrastructure, including the existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ **Minimize areas of vegetation clearing and soil disturbance** ▪ **Locate the communications tower** away from wetlands and other high suitability habitats for species at risk ▪ **Minimize steepness and length of slopes** of disturbed areas and stockpiled soils ▪ **Use clearing equipment that minimizes surface disturbance, soil compaction, and topsoil loss** (e.g., equipment with low ground pressure tracks or tires, blade shoes and brush), where feasible ▪ To the extent practical, **work in sensitive areas** (i.e., erosive soils, wetland features, and fish habitats) would be scheduled **to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation** (e.g., spring freshet) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Work with government and Indigenous communities to **develop caribou mitigation and offsetting actions** ▪ Implement a Project-specific **Environmental Protection Program** ▪ Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program ▪ If in specific situations where the setback distance(s) cannot practically be applied, contact the ENV early in the planning stage to **minimize effects on sensitive species** ▪ Minimize habitat creation and human-wildlife interactions for the Project through design; specifically, by evaluating opportunities to include screening on vents and entranceways to rafters/attics ▪ If bats or birds are observed nesting, roosting, or hibernating, do not disturb them, to the extent practicable. **Contact the ENV and ECCC to discuss** measures for the removal/relocation and to identify further measures that could prevent future access ▪ For **worker protection and prevention** of the spread of rabies and white nose syndrome, **contact the ENV and ECCC if any sick, injured, or dead bats are observed**. Only trained and rabies-vaccinated staff or contractors would be allowed to handle bats. Submit bat carcasses for testing of rabies and/or white nose syndrome, as appropriate, based on communications with the ENV and ECCC	Primary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-02	Project components/activities that alter soil conditions or final terrain (topography) conditions during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ process plant ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ handling and storage of waste rock, special waste rock, and ore ▪ sewage treatment plant and water storage and effluent monitoring ponds ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Habitat alteration:** ▪ Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect wildlife habitat availability and distribution, and survival and reproduction	▪ **Minimize areas of vegetation clearing** and soil disturbance ▪ **Minimize steepness and length of slopes** of disturbed areas and stockpiled soils ▪ As part of reclamation activities, complete **contouring of disturbed areas** to minimize erosion, re-establish drainage, and encourage the growth of vegetation ▪ Fill and **contour the site to blend with the natural surrounding topography**, to the extent practical ▪ To the extent practical, **work in sensitive areas** (i.e., erosive soils, wetland features, and fish habitats) would be scheduled **to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation** (e.g., spring freshet) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ Work with government and Indigenous communities to **develop caribou mitigation and offsetting actions** ▪ Use **native species** or non-aggressive, non-native species appropriate for the conditions for revegetation ▪ **Reclaim and revegetate** areas where non-permanent Project facilities have been decommissioned ▪ Adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have **no net loss of wetland functions** ▪ Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required ▪ Implement a Project-specific **Environmental Protection Program** and actions to avoid and **limit invasive plant species** ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-03	Project components/activities that contribute to sensory disturbance during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ additional infrastructure (e.g., camp, maintenance shop, and offices) ▪ handling and storage of waste rock, special waste rock, and ore ▪ power generation ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	**<u>Sensory disturbance:</u>** ▪ Sensory disturbance (e.g., presence of people, air traffic, lights, dust, smells, noise) can alter wildlife movement and behaviour and adversely affect wildlife habitat availability and wildlife abundance and distribution	▪ **Enclose or dampen equipment in process buildings** where the total sound power level is expected to be more than approximately 80 A-weighted decibels, where feasible ▪ **Use and maintain noise suppression** (i.e., mufflers) on vehicles and inspect regularly to make sure they are functioning properly ▪ Where practical, **maintain overflight altitudes of >300 m above ground level** ▪ **Limit idling of vehicles and equipment** to the extent practical ▪ **Limit light pollution** to the extent practical for built infrastructure ▪ Other than where required to comply with regulatory guidelines (e.g., aviation safety) or worker health and safety, the **following guidance will be used for Project lighting** design when migratory birds may be present: o **limit the use of decorative lighting** and solid burning or slow pulsing warning lights o to the extent possible, **orient lights downward or use shielded fixtures** and limit light use to areas where Project activities are occurring (Dick 2016) o to the extent feasible, **use the amber light [spectrum >500 nanometre],** limit blue spectral light, and do not use white light, (Dick 2016) o **turn off lights** when not in use (e.g., use timers, motion sensors) (Dick 2016) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Implement an Environmental Protection Program that includes **no harassing, feeding, or approaching wildlife** ▪ If sensitive species are confirmed in the Project footprint, **apply activity restriction guidelines for sensitive species** established by the Government of Saskatchewan (ENV 2017) to the Project as required ▪ If bats or birds are observed nesting, roosting, or hibernating, do not disturb them, to the extent practicable. **Contact the ENV and ECCC to discuss** measures for the removal/relocation and to identify further measures that could prevent future access ▪ Work with government and Indigenous communities to **develop caribou mitigation and offsetting actions** ▪ Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Primary pathway
W-04	Project components/activities that alter vegetation ecosystems **during Construction**: ▪ fibre optic line	**<u>Fibre optic line direct loss:</u>** ▪ Direct loss, alteration, and fragmentation of habitat from installation of the fibre optic line can affect wildlife abundance and distribution	▪ Align the fibre optic line **right-of-way adjacent to existing highway and access road** ▪ Implement **sedimentation and erosion control** best practices and standard mitigation (e.g., temporary sediment ponds, silt curtains, sediment traps) during all Project phases ▪ Implement best management practices and mitigation such as **spill prevention** ▪ Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required	Secondary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-05	Project activities that contribute to risk of wildlife injury/mortality **during Construction**: ▪ land clearing, site preparation, and construction of facilities and infrastructure	**Injury and mortality from clearing:** ▪ Vegetation removal and soil alterations during site preparation and construction may result in injury or mortality to individual animals with low mobility (e.g., denning black bears or marten) and destruction of nests, eggs, and individuals of migratory birds (i.e., incidental take)	▪ **Site access road** between gatehouse and mine terrace realigned during Project design **to avoid a wetland** ▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing the use of cleared areas for Project activity o using existing road infrastructure, including the existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ If sensitive species are confirmed in the Project footprint, **apply activity restriction guidelines for sensitive species** established by the Government of Saskatchewan (ENV 2017) to the Project as required ▪ If vegetation removal is required during the black bear denning/hibernation periods, conduct bear den presence/absence surveys and wildlife tree surveys prior to clearing activities ▪ Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required ▪ If in specific situations where the setback distance(s) cannot practically be applied, contact the ENV early in the planning stage to **minimize effects on sensitive species** ▪ **Minimize habitat creation and human-wildlife interactions for the Project** through design; specifically, by evaluating opportunities to include screening on vents and entranceways to rafters/attics ▪ If bats and birds are observed nesting, roosting, or hibernating, do not disturb them, to the extent practicable. **Contact the ENV and ECCC to discuss** measures for the removal/relocation and to identify further measures that could prevent future access. Damage or danger permits may be obtained, if required ▪ For **worker protection and prevention** of the spread of rabies and white nose syndrome, **contact the ENV and ECCC if any sick, injured, or dead bats are observed**. Only trained and rabies-vaccinated staff or contractors would be allowed to handle bats. Submit bat carcasses for testing of rabies and/or white nose syndrome, as appropriate, based on communications with the ENV and ECCC	Secondary pathway
W-06	Project components/activities that contribute to the introduction of designated weed species during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ roads and airstrip ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and materials to and from the site	**Invasive plants affecting habitat:** ▪ Introduction and spread of noxious, exotic, and/or invasive plant species can affect wildlife habitat availability and distribution	▪ Use **native species** or non-aggressive, non-native species appropriate for the conditions for revegetation ▪ **Check construction materials and test seed mixes** for presence of invasive plants prior to use ▪ **Inspect construction equipment** prior to arriving at site and clean, if required o Utilize maintenance shop to support cleaning, once constructed and as required ▪ Implement a Project-specific **Environmental Protection Program**, which includes actions to prevent, detect, control (i.e., remove), and monitor areas with prohibited, noxious, and nuisance weeds / invasive species (e.g., along the access road, airstrip, and loading or staging site), following best practice guidance	Secondary pathway
W-07	Project components/activities that contribute to the Project footprint during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ process plant ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ handling and storage of waste rock, special waste rock, and ore ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Increased edge habitat:** ▪ Vegetation clearing would result in an increase in edge habitat, which could increase nest predation for olive-sided flycatcher and other forest birds	▪ **Site access road** between gatehouse and mine terrace realigned during Project design **to avoid a wetland** ▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing the use of cleared areas for Project activity o using existing road infrastructure, including the existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program ▪ Implement an **Environmental Protection Program** with restricted activity periods to limit effects on denning animals and nesting migratory birds during sensitive time periods (e.g., per Nesting Zone B6 [ECCC 2018] guidelines and the *Migratory Birds Convention Act 1994*). If sensitive periods cannot be avoided, pre-clearing wildlife sweeps will be completed by qualified professionals and buffers applied, as required	Secondary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-08	Project components/activities that change access for predators during **all Project phases**: ▪ development and improvement of access road and site roads ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Increased predator access:** ▪ Increased access for predators (e.g., wolf and black bear) and prey may increase predation risk and decrease survival and reproduction for moose and caribou	▪ **Use existing road** infrastructure, including the existing access road and bridge, to meet Project requirements ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ **Work with government and Indigenous communities to develop caribou mitigation and offsetting actions** ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-09	Project activities that change access for Indigenous and other land users during **all Project phases**: ▪ development and improvement of access road and site roads ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ transportation of personnel and material to and from the site	**Increased public access:** ▪ Changes in public access to hunting/trapping areas and increased density of people (i.e., Project staff and contractors) in the area may alter ungulate and carnivore survival and reproduction and affect abundance	▪ **Use existing road** infrastructure, including existing access road and bridge crossing, to further develop the access road to meet Project requirements ▪ **Install a gate at the site entrance** (i.e., gatehouse) to control public access ▪ **Do not allow hunting by employees** in areas within the Project footprint ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-10	Project components/activities that contribute to deposition of fugitive dust emissions during **all Project phases**: ▪ land clearing, site preparation and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant operation ▪ handling and storage of waste rock, special waste rock, and ore ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and material to and from the site	**Air emission effects via inhalation or ingestion:** ▪ Fugitive dust emissions and associated constituents (e.g., metals, radionuclides) may cause changes in air, soil, and water quality, which can adversely affect wildlife health, survival, and reproduction through inhalation and ingestion of soil/water and food sources	▪ **Apply water and/or suppressants to site roads, access road, and airstrip** as necessary. Dust suppressants used would minimize environmental risk and be government approved for use ▪ **Limit vehicle speed on unpaved site roads** to reduce fugitive dust during Construction and Operations ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring ambient air, water quality, and aquatic organisms and applying adaptive management, if necessary ▪ Implement a Project-specific **Effluent and Emissions Plan** ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-11	Project components/activities that contribute to emissions of criteria air contaminants and fugitive dust during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ additional infrastructure (e.g., camp, maintenance shop, and offices) ▪ handling and storage of waste rock, special waste rock, and ore ▪ non-hazardous waste incineration ▪ power generation ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	**Soil contamination from emissions:** ▪ Deposition of suspended solids in criteria air contaminant emissions (e.g., potential acid inputs) may change soil quality and vegetation and affect wildlife habitat availability and distribution	▪ Primarily **use liquified natural gas for power generation** ▪ Identify and implement **procurement criteria** to confirm stationary and mobile engines meet applicable performance standards ▪ **Use and maintain emissions control devices** on combustion-based equipment ▪ Conduct **regular equipment maintenance** ▪ **Limit idling** of vehicles and equipment to the extent practical ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring ambient air, water quality, and aquatic organisms and applying adaptive management, if necessary ▪ Implement a Project-specific **Environmental Protection Program**	Secondary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-12	Project components/activities that may change surface water and sediment quality through treated effluent release during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ ETP and treated effluent discharge ▪ additional infrastructure (e.g., roads, airstrip, and camp) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Treated effluent discharge:** ▪ Release of treated effluent into Patterson Lake may cause changes to surface water and sediment quality and adversely affect wildlife health, survival, and reproduction through contact and ingestion of water and food sources	▪ Install and operate an ETP to reduce release of COPCs (e.g., major ions, metals, radionuclides) to the environment and discharge treated effluent to Patterson Lake ▪ Locate proposed treated effluent diffuser away from sensitive or unique habitats, to the extent practical ▪ Design the treated effluent diffuser to **provide effective mixing and dilution of the effluent** to limit the area of the receiving environment affected by mine discharge ▪ **Design diffuser/outfall such that discharged flow does not interact with sediment** ▪ **Treat ore processing water** and **monitor site contact water, treating if necessary**, before discharge to the receiving environment ▪ **Monitor treated effluent** flow and quality ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water quality, sediment quality, and aquatic organisms, and applying adaptive management, if necessary ▪ Perform **routine monitoring** process parameters to provide optimal treatment ▪ Implement a Project-specific **Environmental Protection Program** ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-13	Project components/activities that may change surface water and sediment quality through direct site runoff during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant ▪ handling and storage of waste rock, special waste rock, and ore ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Surface water quality from runoff:** ▪ Changes in surface water quality from contact with surface facilities and additional infrastructure could adversely affect wildlife health, survival, and reproduction through ingestion of water and food sources	▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Implement a Project-specific **Mine Waste Management Plan** ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water quality, sediment quality, and aquatic organisms, and applying adaptive management, if necessary ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-14	Project components/activities that potentially change groundwater quality **following Closure**: ▪ WRSAs, UGTMF, and backfilled stopes	**Water quality from WRSAs and UGTMF:** ▪ Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may alter surface water quality in Patterson Lake after Closure and adversely affect wildlife health, survival, and reproduction	▪ Use **engineered cemented paste backfill and tailings** to control source concentrations ▪ **Apply binder** to reduce permeability in backfill and tailings ▪ **Implement source control** (i.e., construction using engineered layers) and installation of a liner for the PAG WRSA ▪ Install **engineered cover system** on PAG and NPAG material during reclamation	Secondary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-15	Project components/activities that potentially alter surface water levels and flows through diversions and releases during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ ETP and treated effluent discharge ▪ domestic waste water discharge following treatment in sewage treatment plant ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Surface flow changes:** ▪ Changes in surface water levels, flows, and drainage areas could affect soils and vegetation, and wildlife habitat availability and distribution	▪ **Limit the Project footprint** to the extent practical using practices such as: o optimizing use of cleared areas for Project activity o using existing road infrastructure, including the existing access road and bridge crossing o storing tailings underground o designing an efficient infrastructure footprint (i.e., buildings clustered together) ▪ Provide adequate **contact water storage capacity** to allow controlled rate of release during both routine and non-routine operation scenarios ▪ **Avoid placing soil stockpiles near waterbodies** (i.e., maintaining 150 m buffer from waterbodies and watercourses), and near natural drainage features, unless required for temporary storage ▪ **Minimize areas of vegetation clearing** and soil disturbance ▪ **Minimize steepness and length of slopes** of disturbed areas and stockpiled soils ▪ **Use erosion control** measures as required ▪ To the extent practical, **work in sensitive areas** (i.e., erosive soils, wetland features, and fish habitats) would be scheduled **to avoid periods that may result in high flow volumes and/or increase erosion and sedimentation** (e.g., spring freshet) ▪ Perform routine inspection and maintenance of **water containment and conveyance structures** (i.e., roadside ditches and culverts) to limit the risk of road wash-out or sediment release to the environment ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Implement a Project-specific **Environmental Monitoring Plan** that includes monitoring water levels and flows and applying adaptive management, if necessary ▪ Implement a Project-specific **Environmental Protection Program** ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-16	Project components that decrease wildlife movements during **all Project phases**: ▪ site water management ▪ site roads and access road ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**Linear barriers:** ▪ Above-ground pipelines and snowbanks on site roads and the access road could decrease habitat connectivity and adversely affect animal distribution	▪ **Design above-ground infrastructure so that the need for wildlife crossing structures is minimized** (e.g., small to moderate diameter pipeline conveyance systems directly along the ground, often through low points such as small ditches) ▪ **Snow clearing along the access road to incorporate road pull-outs** at regular intervals to provide refuge for wildlife ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Implement a Project-specific **Environmental Protection Program**, which includes the following mitigation measures: o providing wildlife with the right of way o maintaining gaps in the road berms and snowbanks to facilitate wildlife crossing and escape routes ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway
W-17	Project components that contribute to risk of injury/mortality to birds during **all Project phases**: ▪ above-ground power distribution lines	**Power line injury and mortality:** ▪ Electrocution by or collisions with power lines may cause injury or mortality to birds	▪ Design power lines to **meet avian-safe standards** in compliance with applicable laws, regulations, and permits to prevent electrocutions (e.g., cover jumper wires, conductors, and equipment), discourage perching and prevent collisions (e.g., install markers to enhance the visibility of lines in key movement corridors and staging areas)	Secondary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-18	Project activities that contribute to risk of vehicle-wildlife collisions during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ handling and storage of clean waste rock, special waste rock, and ore ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and materials to and from the site	<u>**Vehicle injury and mortality:**</u> ▪ Collisions with vehicles, buildings, equipment, and aircraft on site, and vehicles travelling to and from site may cause injury or mortality to individual animals	▪ Implement a Project-specific **Environmental Protection Program**, which includes the following mitigation measures to minimize the risk of injury or mortality to people and wildlife: o **advising staff, contractors, and visitors** to take all reasonable precautions to avoid wildlife collisions o **providing wildlife with the right of way** o **identifying wildlife use areas and movement corridors/crossings** along the access road and providing appropriate signage in high wildlife use areas (including consideration of Canadian toad) o maintaining gaps in the road berms and snowbanks to facilitate wildlife crossing and escape routes o **stopping and reporting/communicating when wildlife is observed on or adjacent to the road** and allow animals to move away before continuing to drive o **reporting any wildlife collisions** observed along any road immediately o **adjusting speed limit** in accordance with conditions (e.g., wildlife use of road, road conditions, grade, weather, and loads on vehicle)	Secondary pathway
W-19	Project components/activities that contribute to attraction of wildlife to the Project site during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ process plant ▪ water storage and treated effluent monitoring ponds ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, and offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	<u>**Wildlife attractants:**</u> ▪ Attraction of wildlife to the Project site (e.g., food waste, sewage, petroleum-based products, dust suppressants, explosive powder, site runoff ponds) may increase human-wildlife interactions and change predator-prey relationships, which can affect animal survival and reproduction	▪ Implement a Project-specific **Environmental Protection Program**, which includes processes for the following: o prohibition against feeding wildlife o lined contact water ponds would either be fenced or fit with animal egress matting or ramps o other measures for deterring wildlife from site where needed for human and wildlife protection, including the use of cannons or bangers ▪ **Collect domestic (e.g., food) and industrial (e.g., used oil and lubricants) waste** and temporarily store in wildlife-proof containers, incinerate on site, transport off site for recycling, or dispose of at a licensed disposal facility, as appropriate ▪ **Apply water and/or suppressants to site roads, access road, and airstrip**, as necessary. Use dust suppressants that minimize environmental risk and are government approved for use ▪ Implement a Project-specific Conventional Waste Management Plan ▪ If in specific situations where the setback distance(s) cannot practically be applied, contact the ENV early in the planning stage to **minimize effects on sensitive species** ▪ **Minimize habitat creation and human-wildlife interactions** for the Project through design; specifically, by evaluating opportunities to include screening on vents and entranceways to rafters/attics ▪ To the extent practical, skirt buildings and stairs to the ground to limit opportunities for use as shelter by wildlife. ▪ If bats or birds are observed nesting, roosting, or hibernating, do not disturb them, to the extent practicable. **Contact the ENV and ECCC to discuss** measures for the removal/relocation and to identify further measures that could prevent future access ▪ For **worker protection and prevention** of the spread of rabies and white nose syndrome, **contact the ENV and ECCC if any sick, injured, or dead bats are observed**. Only trained and rabies-vaccinated staff or contractors would be allowed to handle bats. Submit bat carcasses for testing of rabies and/or white nose syndrome, as appropriate, based on communications with the ENV and ECCC	Secondary pathway
W-20	Project components/activities that influence surface water quality of mine water management facilities during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ process plant ▪ handling and storage of waste rock, special waste rock, and ore ▪ water storage and treated effluent monitoring ponds ▪ additional infrastructure (e.g., roads, airstrip, camp, maintenance shop, offices) ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	<u>**Direct harm from contact water:**</u> ▪ Direct contact with or ingestion of water from water storage / treated effluent monitoring ponds can cause adverse effects on wildlife health, survival, and reproduction	▪ **Conduct wildlife patrols regularly during waterbird nesting periods** (Zone B6: late April to mid-August; ECCC 2018) and the northern and southern migration periods to monitor effectiveness of deterrents and apply adaptive management, as necessary ▪ Implement **progressive reclamation and revegetation** of disturbed areas no longer required ▪ **Reclaim and revegetate areas** where non-permanent Project facilities have been decommissioned ▪ Implement a Project-specific **Effluent and Emissions Plan** and a Project-specific **Environmental Monitoring Plan** ▪ Implement a Project-specific Environmental Protection Program that would include process for wildlife and bird deterrents around contact water ponds (e.g., cannons, bangers, sonic guns), including prior to and during the nesting periods for Zone B6 (late April to mid August; ECCC 2018) and the northern and southern migration periods ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	Secondary pathway

Table 14.4-1: Potential Effects Pathways for Wildlife and Wildlife Habitat

Pathway ID	Project Components/Activities	Effects Pathway	Environmental Design Features and Mitigation	Pathway Assessment
W-21	Project components/activities that contribute to deposition of radon emissions during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ process plant and underground operations ▪ handling and storage of waste rock, special waste rock, and ore ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure	**<u>Air emissions affecting habitat:</u>** ▪ Radon emissions may change soil quality and vegetation ecosystems and affect wildlife habitat availability and distribution	▪ Implement a Project-specific **Environmental Monitoring Plan** that includes ambient air monitoring and adaptive management based on ambient air quality standards	No pathway
W-22	Project components/activities that potentially change groundwater quality during **all Project phases**: ▪ handling and storage of waste rock, special waste rock, and ore	**<u>Groundwater quality changes from seepage:</u>** ▪ Runoff and seepage from the WRSAs may cause changes in groundwater quality and transfer up the food chain, adversely affecting wildlife health, survival, and reproduction	▪ **Segregate PAG material** from NPAG material and store separately ▪ **Implement source control** (i.e., construction using engineered layers) and installation of liner for the PAG WRSA ▪ Install **engineered cover system** on PAG and NPAG material during reclamation ▪ Use **engineered containment and conveyance of PAG waste rock runoff** and seepage to the PAG Runoff Collection Area ▪ Implement a Project-specific **Mine Waste Management Plan** ▪ Implement site water management procedures under an **Environmental Protection Program** that include monitoring seepage from WRSAs and applying adaptive management, if necessary ▪ Develop and implement a **Preliminary Decommissioning and Reclamation Plan** with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program	No pathway
W-23		**<u>Soil contamination from seepage:</u>** ▪ Runoff and seepage from the WRSAs can change soil quality and affect vegetation, which can affect wildlife habitat availability and distribution		No pathway
W-24	Project components/activities that require dust suppressants and may attract wildlife during **all Project phases**: ▪ land clearing, site preparation, and construction of facilities and infrastructure ▪ underground shaft and mine development ▪ handling and storage of waste rock, special waste rock, and ore ▪ removal of infrastructure ▪ reclamation and revegetation of facilities and infrastructure ▪ site traffic ▪ transportation of personnel and material to and from the site	**<u>Harm from dust suppressants:</u>** ▪ Ingestion of chemical dust suppressants may adversely affect wildlife health, survival, and reproduction	▪ **Apply water and/or suppressants to site roads, access road, and airstrip**, as necessary. Use dust suppressants that minimize environmental risk and are government approved for use ▪ Use **water as a dust suppressant** to the extent practical ▪ Implement a Project-specific **Environmental Protection Program** with processes for dust suppression	No pathway
W-25	Project components/activities that have potential to alter the timing and thickness of ice formation and timing of ice thaw in localized area of the Patterson Lake North Arm – West Basin during **all Project phases**: ▪ ETP and treated effluent discharge	**<u>Harm from altered ice conditions:</u>** ▪ Treated water discharged through the diffuser may change timing and thickness of ice formation and timing of ice thaw, which can increase risk of some wildlife (e.g., caribou) breaking through the ice and affect survival and reproduction	▪ **Develop the final ETP diffuser design** such that it would avoid effects on ice cover	No pathway
W-26	Project activities that contribute to risk of wildlife injury/mortality **during Operations**: Communication tower and associated fence	**<u>Permanent communication tower injury and mortality:</u>** Collisions with the permanent communication tower or collisions with / entanglement in the fence surrounding the base of the communication tower may cause injury or mortality to birds and bats	▪ **Limit the tower lighting** to only what is required for aviation safety (e.g., flashing light on the top of the tower) ▪ **Minimize guy wires** on the communication tower and install markers to enhance the visibility of any guy wires that may be required ▪ **Follow avian-safe standards** in compliance with applicable laws, regulations, permits, and best management practices to prevent electrocution (e.g., cover jumper wires, conductors, equipment) and avoid attraction by lights	Secondary pathway

Bolded text represents the key topic of the environmental design features and mitigation.
WRSAs = waste rock storage areas; COPC = constituent of potential concern; ETP = effluent treatment plant; UGTMF = underground tailings management facility; ECCC = Environment and Climate Change Canada; NPAG = non-potentially acid generating; PAG = potentially acid generating; PAG WRSA = potentially acid generating waste rock storage area; dBA = A-weighted decibel; > = greater than.

14.4.1 No Pathways

The following Project interactions were predicted to result in no pathway to wildlife VCs and were not carried forward in the assessment.

W-21: Air emissions affecting habitat:

- Radon emissions may change soil quality and vegetation ecosystems and affect wildlife habitat availability and distribution.

Radon emissions would be released as a gas from the process plant, underground operations, and WRSAs. Members of the BNDN expressed concerns about controlling radon gas and how far chemical emissions (e.g., radon) from the Project travel, as well as the effects of radon gas on terrestrial resources and how it would be monitored (BNDN-JWG 2020b; BNDN-JWG 2021c; BNDN-JWG 2021d).

Soils in the maximum disturbance area are not expected to absorb radon gas; therefore, measurable changes to soil quality are not expected (Section 12.4.1, No Pathways). Radon atoms released through radium decay within soil pore space and are dispersed to the atmosphere, and do not reabsorb into the soil particle. An Environmental Monitoring Plan would be implemented to monitor air emissions.

Radon emissions are not expected to affect vegetation ecosystems (Section 13.4.1, No Pathways) and subsequently would have no influence on wildlife habitat; therefore, the pathway was removed from the assessment.

W-22: Groundwater quality changes from seepage:

- Runoff and seepage from WRSAs may cause changes in groundwater quality and transfer up the food chain, adversely affecting wildlife health, survival, and reproduction.

AND

W-23: Soil contamination from seepage:

- Runoff and seepage from the WRSAs can change soil quality and affect vegetation, which can affect wildlife habitat availability and distribution.

Extracted ore, special waste rock, and waste rock would be stored at surface in designated areas or WRSAs (Section 5.11.4, Mine Waste Management). Runoff and seepage from these storage areas during all Project phases could cause changes to groundwater quality, which has the potential to change soil quality and adversely affect vegetation, resulting in subsequent adverse changes to wildlife habitat availability and distribution. Wildlife health, survival, and reproduction may also be negatively affected through the ingestion of water, and aquatic and terrestrial plants and animals.

- Indigenous Groups expressed concerns related to the effects of Project activities in general, including of mine waste materials on underground water quality and environmental health (TSD II: BNDN; TSD V.2: CRDN; BRDN-JWG 2020b; MN-S-JWG 2019a).

Seepage from the WRSAs during the Project lifespan would be mitigated by a number of proven engineering design features and techniques. Management of waste rock would begin when materials are hoisted from the underground mine to the surface. Ore, special waste rock, potentially acid generating (PAG), and NPAG material would be separated and stored separately. Ore stockpiles, special waste stockpiles, and the PAG WRSA would be lined with high density polyethylene to prevent seepage (Mine Waste Management Plan). The NPAG waste rock storage area would be unlined and used for short- and long-term storage of NPAG waste rock. Runoff the ore stockpiles, special waste stockpiles, and the PAG WRSA would be contained and diverted to the ETP and released to the environment after meeting discharge criteria. Runoff from the NPAG waste rock storage area would be collected for containment, and if it meets discharge criteria, would be released to the environment. Water not meeting discharge criteria would be considered contact water and diverted to the ETP for treatment prior to release (Effluent Monitoring Plan). As part of the Environmental Protection Program, WRSAs would be monitored for seepage to support groundwater protection and to verify the mine waste management measures are effective. A Preliminary Decommissioning and Reclamation Plan would also be developed and implemented with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program.

Groundwater potentially affected by seepage from WRSAs is not expected to interact with the top layers of soils that support the establishment and growth of vegetation. Any changes to groundwater from the WRSAs would occur below the surficial soil layers (Section 12.4.1). In the ecological health risk assessment, direct contact or uptake exposure pathways associated with groundwater were predicted to be incomplete (i.e., no direct pathway), as it was assumed that groundwater is inaccessible to ecological receptors (e.g., terrestrial plants and earthworms) or negligible relative to other pathways (TSD XXI). Subsequently, there would be no pathway to vegetation (Section 13.4.1) and no pathway to changes in wildlife habitat. There would also be no pathway to surface water quality (Section 10.4.1, No Pathways) and no pathway to fish health (Section 11.4.1, No Pathways), which removes potential changes to wildlife survival and reproduction. Both pathways (i.e., W-22 groundwater quality changes and W-23 soil contamination) were not carried forward in the assessment.

W-24: Harm from dust suppressants:

- Ingestion of chemical dust suppressants may adversely affect wildlife health, survival, and reproduction.

During community information sessions in the community of La Loche, conversations with participants indicated concern that the product applied to roads to control dust would not be safe for the environment, including wildlife (Section 2, Indigenous, Regulatory, and Public Engagement). To reduce fugitive dust (i.e., suspended dust particles in air) emissions (e.g., metals, radionuclides) from the Project, water and/or chemical dust suppressants would be applied to site roads, the access road, and airstrip as necessary (i.e., during dry conditions in the non-winter period). Watering is the most common control technique for unpaved road surfaces; however, chemical stabilization may also be used to reduce emissions of road dust (Government of Canada 2021). Dust suppression would occur in accordance with the Environmental Protection Program processes (Table 14.4-1). Appropriate dust suppression products would be chosen in consideration of environmental risks. When used in accordance with manufacturer's instructions, dust suppressants can lower the environmental health and safety effects associated with dust (Government of Nunavut 2014). Primary use of water as a dust suppressant and monitoring and adaptive management are predicted to result in no residual effects on wildlife health, survival, and reproduction; therefore, the pathway was not carried forward for further assessment.

W-25: Harm from altered ice conditions:

- Treated water discharged through the diffuser may change timing and thickness of ice formation and timing of ice thaw, which can increase risk of some wildlife (e.g., caribou) breaking through the ice and affect survival and reproduction.

Treated water from the ETP for the proposed Project would be discharged through a diffuser in Patterson Lake North Arm – West Basin. Evaluation of the conceptual design suggested that operation of the diffuser is expected to increase the flow velocity at the lake water surface, which could delay ice freeze-up, reduce ice thickness if ice is formed, and advance ice break-up in a localized area around the diffuser. For animals that have previously travelled over this area of Patterson Lake during winter, Project-related changes in ice conditions could increase the risk of injury or mortality if animals break through the ice. To avoid risk of injury or mortality to wildlife, the final ETP diffuser design for the Project would avoid changes to ice cover relative to existing conditions; therefore, this pathway was not carried forward in the assessment.

14.4.2 Secondary Pathways

The following Project interactions were predicted to result in secondary pathways to wildlife VCs and were not carried forward in the assessment.

W-04: Fibre optic line direct loss:

- Direct loss, alteration, and fragmentation of habitat from installation of the fibre optic line can affect wildlife abundance and distribution.

An approximately 160 km fibre optic line may be installed underground from La Loche, SK, to the Project site. All construction is expected to occur in previously disturbed road allowances of Highway 955 and the existing access road for the Project, which would avoid new loss and fragmentation of wildlife habitat. Given that plough-in construction methods are anticipated to be used (i.e., cable is buried with a specialized plough instead of digging a trench), the disturbance width would be minimal (i.e., approximately 1 m based on existing construction practices), and natural plant regeneration is expected to adequately reclaim the disturbance over time. Wildlife species that currently avoid the highway and vehicle traffic are not expected to be affected by construction activities associated with installation of the fibre optic line. Any changes in wildlife movement and behaviour from sensory disturbance would be limited to the installation of the fibre optic line and are predicted to be small and reversible shortly after construction.

If construction occurs during the migratory bird nesting period (i.e., 24 April to 31 August [Nesting Zone B6; ECCC 2018]), then non-intrusive methods or pre-clearance nest searches would be conducted by qualified professionals to determine presence of bird nests and to protect these nests with an appropriate setback (ENV 2017; ECCC 2018). If any listed wildlife species are encountered within the work area, construction would cease, and the Saskatchewan Activity Restriction Guidelines for Sensitive Species (ENV 2017) would be adhered to, in consultation with the ENV, as applicable.

NexGen is committed to implementing best management practices to mitigate effects on the environment during construction (e.g., erosion control practices, spill prevention measures). Therefore, changes to wildlife habitat availability and distribution and survival and reproduction from installation of the fibre optic line are predicted to be minor relative to existing conditions and result in negligible residual effects on wildlife abundance and distribution. As such, the pathway was assessed as secondary and not carried forward in the assessment.

W-05: Injury and mortality from clearing:

- Vegetation removal and soil alterations during site preparation and construction may result in injury or mortality to individual animals with low mobility (e.g., denning black bears or beaver) and destruction of nests, eggs, and individuals of migratory birds (i.e., incidental take).

The ability of VCs to avoid or move away from construction activities can be extremely constrained during certain life-history periods or stages. For example, although all bird VCs are extremely mobile, their nests, eggs, and fledglings are not. Similarly, black bear and beaver can move quickly to avoid potential harmful interactions, but bears are susceptible to human-related stressors during denning periods, and beaver movements are more constrained during winter. Caribou and moose may also be adversely influenced immediately prior to and for a short period after calving. Direct removal of habitat during these periods of the life history of VCs can increase the risk of injury or mortality to adults and their young.

The *Migratory Birds Convention Act, 1994* prohibits the destruction of migratory bird nests (e.g., songbirds [excluding corvids] and waterfowl) during the breeding season. Raptors (e.g., hawks and owls) are not protected under the *Migratory Birds Convention Act*, *1994*; however, they are protected under *The Wildlife Act*. During baseline wildlife surveys, four breeding bird species listed under Schedule 1 of the SARA were observed in the LSA, including common nighthawk (i.e., SARA status as Special Concern), barn swallow (i.e., SARA status as Threatened), olive-sided flycatcher (i.e., SARA status as Special Concern), and rusty blackbird (i.e., SARA status as Special Concern; Government of Canada 2023). These species are protected under the SARA, which prohibits the damage or destruction of the residence (e.g., nest) of species listed under Schedule 1 of SARA as Special Concern, Endangered, Threatened, or Extirpated.

Bird nests, eggs, and/or birds could be destroyed during land clearing, site preparation, and construction of facilities and infrastructure. To the extent possible, clearing and grubbing of vegetation would be completed outside of the breeding/nesting season (i.e., 24 April to 31 August annually [Nesting Zone B6; ECCC 2018]), which would mitigate injury or mortality for nesting birds. Minimizing disturbance during bird nesting would also minimize disturbance to calving ungulates. If vegetation removal is required during the nesting period, then non-intrusive nesting surveys (i.e., searches for active nests and to document breeding bird behaviour such as pairing, singing, alarm calling, carrying food, and distraction displays) would be completed by qualified biologists prior to clearing activities. If nests are discovered, the qualified biologist would consult with ECCC or the ENV, as required, to apply appropriate buffers to avoid disturbance. Application of timing restriction for nesting birds also provides mitigation to reduce effects on bat maternity roosting habitat (i.e., bats roost in forested areas during summer months).

Animals in dens may be at higher risk of injury if these dens occur within the anticipated Project footprint and are not detected by pre-construction surveys. Juveniles in dens would be at higher risk of mortality because they are not mobile immediately after birth. For bears, the survival of young could decrease if anthropogenic disturbance leads to relocation of den sites (Argue et al. 2008). In a study in the Boreal Shield of Saskatchewan, Neufeld (2018) reported black bear denning dates ranging from 10 September to 23 October annually, and den emergence from 19 April to 27 April annually (McLoughlin 2021). As a result, denning dates for black bear in the RSA are expected to be late September to mid-April. American marten natal (i.e., birthing) and maternal dens could occur in the LSA, and harm would be reduced by avoiding clearing mature forest and wildlife trees (i.e., dead or decaying trees, standing, or fallen) from 11 March to 31 July (Ellis 1999; Environment Canada 2013c; Strickland and Douglas 1987), which mostly overlaps the migratory bird breeding/nesting season. If vegetation removal is required during the black bear denning/hibernation periods (i.e., fall to winter) or marten denning periods (i.e., 11 March to 31 July [Ellis 1999; Environment Canada 2013c; Strickland and Douglas 1987]), then bear den presence/absence surveys and wildlife tree surveys would be completed by qualified biologists prior to clearing activities. If dens are discovered, then ENV would be consulted to determine appropriate mitigation.

Little is known of the denning requirements of black bears in the LSA; however, Neufeld (2018) observed that for 14 black bears denning in the Saskatchewan Boreal Shield, sites selected by bears showed avoidance of water within 100 m of dens and average denning of at least 14 km from a road. The proposed Project footprint is located approximately 11 km from Highway 955, and the existing access road would be used during Construction and Operations. It is predicted that the LSA would likely represent unsuitable denning habitat for black bears. Under existing conditions, high and moderate suitability beaver habitat is uncommon in the LSA, primarily due to fire disturbance, suggesting that the LSA may provide limited habitat value for beavers relative to other areas in the RSA.

The implementation of mitigation is anticipated to avoid and reduce Project-related changes to the survival and reproduction of black bears, marten, and beavers that may be denning, migratory birds that may be nesting, or bats maternity roosting in the LSA. Any adverse interactions between the Project and wildlife are expected to be infrequent and have a minor influence on the regional population relative to existing conditions and are predicted to result in negligible residual effects on VCs. As such, the pathway was assessed as secondary and not carried forward in the assessment.

W-06: Invasive plants affecting habitat:

- Introduction and spread of noxious, exotic, and/or invasive plant species can affect wildlife habitat availability and distribution.

In Saskatchewan, weeds are designated as prohibited, noxious, or nuisance species under *The Weed Control Act*. Weed species primarily have the potential to alter ecosystem condition (i.e., wildlife habitat) in areas adjacent to new disturbance (i.e., edge habitats), particularly where the edge-to-interior ratio (i.e., the quantity of edge habitat compared to the area of interior forest) is high (Honnay et al. 2002). Ecosystems with undisturbed soils that occur away from disturbances are relatively resistant to invasion by weed species. However, habitat edges are prone to invasion in part because of the increased likelihood of soil disturbance. Anthropogenic activities have the potential to accelerate the invasion of native ecosystems by weeds through the introduction of seeds or disturbance of soils (Hobbs and Humphries 1995). Non-native plant species can negatively affect wildlife habitat availability if non-native species come to dominate native vegetation in certain areas, thereby reducing habitat niches for some wildlife.

An Environmental Protection Program would be implemented to prevent, detect, control (i.e., remove), and monitor areas with prohibited, noxious, and nuisance weed species (e.g., along the access road, airstrip, and laydown areas). Construction equipment would be inspected and cleaned, if required, prior to arriving on site. Once the maintenance shop is built, vehicles would be cleaned in the wash bay with a containment and a sump. Construction materials would be checked and seed mixes tested for presence of invasive plants prior to use for reclamation.

The implementation of best management practices and mitigation is expected to avoid and minimize the introduction and spread of weed species in the maximum disturbance area of the Project and result in minor changes to the condition of upland, wetland, and riparian ecosystems (Section 13.4.2, Secondary Pathways). As such, any potential changes are predicted to have a negligible residual effect on wildlife and wildlife habitat, and the pathway was assessed as secondary and not carried forward in the assessment.

W-07: Increased edge habitat:

- Vegetation clearing would result in an increase in edge habitat, which could increase nest predation for olive-sided flycatcher and other forest bird species.

For many species of forest birds, nest predation and parasitism (i.e., relationship where one species benefits at the expense of the other) rates are higher along forest edges than in interior forest (Paton 1994; Robinson et al. 1995). The creation of new forest edge may facilitate predator movement and access to nests in adjacent forest habitats, particularly by avian predators like corvids (e.g., crows, ravens, and jays) because these species can occur at higher densities in disturbed habitat relative to undisturbed habitats (Andrén 1994; Chalfoun et al. 2002). Small mammalian predators appear less opportunistic in selecting edge habitat than avian predators (Chalfoun et al. 2002) but can still exploit ground-nesting birds (e.g., mallard).

Olive-Sided flycatchers are associated with high contrast habitats including burned forests, logged areas, and natural forest openings such as gaps, meadows, rivers, and wetlands (Altman and Sallabanks 2012). Edge habitat preferred by olive-sided flycatcher includes small forest clearings of less than 10 ha within mature forest (Norris et al. 2021). Within the LSA, 17.4% of upland and wetland habitat has remained unburned in the past 40 years while 64.9% has been burned in the past 40 years. The Project could incrementally increase the amount of edge habitat within the LSA, which has the potential to adversely influence olive-sided flycatcher survival and reproduction. However, vegetation clearing due to the Project would result in small amounts of additional high contrast habitats due to limited amounts of dense or mature habitat types in the LSA.

The increase in forest edge habitat would likely be ecologically non-measurable because the maximum disturbance area overlaps an existing access road, previously created trails and roads, and clearings associated with the existing exploration camp. The Project would not result in an increase in the density of linear features in the LSA and RSA relative to existing conditions. All roads and non-permanent Project features would be reclaimed and revegetated, and a Preliminary Decommissioning and Reclamation Plan would be developed and implemented with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program (Table 14.4-1). Thus, the increase in edge habitat due to the Project could result in minor changes in nest survival of olive-sided flycatcher and other forest breeding birds in the LSA relative to existing conditions, but changes are more likely to be not measurable. Any minor changes are predicted to have a negligible residual effect on olive-sided flycatcher and other forest birds; therefore, the pathway was assessed as secondary and not carried forward in the assessment.

W-08: Increased predator access:

- Increased access for predators (e.g., wolf and black bear) and prey may increase predation risk and decrease survival and reproduction for moose and caribou.

AND

W-09: Increased public access:

- Changes in public access to hunting/trapping areas and increased density of people (i.e., Project staff and contractors) in the area may alter ungulate and carnivore survival and reproduction and affect abundance.

Roads and associated access provide increased opportunities for humans and predators to use an area, which can result in increased mortality from hunters, poachers, wolves, and bears, since linear features allow ease of movement into previously inaccessible areas (Horejsi 1979; Bergerud et al. 1984; McLellan 1988; Brody and Pelton 1989; Jalkotzy et al. 1997; Stuart-Smith et al. 1997; Rettie et al. 1998; James 1999; James and Stuart-Smith 2000; Tigner et al. 2014; Dickie et al. 2016).

The BRDN and MN-S commented that wolves are one of the key threats to moose (BRDN-JWG 2020a; MN-S-JWG 2019a) and caribou populations (BNDN-JWG 2021b; BRDN-JWG 2020a; MN-S-JWG 2020a). The

CRDN and BNDN have commented that the development of new roads and cutlines in the Patterson Lake area from mineral exploration activities have led to greater access for outside hunters and resulted in decreases in wildlife populations and increased competition for wildlife resources (TSD II: BNDN; TSD V.1: CRDN; TSD V.2: CRDN). Indigenous Groups are concerned about increased traffic on Highway 955 from the Project and from non-Indigenous recreational users leading to increased hunting activities and decreased opportunities for Indigenous land users (TSD II: BNDN; CRDN 2019; MN-S-JWG 2020a). For example, the MN-S suggested that truckers may hunt animals along the way to the Project site (MN-S-JWG 2020a). Project concerns raised by Indigenous Groups related to Indigenous land and resource use and where they are addressed are discussed in more detail in Section 16 (Cultural and Heritage Resources and Indigenous Land and Resource Use).

The Project would not increase access for humans and predators as an access road to the area of the Project already exists. The existing access road would be upgraded and used during all Project phases. Improvements to roads can affect wildlife through increased access for hunting/trapping (Jalkotzy et al. 1997; Trombulak and Frissell 2000); however, upgrades to the access road for the Project are expected to result in no measurable change to existing access for hunting/trapping. The proposed road upgrades are intended to enable the safe and efficient transport of heavy materials, equipment, and fuel, which would not increase the current use of the road for light and all-terrain vehicles and snowmachines. Further, mitigations described in Table 14.4-1 (e.g., gated Project site entrance, no hunting by employees in areas within the Project footprint) are expected to limit hunting and trapping in the LSA.

Traffic along the access road may cause avoidance by wolves, caribou, and moose. Roads with high traffic volumes may be a partial barrier to wolf movement, while roads with low traffic volumes may be preferred travel corridors for wolves (Gurarie et al. 2011; Paquet and Callaghan 1996). Caribou have been found to reduce their use of areas within approximately 1 km of oil and gas wells and 250 m of roads (Dyer et al. 2001). Laurian et al. (2008) found that moose showed avoidance of areas up to 500 m from highways, and that highway and forest road crossing frequencies were 16 and 10 times lower than expected by chance, respectively. In a subsequent study, moose avoidance of roads was found to vary seasonally from 100 m to 250 m (Laurian et al. 2012). Avoidance of traffic by wolves, caribou, and moose would decrease the potential for increased access due to road upgrades.

Black bears are not expected to avoid roads and trails, especially in relation to human activity; however, this behaviour is likely strongly linked, at least in spring, to outfitting activities that may occur along roads in the RSA where baiting for bears is likely (McLoughlin 2021). Habituation to vehicles suggested by MN-S-JWG (2019a) may be associated with baiting (McLoughlin 2021). The main Project site entrance would be gated to control public access, and no hunting by employees would be allowed in areas within the Project footprint (Table 14.4-1), which is anticipated to limit potential attraction or habituation of black bears to the LSA due to baiting.

There is currently limited risk of human-caused mortality from hunting of caribou in the LSA and RSA. Recreational hunting of caribou has not been permitted in the province since 1987 although there is no mandatory or voluntary reporting, so harvest levels of caribou are difficult to determine (ENV 2013). Although caribou are still considered an important cultural species to Indigenous Groups, they have indicated that there is currently no real local hunt for caribou (MN-S-JWG 2020a), places that were traditionally hunted now have no caribou (BNDN-JWG 2020b), people have voluntarily stopped hunting them because they want to see caribou numbers return (CRDN-JWG 2021), and moose have always been the primary species for hunting (BNDN-JWG 2021). An increase in people in the area is not expected to result in a proportional increase in harvest of ungulates as government-regulated hunting limits would be maintained. Nonetheless, increased access into the region from improved roads and increased knowledge of the region due to the influx of workers and contractors could result in poaching. This would be minimized through NexGen wildlife policies and employee and contractor training programs.

Overall, the Project is anticipated to result in no measurable change in access for predators, prey, and hunters in the LSA and RSA relative to existing conditions. The increase in the level of human activity in the LSA associated with the Project is also expected to deter most predators, and prey, from using the access road and Project site. The increase in the number of people in the area during the Project lifespan could result in a minor increase in illegal harvesting of animals. As such, Project-related access and activities are predicted to have a negligible residual effect on the abundance of wildlife VCs, and the pathway was assessed as secondary and not carried forward in the assessment.

W-10: Air emission effects via inhalation or ingestion:

- Fugitive dust emissions and associated constituents (e.g., metals, radionuclides) may cause changes in air, soil, and water quality, which can adversely affect wildlife health, survival, and reproduction through inhalation and ingestion of soil/water and food sources.

Activities such as land clearing, site preparation, construction of facilities, site traffic, handling of waste rock during Construction and Operations, and removal of infrastructure and revegetation during Closure would generate fugitive dust. Accumulation of airborne dust produced from the Project may result in local and direct changes to vegetation (Section 13.4.2), which could affect wildlife habitat. Metals and radionuclides in dust can also affect plants, either indirectly through the soil (Section 12.4.2, Secondary Pathways) or directly through the surface of the plant (Section 13.4.2), which could change wildlife habitat availability and distribution.

Indigenous Groups reported that having access to a healthy environment and clean natural resources is critical for harvesting activities, including hunting, trapping and plant gathering, and for community well-being. For example, the CRDN stated that living and harvesting activities "are predicated on clean air and clean water" (TSD V.2: CRDN). In community information sessions, LPA community members noted that air quality was a key interest and concern and important component of the environment (NexGen 2019a).

Indigenous Groups raised concerns about the potential effects of air emissions and radiation from Project activities on water quality, vegetation, and wildlife health, which in turn could affect the safety of wild foods and hunting, trapping, and gathering activities (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BRDN-JWG 2020b; BRDN-JWG 2021a; CRDN-JWG 2020b; CRDN-JWG 2020; MN-S-JWG 2019b). Specific concerns were expressed by Indigenous Groups related to the adverse effects of uranium dust on the environment, which is believed to travel hundreds of kilometres with the wind and affect the air, water, and vegetation (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; MN-S-JWG 2019b). Air quality modelling and an ecological risk assessment were completed to determine whether the dust concerns are a risk for the environment. Project concerns raised by Indigenous Groups related to Indigenous land and resource use and where they are addressed are discussed in more detail in Section 16.

Air quality modelling was completed to predict the amount and spatial extent of dust deposition and associated constituents from the Project during Construction and Operations (Appendix 7A, Air Dispersion Modelling Report). Results indicate that the dust deposition rate was higher during Operations than Construction, which is a function of the type of dust, height that dust is released, and the fraction of PM_{10} (i.e., particulate matter with a diameter of 10 µm or less) in total suspended particulates. Rates of dust deposition and accumulation also depend on the rate of supply from the source, wind speed, precipitation events, topography, and vegetation cover (Brown and Berg 1980; Rusek and Marshall 2000).

The annual dust deposition rate during Operations was predicted to be 11.2 micrograms per cubic metre ($\mu g/m^3$) at the boundary of the maximum disturbance area, which is well below the Saskatchewan Ambient Air Quality Standard of 60 $\mu g/m^3$ (Section 7.2.5, Residual Effects Analysis). Therefore, dust from the Project would be highly localized within the LSAs of wildlife VCs. Wildlife are also expected to avoid or spend little time in the Project footprint due the presence of noise and other mine-related activities, which would reduce exposure to constituents.

Metals that are non-radionuclides and radionuclides in dust may also be accumulated by wildlife through inhalation of dust and ingestion of soil, water, and food resources and adversely affect the health of animals. An ecological risk assessment was completed to determine the health risks to aquatic and terrestrial wildlife receptors from the Project, which included inhalation and ingestion (i.e., soil, sediment, water, plants, animals) exposure pathways. The risk assessment modelled exposure pathways during Operations and an upper bound scenario (i.e., a more conservative, precautionary model). Results indicated that predicted levels of metals and radionuclides in the environment from the proposed Project for the upper bound scenario would not cause adverse effects on the health of wildlife VCs and other wildlife receptors (TSD XXI).

Mitigation in the Effluent and Emissions Plan is expected to be effective at reducing the magnitude and spatial extent of fugitive dust deposition (Table 14.4-1). Water and/or dust suppressants would be applied to the airstrip, site roads, and the access road as necessary (i.e., during dry conditions in the non-winter period). Speed limits would be enforced and are expected to reduce the production of dust emissions. After implementing mitigation, dust deposition is expected to result in minor changes in vegetation ecosystems. However, these changes are predicted to be well within the maximum disturbance area and have a negligible residual effect on wildlife habitat availability and distribution. Metals and radionuclides in fugitive dust emissions are also predicted to not cause adverse effects on survival and reproduction of wildlife VCs. As a result, the pathway was assessed as secondary and not carried forward in the assessment.

W-11: Soil contamination from emissions:

- Deposition of suspended solids in criteria air contaminant emissions (e.g., potential acid inputs) may change soil and vegetation and affect wildlife habitat availability and distribution.

Deposition of suspended solids in criteria air contaminant emissions associated with Project activities are expected to occur from the combustion of fossil fuels in large equipment, aircraft, trucks, vehicles, power generation, and the incineration (i.e., burning) of non-hazardous waste materials (e.g., food garbage). Criteria air contaminants include $PM_{2.5}$ (i.e., particulate matter with a diameter of 2.5 μm or less) and PM_{10}, total suspended particulates, carbon monoxide, sulphuric acid, sulphur dioxide, and nitrogen dioxides.

Changes in soil and vegetation ecosystems resulting from Project air contaminant emissions could affect the availability and distribution of wildlife habitat. Air particulate emissions can change soil quality and subsequently lead to effects on vegetation by altering soil pH, nutrient content, and the composition of soil organisms (Section 13.4). Deposition of sulphur dioxide and nitrogen dioxide could lead to acidification of soils, and short-term (e.g., 24-hour) exposures to high concentrations of sulphur dioxide may also result in dead or chlorotic (i.e., pale or yellow due to insufficient chlorophyll) plant tissue. However, long-term exposures (e.g., annual) to lower concentration levels of sulphur dioxide may or may not result in visible injury to plants (Alberta Environment 2004). Mineral (i.e., clay) and organic matter colloid content (i.e., particle size of 2 μm in diameter or less) of soil, and pH level affect sensitivity of soil to acidification (Holowaychuck and Fessenden 1987) and, therefore, can also affect the sensitivity of vegetation ecosystems to acidification.

Indigenous Groups have expressed concerns about changes in air quality from Project activities and effects on terrestrial environmental health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN). For example, the CRDN expressed concerns about Project-related air emissions, “containing an unknown combination of toxins and contaminants, will flow for considerable (unknown) distances in all directions and will permeate all life forms in their rise and fall back to the ground as acid rain and snow” (TSD V.2: CRDN). These concerns are based, in part, on Indigenous Groups reporting they have observed the effects of poor air quality and acid rain from existing or previous industrial developments, including from the Alberta oilsands region and the Cluff Lake Mine, which they believe has affected terrestrial environmental health (TSD II: BNDN, TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BRDN-JWG 2019a; BRDN-JWG 2019b; CRDN-JWG 2021; MN-S-JWG 2019b). For example, the CRDN and MN-S commented that they will not eat berries or hunt wildlife in the Cluff Lake Mine area because of their belief that the area is contaminated (TSD V.2; CRDN; CRDN-JWG 2020b; CRDN-JWG 2020c; CRDN-JWG 2021; MN-S-JWG 2019b).

Members of BRDN commented about changes observed in the vegetation in the BRDN’s traditional territory, noting that half the trees are different colours, which is attributed to acid rain from Alberta, and that the trees are dying from the top down, which is a sign of poor air quality (BRDN-JWG 2019a; BRDN-JWG 2019b). The MN-S stated that the trees on the side of the road near the Cluff Lake Mine were dying, which was attributed to carbon emissions or dust from increased traffic (MN-S-JWG 2019a). The MN-S described how fewer wildflowers, butterflies, and grasshoppers are observed now because of air emissions from the oil sands region near Fort McMurray (MN-S-JWG 2019b). Air quality modelling was completed to determine whether the types of effects observed at Cluff Lake and in the oil sands would be expected for the Project.

Air quality modelling was used to predict maximum ground-level concentrations of criteria air contaminant emissions during Construction and Operations (Section 7.2.5, Residual Effects Analysis). Cumulative concentrations were calculated by adding values for the Base Case to maximum predicted values for Construction and Operations. Results indicate that concentrations of criteria air contaminants beyond the maximum disturbance area would be well within Saskatchewan air quality guidelines during Construction and Operations (Section 13.4.2; Table 13.4-2), including carbon monoxide and sulphuric acid. Emissions for nitrogen dioxide and sulphur dioxide during Construction and Operations were also well below World Health Organization guideline values for protecting vegetation (Section 13.4.2). The exception is PM_{10}, which is predicted to exceed the associated air quality guideline value during both Project phases. During Construction, most of the area of exceedance of PM_{10} (i.e., 279 ha) would overlap Patterson Lake North Arm and extend approximately 1.2 km from the boundary of the maximum disturbance area (Section 7.2.5.2, Application Case during Closure). In contrast, during Operations, the area of exceedance towards the North Arm would be substantially reduced (i.e., 9 ha) and extend 203 m from the boundary of the maximum disturbance area. Since exceedances would occur mostly over Patterson Lake North Arm, it is anticipated that there would be minimal changes to vegetation ecosystems (Section 13.4.2).

Environmental protection and monitoring plans developed for the Project are expected to limit the emissions of criteria air contaminants and associated effects on soils, vegetation ecosystems and wildlife habitat (Environmental Protection Program, Environmental Monitoring Plan). Project designs and mitigation would include primary use of liquid natural gas for power generation, minimizing idling, emission control devices on combustion-based equipment and vehicles, regular maintenance of equipment, and procurement criteria that require specific stationary and mobile equipment to meet applicable performance standards (Table 14.4-1).

After implementation of environmental design features, mitigation, and monitoring, the deposition of criteria air contaminant emissions could result in a minor change to vegetation ecosystems within the maximum disturbance area, but most changes are likely to be too small to be measurable relative to existing conditions (Section 13.4.2). Any measurable changes are predicted to have a negligible residual effect on wildlife habitat availability and distribution and the pathway was not carried forward in the assessment.

W-12: Treated effluent discharge:

- Release of treated effluent into Patterson Lake may cause changes to surface water and sediment quality and adversely affect wildlife health, survival, and reproduction through contact and ingestion of water and food sources.

AND

W-13: Surface water quality from runoff:

- Changes in surface water quality from contact with surface facilities and additional infrastructure could adversely affect wildlife health, survival, and reproduction through ingestion of water and food sources.

Water from site runoff (i.e., contact water) and underground operations would be monitored, treated as required, and discharged to Patterson Lake after meeting discharge criteria. Domestic waste water would also be treated and discharged to Patterson Lake after meeting discharge criteria. The release of treated effluent may alter surface water and sediment quality and aquatic food resources, and adversely affect wildlife health, survival, and reproduction.

Indigenous Groups and LPA communities have commented on the potential for Project-related contaminants to enter the food chain through effects on water quality in Patterson Lake, and subsequent effects on terrestrial health (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019b; BRDN-JWG 2019a; BRDN-JWG 2020b; CRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019b; NexGen 2019a).

Surface water quality changes in Patterson Lake and lakes farther downstream in the aquatic LSA from the start to the end of Operations were assessed using a nearfield model and regional receiving environment model. Operations was assessed as this Project phase represents the period of maximum expected changes to surface water quality from the discharge of treated effluent and treated sewage from the Project. The expected magnitude, spatial extent, and duration of Project effects in the aquatic LSA were assessed using the regional model, while the nearfield model was used to assess potential effects in the immediate areas of the ETP diffuser and sewage treatment plant outfall (Section 10.2.6, Existing Conditions). Water quality thresholds were developed based on the Canadian Environmental Quality Guidelines for the Protection of Aquatic Life, and on provincial or federal objectives when no Canadian Council of Ministers of the Environment guidelines were available (Section 10.2.8.1, Water Quality Model Development and Integration).

Results indicate that no modelled water quality constituents or parameters exceeded their respective threshold values during Operations for the nearfield and regional assessments (Section 10.5, Residual Effects Analysis). Results for the upper bound scenario, a more conservative (i.e., precautionary) model, for the regional assessment indicated that most modelled constituents were below threshold values during Operations. The exception was chloride, which showed a slight localized exceedance (i.e., ~10 mg/L) for a brief period (i.e., approximately two years) that was limited to the Patterson Lake North Arm – West Basin.

An ecological risk assessment was completed to determine the health risks to aquatic and terrestrial wildlife receptors from changes in surface water quality due to the proposed Project, which included exposure pathways associated with the ingestion of sediment, water, plants, and animals. The risk assessment modelled exposure pathways during Operations and an upper bound scenario (i.e., a more conservative, precautionary model). Results indicated that predicted levels of water quality constituents in the environment from the Project for the upper bound scenario would not cause adverse effects on the health of wildlife VCs and other wildlife receptors (TSD XXI, Environmental Risk Assessment).

The Environmental Protection Program would be implemented to avoid and minimize changes in surface water quality during all Project phases, which would also mitigate effects on wildlife VCs (Table 14.4-1). Routine monitoring of water quality parameters would be conducted to inform optimal treatment of water, which would meet discharge criteria before release into Patterson Lake. The diffuser for the ETP and outfall for the sewage treatment plant would be designed to provide effective initial mixing and avoid sensitive aquatic habitat. The designs would also avoid direct interactions with lake bed sediments.

With the implementation of environmental design features, mitigation, monitoring and adaptive management, water quality in Patterson Lake and farther downstream is not predicted to cause adverse effects on the health, survival, and reproduction of wildlife VCs. Both pathways (i.e., W-12 and W-13) were not carried forward in the assessment.

W-14: Water quality from WRSAs and UGTMF:

- Runoff and seepage from the WRSAs and groundwater flow from the UGTMF may alter surface water quality in Patterson Lake after Closure and adversely affect wildlife health, survival, and reproduction.

Following Project Closure, runoff and seepage from the WRSAs and groundwater flow from the UGTMF may alter surface water quality in Patterson Lake and adversely affect the health, survival, and reproduction of wildlife. Proven engineered designs would be applied to the proposed Project to limit runoff and seepage from WRSAs such as installing covers on the WRSAs at Closure. During Operations, PAG waste rock would be separated from NPAG waste rock, and special waste rock would also be stored separately. The special waste rock stockpile and PAG WRSA would be lined with high density polyethylene to prevent seepage (Mine Waste Management Plan). Engineered paste tailings would be used in the UGTMF to control sources of COPCs (Table 14.4-1). A Preliminary Decommissioning and Reclamation Plan would also be developed and implemented with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program.

Surface water quality changes in Patterson Lake and lakes farther downstream of the aquatic LSA beyond Closure were assessed using a far-future scenario. The far-future scenario includes two stages to occur for 357 years (Section 10.2.4, Temporal Boundaries). The first stage (i.e., 157 years) includes natural hydrological and hydrogeological processes from the Project during post-closure (i.e., after Closure has concluded), such as seepage from the UGTMF and the WRSAs, and surface runoff from the covered and reclaimed areas. The first stage continues for at least three climate cycles to examine effects of climate on water quality. The second stage (i.e., 200 years) includes natural hydrological and hydrogeological processes where maximum mass loadings associated with seepages to groundwater are applied to Patterson Lake North Arm – West Basin to examine maximum potential effects on Patterson Lake and lakes farther downstream until steady-state conditions are achieved.

To evaluate the potential for effects on surface water quality, the maximum loadings (i.e., those reached towards the end of the solute transport model) were applied to the period of 157 to 357 years past Closure (i.e., the far future was effectively fast-tracked to the maximum loadings time period). This approach allows for a much shorter modelling timeframe to project the maximum potential changes to surface water quality in Patterson Lake in the far future and conservatively assumes that the UGTMF loadings that occur hundreds of thousands of years in the future overlap with loadings from the WRSAs.

The far-future scenario was assessed using the regional model and included an upper bound scenario (Section 10.2.8, Residual Effects Analysis). Most water quality parameters remained below their respective threshold values in the far-future scenario, except for cobalt and copper. In this scenario, cobalt exceedances were predicted for Patterson Lake North Arm – West Basin and Patterson Lake South Arm. Copper exceedances were predicted for Patterson Lake North Arm – West Basin (Section 10.5.1.2, Regional Surface Water Quality Model). For the upper bound scenario, cobalt exceedances were predicted for Patterson Lake North Arm – West Basin, Patterson Lake South Arm, Forrest Lake North Basin, and Beet Lake. Copper exceedances in the upper bound scenario were predicted for Patterson Lake North Arm – West Basin and Patterson Lake South Arm (Section 10.5.2.1). The ecological risk assessment applied the modelled concentrations of water quality constituents as input values for exposure pathways associated with the ingestion of sediment, water, plants, and animals to determine the health risks to wildlife receptors for the far-future and upper bound scenarios. The ecological risk assessment predicted that changes in surface water quality for the upper bound scenario would not cause adverse effects on the health of wildlife VCs and other wildlife receptors (TSD XXI).

Project designs are anticipated to minimize changes in surface water quality in Patterson Lake due to seepage from the WRSAs and groundwater flow from the UGTMF in the far future beyond Closure. Alterations in surface water quality in Patterson Lake farther downstream are not predicted to cause adverse effects on the health, survival, and reproduction of wildlife VCs; therefore, the pathway was not carried forward in the assessment.

W-15: Surface flow changes:

- Changes in surface water levels, flows, and drainage areas could affect soils and vegetation, and wildlife habitat availability and distribution.

Changes in the volume or rate of surface water flows due to the Project may adversely affect soils and vegetation ecosystems through desiccation (i.e., loss of moisture) or inundation (i.e., flooding). Wetland and riparian ecosystems experience water level fluctuations as part of natural variability, and riparian ecosystems can recover relatively quickly from flooding. Fluctuating water levels typically influence plant species composition, community structure, and species richness, and changes in the amplitude, frequency, and timing of flood or drought compared to historical levels can cause adverse effects on wetlands (Section 13.4.2).

A regional hydrological model was used to characterize and predict changes from Project activities to water surface levels and watercourse flow rates for the RSA (Section 9.6, Residual Effects Analysis). Outputs from the regional hydrological model were used as inputs to stream channel relationships and a fluvial sediment transport model. The regional hydrological model predicted surface water flows and levels from the start of Construction to the end of Closure. The results indicate that the net discharge of water to Patterson Lake from Project activities is expected to create small and difficult to measure changes such as increasing water surface elevation by 5 cm, increasing flows in the Clearwater River downstream of Patterson Lake by less than 5%, and changing stream channel parameters (i.e., wetted area) by less than 1%. Erosional losses in the upper reach of the Clearwater River and subsequent sediment deposition in the lower reach may increase by a non-detectable margin, and the net balance of sediment transported to Forrest Lake is expected to remain unchanged. Changes in surface water patterns from the Project are predicted to have a negligible residual effect on vegetation ecosystems in the LSA (Section 13.4.2).

Surface water in the receiving environment downstream of the Project would be protected and managed through the Environmental Monitoring Plan. Site contact water would be intercepted and managed in ways to reduce effects on the surrounding environment in accordance with the Environmental Protection Program (Table 14.4-1). The Project footprint is designed to minimize areas of vegetation clearing and soil disturbance and to optimize use of the existing access road, trails, and disturbed areas. The tailings management facility would be located underground, which avoids permanent disturbance to vegetation (i.e., natural control for soil erosion) and considers the concerns of Indigenous Groups regarding surface deposition of mine waste (Section 2).

In addition, work required in areas that may be more prone to erosion from surface water runoff and changes in surface water levels, flows, and drainage areas would be scheduled to avoid the time of year when erosion is most likely (i.e., spring freshet). The rate of discharge from the ETP would be managed by having adequate storage capacity to allow for controlled release rates, if required. A minimum 150 m buffer between soil stockpiles and waterbodies or drainages would be maintained (unless required for temporary storage) and all containment and conveyance structures (i.e., ditches and culverts) would be routinely inspected and maintained to limit risk of road wash-out or sediment release. Progressive reclamation and revegetation would also be implemented as disturbed areas are no longer required, and non-permanent features would be reclaimed and revegetated as they are removed. The Environmental Monitoring Plan includes monitoring surface water levels and flows. A Preliminary Decommissioning and Reclamation Plan would also be developed and implemented with government and Indigenous communities to decommission and transfer the site to the province under the Institutional Control Program.

Overall, environmental design features, mitigation, and monitoring are anticipated to minimize changes in surface water levels and flows, drainage areas, and channel parameters (Section 9.5, Project Interactions and Mitigations). Minor changes in surface water quantity from the Project are predicted to have negligible residual effects on vegetation and wildlife habitat availability and distribution; therefore, the pathway was not carried forward in the assessment.

W-16: Linear barriers:

- Above-ground pipelines and snowbanks on site roads and the access road could decrease habitat connectivity and adversely affect animal distribution.

Fragmentation of wildlife habitat can result from linear corridor developments such as above-ground pipelines and cleared rights-of-way through contiguous habitats, which can decrease species densities (Andrews 1990; Bayne et al. 2005). Barrier effects or alterations in species movement patterns could also result from linear corridors intersecting habitats (Carthew et al. 2009; Dunne and Quinn 2009). Along the Project site roads and the access road, gaps would be maintained in road berms and snowbanks to facilitate wildlife crossing at drainages, wildlife trails, or connected habitat patches so that wildlife movements across roads are not blocked, as determined in the field. Along the access road, low snowbanks would be maintained with breaks in snowbanks placed at regular intervals to allow passage of wildlife. Snow clearing along the access road would incorporate road pull-outs at regular intervals to provide refuge for wildlife moving along the road corridor.

Above-ground pipelines may affect the movement of wildlife either through avoidance (i.e., perceived obstruction) or acting as an actual physical barrier (Golder 2004). Above-ground pipelines associated with the Project would be small to moderate diameter conveyance systems placed directly along the ground, often through low points such as small ditches, such that the need for wildlife crossing structures would be minimized. These pipelines would not be expected to act as physical barriers to the movement of large mammals. Smaller mammals such as beaver, snowshoe hare, fox, American marten, and weasel would also be anticipated to travel over pipelines designed for the Project and at crossing structures. In contrast, pipelines may act as a movement barrier for Canadian toad; a study on amphibians showed that railroad mortality was highest among adult common toads and suggested that railroad tracks may be challenging for the species to cross (Budzik and Budzik 2014). Above-ground pipelines and snowbanks are not expected to affect bird VCs, which can fly over such features. Importantly, above-ground pipelines would be restricted to the main mine terrace and mill terrace area (i.e., not along the access road for the Project), which should limit potential barrier effects for wildlife, including Canadian toad. The mine terrace and mill terrace areas are also expected to be avoided by most wildlife VCs during all Project phases and are not predicted to provide quality habitat for wildlife VCs.

The implementation of mitigation measures (Table 14.4-1) is expected to result in a minor reduction in habitat connectivity and wildlife movement from snowbanks along the access road and pipelines in the mine terrace and mill terrace areas. The changes would be localized to the Project footprint and are predicted to have a negligible residual effect on wildlife VCs; therefore, the pathway was assessed as secondary and not carried forward in the assessment.

W-17: Power line injury and mortality:

- Electrocution by or collisions with power lines may cause injury or mortality to birds.

Power for the Project would be generated using a 13.8 kV liquid natural gas electrical power plant that would be located at the mill terrace (Section 5.4.7.5, Power Supply and Distribution). Power would be distributed by facilities overhead and buried lines. Two overhead lines would provide power to the mine terrace, and a third overhead line would provide power along the site roads in the Project footprint to the airstrip. Buried cables would be routed along the mill terrace edge to provide power to the process plant buildings and the ETP. Transmission lines carry 115 kV or higher, while distribution lines carry lower loads of electricity (1 kV to 69 kV; APLIC 2012). The proposed Project overhead and buried power lines would carry nominally 15 kV.

Birds are most commonly electrocuted when they come in contact with two adjacent conductors (i.e., phase-to-phase electrocution). The Avian Power Line Interaction Committee (APLIC 2006) provides a summary of issues and solutions to avoid electrocutions. In general, electrocutions can occur on structures with the following features (APLIC 2006):

- phase conductors (i.e., live high voltage wires) separated by less than the wrist-to-wrist, head-to-foot, or flesh-to-flesh distance of a bird; or
- distance between grounded hardware (e.g., grounded wires and metal towers) and any energized phase conductor that is less than the flesh-to-flesh distance of a bird.

Birds are generally more vulnerable to collisions with transmission lines (i.e., higher voltage) than distribution lines (i.e., lower voltage; Rioux et al. 2013). The poor manoeuverability of waterfowl and other waterbirds (e.g., grebes, cranes) appears to increase these species’ vulnerability to collisions with power lines, especially when power lines are located near wetlands (Erickson et al. 2005; Calvert et al. 2013; Rioux et al. 2013). Raptors and songbirds seem to be the most vulnerable to collisions with power lines in upland areas (Erickson et al. 2005). Larger birds, such as raptors, are vulnerable to electrocution because of their large wingspan and perching behaviour (Bevanger 1998; Manville 2005; Dwyer and Mannon 2007; Lehman et al. 2010). All bird groups are more vulnerable to electrocution and collisions with power lines during migration periods (Rioux et al. 2013), which may be due to flocking behaviour or inexperience of young birds (i.e., during fall migration).

The differences in the documented results of collision rates may vary among studies because power line collisions are a function of the following factors (Avery 1979; Bevanger 1995; Bevanger and Brøseth 2004; APLIC 2012):

- awareness of the presence of power lines;
- wind and weather, especially fog;
- time of day: collisions are more frequent at dawn and dusk;
- disturbance or distractions (e.g., mating);
- cable size: smaller gauge wires have higher collision rates;
- use of a shield wire to protect against lightning strikes: the shield wire is smaller in diameter;
- age of birds: increased collision frequency among juvenile birds; and
- line location: lines near wetlands or above treetops are more hazardous to birds.

Industry standards for power line construction have been developed (APLIC 2006) and would be considered for the Project. Although avian-safe construction reduces electrocution risk, electrocutions can never be completely eliminated. Bird feathers do not conduct electricity well; therefore, contact must usually be made with fleshy parts, such as the skin, feet, or bill (APLIC 2006). However, wet feathers may conduct electricity, and larger birds may be electrocuted when their wings span contacts conductors or grounded hardware. Management of nests during the non-breeding season, such as insulating conductors, moving nests to alternate structures, and removing unoccupied nests, can minimize the risk of avian mortality from electrocution (APLIC 2006).

The Project could also cause injury or mortality to some bird VCs through collisions with conductors and shield wires. Shield wires are suspected to be the cause of most bird collisions because shield wires are thinner and less visible than the conductor lines (Bevanger and Brøseth 2001; APLIC 2012).

The primary risk to bird mortality would be associated with Project overhead power lines, as buried power lines would prevent injury and mortality to birds from electrocution and collisions. The Project would implement best management practices for the construction and maintenance of overhead distribution lines to limit mortality to birds due to electrocution (e.g., cover conductors) and collisions (e.g., install markers to enhance the visibility of lines in key movement corridors and staging areas; Table 14.4-1). With implementation of mitigation, a minor increase in injury or mortality to birds from overhead distribution lines relative to existing conditions is predicted, which should result in a negligible residual effect on populations of bird VCs and other bird species. Therefore, the pathway was assessed as secondary and not carried forward in the assessment.

W-18: Vehicle injury and mortality:

- Collisions with vehicles, equipment, buildings, and aircraft on site, and vehicles travelling to and from site may cause injury or mortality to individual animals.

Vehicle mortality affects virtually all wildlife species (Kelsall and Simpson 1987; Jalkotzy et al. 1997). Frequencies of road mortalities are often related to specific locations, traffic volume, and speed (Oxley et al. 1974; Jalkotzy et al. 1997). The BNDN commented about the potential for wildlife mortality on Highway 955 from increased Project-related traffic and requested that this is considered in the assessment of effects on wildlife (BNDN-JWG 2021b). Literature on the effects of road mortalities on small- to medium-sized mammals is sparse, likely due to the difficulty in obtaining accurate numbers of mortalities (Oxley et al. 1974). Smaller mammals and birds killed by vehicles may be largely unnoticed and are quickly scavenged. Large mammals such as deer and moose often cause damage to vehicles and are frequently reported. The CRDN noted that spruce grouse have been hit by vehicles are often observed on the side of the road (CRDN-JWG 2020b). Although all bird species whose habitat is bisected with roads are vulnerable to road mortalities to some extent, specific levels of the effect are not commonly reported, and it is anticipated that vehicle-related mortality would be low for birds (e.g., birds typically fly above vehicles).

During Construction, Operations, and the Active Closure Stage, the increase in Project-related traffic may increase the number of wildlife-vehicle collisions on the access road and site roads relative to existing conditions or background traffic volumes. During the Transitional Monitoring Stage, vehicle traffic related to the Project would approach background volume levels. Project-related activities would also increase the traffic volume on Highway 955 south of the Project.

A Traffic Impact Study Report measured the traffic volume during peak hour conditions (i.e., 16:30 to 17:30) at the intersection of Highway 955 and Highway 155 in 2019 (NexGen 2019b). The number of vehicles using the intersection during the peak hour were counted and then a model was created to determine the anticipated number of vehicles using the same intersection at the same time of day in the future without the Project to account for the projected increase in background traffic volume in the modelling. The number of vehicles associated with Construction, Operations, and Active Closure Stage of the Project was added to the projected background traffic volume to calculate a total volume for the intersection during peak hour. Traffic volumes were estimated for a snapshot in time during each of the Project phases including Construction, Operations, and Active Closure Stage, respectively. Although the intersection does not occur in the RSA, all Project vehicles accounted for at the intersection of Highway 955 and Highway 155 in the report were conservatively assumed to be travelling along Highway 955 to the Project in the RSA.

In 2019, 657 vehicles were counted at the intersection of Highway 955 and Highway 155 during the peak traffic hour (NexGen 2019b). The projected number of vehicles using the intersection at peak hour during Construction increased to 757 (i.e., approximately 15% increase from 2019 conditions), 87 of which were attributed to Project activity. This represents an average of approximately 13% Project-related increase in traffic volume (i.e., 87/657 = 0.13) during Construction, compared to 2019 conditions.

Total traffic volume at peak hour during Operations was modelled at 722 vehicles (i.e., approximately 10% increase from 2019 conditions), 15 of which were related to Project activity (NexGen 2019b). Project-related traffic is therefore expected to account for an average of approximately 2% increase in traffic volume during Operations, compared to 2019 conditions.

A total of 1,008 vehicles were modelled to be using the intersection at peak hour during Active Closure Stage, an increase of 351 vehicles (i.e., approximately 53% increase) compared to 2019 conditions (NexGen 2019b). Of the 1,008 vehicles, 71 were attributed to Project activity, indicating that the Project is expected to increase traffic volume by an average of approximately 11% during the Active Closure Stage.

Overall, the Project would contribute to an increase in traffic volume relative to 2019 conditions of 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively. The increase in traffic from the Project is expected to result in a minor increase in risk of mortality to wildlife from collisions with vehicles, particularly during Construction and the Active Closure Stage. Vehicle-wildlife collisions are predicted to be infrequent along Highway 955 based on government data that showed no recorded collisions between 2014 and 2018 (NexGen 2019b). However, it is acknowledged that small to medium-sized mammals and birds would likely not be recorded (Oxley et al. 1974). Frequencies of wildlife-vehicle mortalities are often related to traffic volume and speed, and Highway 955 is a gravel secondary highway with a speed limit of 80 km/h. Vehicle speed on Project site roads and the access road would be adjusted according to conditions (e.g., wildlife in the area, weather conditions). Lower speeds reduce the risk of vehicle-wildlife collisions (van Langevelde et al. 2009). Long-term monitoring at diamond mines in the NWT and Nunavut has shown that the frequency of accidental mine-related wildlife mortalities from vehicle collisions has been extremely low (Dominion Diamond 2014). From 1998 through 2013, there were six occasions where carnivore species were accidentally killed from vehicle-wildlife collisions and no caribou were killed or injured, which demonstrates the effectiveness of mitigation such as staff awareness, giving wildlife the right of way, and implementing and adjusting speed limits. Similar success would be expected for the Project with implementation of these mitigation measures.

Bird strikes with aircraft are common and are most likely to occur during takeoff and landing as most bird flights occur within a few hundred metres of the ground, typically below 150 m (COSEWIC 2017). However, strikes with flocking birds, particularly migratory waterfowl, can occur more than 150 m above ground (COSEWIC 2017). Bird strikes increase in frequency during bird migratory periods and peak in the summer (i.e., 14% to 17% from July to September), as large numbers of birds are in an area after nesting season and young do not have experience with aircraft (COSEWIC 2017).

Amphibians, including Canadian toad, would be most at risk to collision with vehicles between late June and early September when adults and emerging young-of-the-year (i.e., metamorphs) are expected to leave breeding habitat and complete migratory or dispersal movements into terrestrial habitats (Fahrig et al. 1995; Mazerolle et al. 2005). Migrating or dispersing amphibians are typically slow moving and will remain immobile instead of fleeing when approached by vehicles, making them particularly vulnerable to vehicle collision (Mazerolle et al. 2005). To mitigate potential mortality to toads and other amphibians, surveys would be initially completed at possible breeding habitats near site roads and the access road to assess the risk. If and where necessary based on the survey results, employee and contractor reminders would be issued seasonally or signs would be installed to remind drivers to reduce speed and watch for amphibians crossing roads during the migration season. Confirmed breeding habitats (e.g., wetlands) would be identified with signs or other markers and communicated to staff to heighten awareness of the possible movement of amphibians in the area.

As part of the Project Environmental Protection Program, an education program would be implemented that details to staff, contractors, and visitors how to take all reasonable precautions to avoid wildlife collisions. In addition, implementation of mitigation measures including staff, contractor, and visitor orientations, giving wildlife the right of way, identification of wildlife crossings, leaving gaps in road berms and snowbanks, mandatory encounter and incident reporting, and speed limit adjustments (Table 14.4-1) are expected to result in a minor increase in injury or mortality to individual animals from vehicle-wildlife collisions relative to existing conditions. The change is predicted to have a negligible residual effect on populations of wildlife VCs. Therefore, the pathway was assessed as secondary and not carried forward in the assessment.

W-19: Wildlife attractants:

- Attraction of wildlife to the Project site (e.g., food waste, sewage, petroleum-based products, dust suppressants, explosive powder, site runoff ponds) may increase human-wildlife interactions and change predator-prey relationships, which can affect animal survival and reproduction.

Food smells and other aromatic compounds such as petroleum-based chemicals, grey water, and sewage can attract carnivores to human developments (Beckmann and Lackey 2008; CWS 2007; Peirce and Van Daele 2006). In addition, infrastructure may also attract carnivores since it can serve as a temporary refuge to escape extreme heat or cold (CWS 2007). Corvids and raptors may also be attracted to infrastructure and anthropogenic food sources (Baxter and Allan 2008; CWS 2007; Kristan and Boarman 2007; Marzluff and

Neatherlin 2006; Restani et al. 2001). Attraction of carnivores and predatory birds (e.g., ravens and gulls) to the Project site can increase predation pressure on prey species (e.g., passerines and waterfowl) and may cause local population declines for these prey species (CWS 2007; Liebezeit et al. 2009; Monda et al. 1994). Attraction of carnivores to developments can also result in negative human-animal interactions and increase the risk of loss of individual animals (e.g., relocation or destruction) from the population. Water management ponds at the Project site are a potential attractant to a range of species that can become entrapped in ponds with steep sides or smooth liners.

As a result of attractants, individual animals from various wildlife species have been intentionally destroyed at the Ekati, Diavik, Snap Lake, and Jericho mines, either by government biologists or with government permission. Intentional destruction of individual animals generally followed habituation of the animal to operating mines over an extended period of time and after multiple deterrent attempts failed with the same individual. Animals destroyed due to habituation from obtaining food rewards or shelter included four grizzly bears, seven wolverines, 17 foxes, and two wolves (Dominion Diamond 2014). From 1996 to 2001, there were an average of three animals per year intentionally destroyed at diamond mines. From 2002 to 2014, there were an average of 1.3 animals per year intentionally destroyed at diamond mines. The decrease in the number of intentionally destroyed animals over time was a result of diamond mines using the lessons learned and implementing more robust, effective, and diligent waste management policies and practices including continuing education of mine staff and providing garbage cans labelled for food waste in areas where people eat. Similar waste management practices would be implemented at the Project site.

The Environmental Protection Program and Conventional Waste Management Plan would be implemented to limit the attraction of wildlife to the Project site and the associated changes in predator-prey relationships and human-wildlife interactions (Table 14.4-1). Food wastes and oil products would be collected and temporarily stored in wildlife proof containers. Wastes would be incinerated or transported off site for recycling or disposed at a licensed disposal facility as appropriate. Lined water management ponds would be fenced to deter entrance or fitted with wildlife egress matting or ramps to help animals exit the ponds, and additional deterrents such as cannons, bangers, or sonic guns would be implemented to further discourage wildlife entry into water management pond areas. Environmental design features and management plans could limit attractants to the Project and result in a minor increase in wildlife mortality risk from predation or adverse human-wildlife interactions relative to existing conditions. Therefore, this pathway is predicted to have a negligible residual effect on wildlife VCs and was not carried forward in the assessment.

W-20: Direct harm from contact water:

- Direct contact with or ingestion of water from water storage / treated effluent monitoring ponds can cause adverse effects on wildlife health, survival, and reproduction.

Indigenous Groups and LPA communities expressed concerns about Project-related contaminants entering the food chain within the Clearwater River watershed through effects on water quality in Patterson Lake, and adversely affecting the health of fish, plants and wildlife (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD V.2: CRDN; BNDN-JWG 2019b; BRDN-JWG 2019a; BRDN-JWG 2020b; CRDN-JWG 2021; MN-S-JWG 2019b; NextGen 2019a). Trappers and LPA community members also commented on the potential Project effects on water quality, fish, and wildlife in the area of the Project (NexGen 2019a).

An Effluent and Emissions Plan and Environmental Monitoring Plan would be implemented to avoid and minimize changes in surface water quality during all Project phases. Site precipitation events (e.g., rain, snow melt) that occur and contact Project facilities and infrastructure (i.e., contact water) would be captured, collected, and directed to respective site runoff ponds or collection areas. Contact water would be collected from the mine terrace, mill terrace, NPAG and PAG WRSAs, ore storage stockpile, special waste rock stockpile, camp area, and conventional waste management area (Section 5.4.5, Site Water Management).

Contact water would be directed to and stored in water management ponds for testing and treating, if required, prior to release to Patterson Lake after meeting discharge criteria (Section 5.4.5). The ponds would be located between the mine terrace and mill terrace. Water in the ponds may adversely affect the health of wildlife that drink or directly contact the water in the ponds (e.g., birds landing on the ponds).

The presence of operating equipment, people, noise, and lights during all Project phases is expected to result in avoidance of the Project, particularly the Project footprint, by most wildlife VCs and other species. Avoidance of the Project footprint is predicted to result in infrequent interactions between wildlife and the water management ponds. An Environmental Protection Program would be implemented that would include regular, systematic monitoring of the ponds to determine frequency of mammal and bird use and presence. Water quality would also be monitored to determine potential health risk to wildlife. Bird deterrents (e.g., cannons, bangers) may be used around the ponds prior to nesting periods (Zone B6: late April to mid August; ECCC 2018) and during the northern and southern migration periods to deter bird nesting activity. Monitoring would occur regularly to evaluate the effectiveness of deterrents, and adaptive management would be applied as necessary.

Implementation of mitigation, monitoring, and adaptive management is expected to minimize the risk of interactions between wildlife and the contact water storage/monitoring ponds and result in negligible residual effects on wildlife health, survival, and reproduction. The interaction was assessed as a secondary pathway and not carried forward in the assessment.

W-26: Permanent communication tower injury and mortality:

- Collision of birds and bats with the permanent communication tower can affect bird and bat survival.

AND

- Collision or entanglement of birds and bats with the fence surrounding the permanent communication tower base can affect bird and bat survival.

The proposed permanent communication tower would have a height of approximately 14.6 m and would be designed in a manner where guy wires would likely not be required for structural support. The base of the tower would be surrounded by a chain link fence, with the top of the fence extended with barbed wire. The proposed chain link fence would be typical of industrial fencing around communication towers; the fence would have a height of approximately 1.8 m and the barbed wire would extend approximately 0.5 m above the chain-linked portion of the fence (i.e., total fence height would be approximately 2.3 m).

Structures that intrude into open air spaces such as fences and communication towers are often key sources of bird and bat mortality (Drewitt and Langston 2008; Martin 2011; Calvert et al. 2013). Most birds are prone to collision with structures that have reflective surfaces or are partially obscured by vegetation (Martin 2011). Factors such as structure location, height, and lighting; inclement weather; and species abundance and behaviour also influence collision risk and these factors can have interactive effects (Drewitt and Langston 2008; Thaxter et al. 2017). For example, bird collisions with tall structures can increase during inclement weather when birds fly at lower altitudes and have reduced ability to detect obstacles (Thomas 2008). Low-flying species (e.g., grouse [Family Phasianidae], short-eared owl [*Asio flammeus*]) can also collide with fences (Baines and

Andrew 2003; Wolfe et al. 2007; Robinson et al. 2016; Miller et al. 2020). Bats are more prone to collision with structures that have moving components (e.g., wind turbines) (Barclay et al. 2007); however, the permanent communication tower would not have moving components.

In general, bird and bat mortality rates increase with increasing height of the structure. Tall (i.e., more than 305 m) communication towers with guy wires had bird mortality rates that were nearly five times greater than medium (i.e., 116 m to 146 m) communication towers with guy wires. The presence of guy wires is also shown to greatly affect bird mortality rates. Mortality rates at medium guyed towers were approximately 16 times higher than those of medium non-guyed towers (Gehring et al. 2011). Drewitt and Langston (2008) recommended that communication towers be less than 61 m tall as there is a substantially lower risk to migrating passerines below this height.

The height of the proposed Project permanent communication tower would be 14.6 m, which is much lower than heights shown to have high bird collision rates, and this structure would minimize or avoid the use of guy wires; both of these environmental design features are expected to reduce the risk of collisions for birds and bats. Bird collision rate with the proposed Project permanent communication tower is likely to be infrequent and highest during short, low-level, localized flights such as when individuals are landing, taking off, hunting, or being pursued by predators (Paige 2020; Smallwood 2022). Bat collision rates with the permanent communication tower are likely to be infrequent as the tower would be stationary and effectively detected by bat echolocation signals and, therefore, avoided by bats.

Steady-burning lights can attract birds to communication towers and increase mortality from collisions, particularly during inclement weather events (Gehring et al. 2009). Red or white flashing lights can reduce bird mortality by 51% to 70% compared to steady-burning red lights (Gehring et al. 2009). The Project would implement red or white flashing lights on the top of the permanent communication tower to decrease bird collision risks.

An evaluation of techniques to reduce avian fatalities at communication towers found that alternating bands of aviation orange and white on the tower was good protection against daytime bird collisions (Patterson 2012). The Project permanent communication tower would also investigate having alternating bands of aviation orange and white to minimize daytime bird collisions.

Bird and bat mortality is also possible through interactions with fences. Bird and bat mortality can be caused both by collisions with fences and through becoming entangled in fences after collision, eventually perishing due to injuries, exhaustion, starvation, or thirst (Paige 2020). Typically, entanglement occurs when individuals collide with fencing structures that are made of loose material, barbed wire, or have a sufficiently large aperture that can entrap wildlife (i.e., more than 20 mm) (Preston 2007; van der Leek 2009; Paige 2020). Low-flying birds with poor manoeuverability, such as grouse and short-eared owl, are more vulnerable to collision and entanglement with fences than other bird species (Baines and Andrew 2003; Wolfe et al. 2007; Robinson et al. 2016; Miller et al. 2020). The area fenced around the communication tower would likely be less than 100 m^2 and is anticipated to result a small, infrequent, and localized source of bird mortality relative to existing conditions. No mitigations are proposed for the fencing design; however, the fencing would be properly maintained and regularly monitored to free birds and bats, should they become entangled.

The Project would implement best management practices for the construction and maintenance of the permanent communication tower and associated fence to limit mortality to birds and bats due to collisions (e.g., minimize tower height, flashing red or white lights at the top of the tower, minimize or avoid guy wires). The permanent communication tower may also have demarcation and lighting requirements for air navigation safety as required by the Canadian Aviation Regulations. The legal safety requirements for the airstrip would be adhered to and are anticipated to be consistent with the proposed wildlife mitigations for the permanent communication tower.

With implementation of mitigation, a minor increase in injury or mortality to birds from the permanent communication tower and fence relative to existing conditions is predicted, which would result in a negligible residual effect on populations of bird and bat VCs and other bird and bat species. Therefore, the pathway was assessed as secondary and not carried forward in the assessment of residual effects in the Application Case or the RFD Case.

14.4.3 Primary Pathways

The following Project interactions were predicted to be primary pathways to wildlife VCs (Table 14.4-1) and were carried forward for further assessment in the residual effects analysis (Section 14.5):

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of wildlife habitat and affect wildlife abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect wildlife habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, air traffic, lights, dust, smells, noise) can alter wildlife movement and behaviour and adversely affect wildlife habitat availability and wildlife abundance and distribution.

14.5 Residual Effects Analysis

14.5.1 Woodland Caribou

14.5.1.1 Application Case

This subsection presents the results of the residual effects analysis for woodland caribou and woodland caribou habitat from the primary pathway identified in Section 14.4.3. Mitigation measures have been incorporated into the Project (Table 14.4-1), where feasible, to limit potential effects on woodland caribou from Project components or activities. The residual effects analysis for caribou focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of woodland caribou habitat and affect caribou abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect woodland caribou habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter woodland caribou movement and behaviour and adversely affect caribou habitat availability and caribou abundance and distribution.

14.5.1.1.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project is located within a Tier 1 Caribou Habitat Management Area, as identified in the final SK2 West Caribou Range Plan (ENV 2021). The Project is expected to affect caribou habitat availability in the LSA, caribou home range, RSA, and SK2 West by causing an incremental increase in the amount of disturbance. Direct loss would be contained within the maximum disturbance area, and indirect losses would occur within a 500 m buffer. The Project design has been optimized to limit the footprint size and use existing infrastructure (i.e., access road and trails) to the extent possible (Table 14.4-1). The area of vegetation clearing would be minimized during Construction to limit direct habitat loss. The effect from direct habitat loss is certain and expected to be continuous from Construction through Closure.

Overall, the proportion of disturbance in the caribou home range is expected to increase by 0.3% (90.3 ha) with the application of the Project, resulting in a decrease of 0.6% (32.4 ha) of suitable caribou habitat (Table 14.5-1). The remaining portion of disturbance that is expected to increase as a result of the application of the Project and a 500 m buffer around anthropogenic disturbances occurs over water (57.9 ha; Table 14.5-1). In SK2 West, the proportion of disturbance is expected to increase by less than 0.1%, resulting in a decrease of less than 0.1% of suitable caribou habitat. The changes would include both direct (i.e., physical footprint) and indirect (i.e., sensory disturbance / perceived predation risk) effects.

A loss of 7.5 ha of high suitability habitat is predicted as a result of the Project and the 500 m buffer, which represents a decrease of 0.3% of high suitability habitat at the scale of the caribou home range and less than 0.1% at the scale of SK2 West (Table 14.5-1). A total of 2,813.5 ha and 322,419.7 ha of high suitability habitat would remain in the caribou home range and SK2 West, respectively (Table 14.5-1). A loss of 24.6 ha of moderate suitability habitat is predicted as a result of the Project and the 500 m buffer, which represents a decrease of 1% of moderate suitability habitat at the scale of the caribou home range and less than 0.1% at the scale of SK2 West (Table 14.5-1). The remaining habitat loss as a result of the Project and the 500 m buffer (0.3 ha) would occur in areas of low habitat suitability, representing a change of 0.4% of low suitability habitat in the caribou home range and less than 0.1% at the scale of SK2 West (Table 14.5-1). Overall, the Project would result in a decrease of 32.4 ha of suitable caribou habitat.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the terrestrial ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1, Ecosystem Availability). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ from those present before disturbance (Section 13.5.1, Upland Ecosystems). The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Table 14.5-1: Changes to Woodland Caribou Habitat Availability in the Caribou Home Range, Regional Study Area, and SK2 West Caribou Administration Unit at Application Case

Habitat Suitability[a,b]	Caribou Home Range				RSA				SK2 West Caribou Administration Unit			
	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	2,821.0	2,813.5	-7.5	-0.3	12,641.4	12,633.9	-7.5	-0.06	322,427.2	322,419.7	-7.5	< -0.1
Moderate	2,540.9	2,516.3	-24.6	-1.0	6,015.2	5,990.6	-24.6	-0.4	1,545,421.2	1,545,396.6	-24.6	< -0.1
Low	72.5	72.2	-0.3	-0.4	182.0	181.7	-0.3	-0.2	345,911.2	345,910.9	-0.3	< -0.1
Unclassified[c]	421.2	421.2	0.0	0.0	330.5	330.5	0.0	0.0	23,163.5	23,163.5	0.0	0.0
Water	9,140.1	9,082.2	-57.9	-0.6	15,450.9	15,393.0	-57.9	-0.4	510,399.0	510,341.1	-57.9	< -0.1
Natural disturbance	7,448.3	7,332.8	-115.5	-1.6	43,524.3	43,408.8	-115.5	-0.3	1,062,819.5	1,062,704.0	-115.5	< -0.1
Anthropogenic disturbance[d]	21,077.3	21,283.1	205.8	1.0	29,346.4	29,552.2	205.8	0.7	1,018,584.7	1,018,790.5	205.8	< 0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) ENV 2020a; habitat suitability designations of high, moderate, low, and unclassified contribute to undisturbed habitat for caribou.

b) Boreal shield ecosites were categorized as high, moderate, and low suitability based on results of the habitat selection of caribou in the Boreal Shield (McLoughlin et al. 2019) and a review of literature and professional judgment; habitat suitability designations of high, moderate, low, and unclassified contribute to undisturbed habitat for caribou.

c) Characterized as unknown/unclassified in ENV (2020a) habitat suitability maps. Considered to be undisturbed habitat for caribou.

d) Anthropogenic disturbances in the Application Case include existing disturbances and the Project.

< = less than; ENV = Saskatchewan Ministry of Environment.

Reclamation of existing disturbance is also being considered to improve existing habitat. Reclamation of linear anthropogenic features may include seeding, planting, installation of coarse woody debris, tree tipping, biodegradable fencing, and earth mounding to promote regrowth and disrupt linear sight lines and linear features. Investigations completed during the linear feature natural regeneration assessment program (Annex VII.1) and linear feature reclamation pilot program (Omnia 2020) would be used to inform other on-site reclamation activities. Additional reclamation activities would be implemented during the lifespan of the Project that focus on the restoration of existing linear anthropogenic disturbances (Omnia 2020). Potential net benefits from reclamation of non-Project features were not included in the residual effects assessment; however, reclamation of existing linear anthropogenic disturbances would be anticipated to contribute to caribou habitat offsetting.

Although progressive reclamation and revegetation would be completed, habitat is not considered restored for caribou until areas have reached mature forest habitat conditions (i.e., more than 40 years old; Environment Canada 2011; ENV 2021). Thus, the establishment of reclaimed upland vegetation ecosystems is predicted to occur at least 40 years beyond the Active Closure Stage, particularly for mature forest types (i.e., a duration of 73 years). The loss of caribou habitat is reversible, though some loss (e.g., wetlands, permanent features) would be irreversible. Once habitat is removed, caribou would experience the effect of this loss continuously until functional habitat is reclaimed.

Mitigation efforts to avoid and minimize direct habitat loss for caribou are outlined in Table 14.4-1. Specifically, NexGen would commit to the development of a Caribou Mitigation and Offsetting Plan through engagement with the ENV and Indigenous Groups. Reclaimed areas and some of the existing natural and anthropogenic disturbances in the LSA, caribou home range, RSA, and SK2 would, if not re-disturbed by human activity, grow into mature forest. Effectiveness of reclamation efforts would be monitored during the Transitional Monitoring Stage. If required, adaptive management would be employed to modify or enhance any reclamation efforts. Over the long term, reclamation in conjunction with measures undertaken as part of the Caribou Mitigation and Offsetting Plan would be implemented to achieve a net increase in functional caribou habitat work.

Sensory Effects from Anthropogenic Disturbance

Increased sensory disturbance (e.g., noise, light, smells) can affect habitat availability for caribou. Effects would vary depending on proximity to the development footprint and level of disturbance. Most effects are expected within 5 km of the development footprint (Smith et al. 2000; Dyer et al. 2001; Vistnes and Nellemann 2008; Courtois et al. 2008; Nagy 2011; Polfus et al. 2011; Leblond et al. 2013; Johnson et al. 2015; Eftestøl et al. 2016). Effects are likely greatest during the late winter season and during spring / early summer caribou calving and post-calving periods because these are seasons when caribou are most likely to avoid or reduce their use of areas in proximity to disturbances. Calving areas have not been delineated in Saskatchewan, but it is assumed they are linked to the high suitability areas that contain the necessary biophysical attributes for successful recruitment (i.e., bogs and mature forests, peatlands and stands dominated by black spruce and lowland black spruce stands within muskeg [ECCC 2020]). Existing anthropogenic disturbances such as roads and trails used by the public are expected to remain in use indefinitely, such that human activity has permanently altered some portions of the LSA unsuitable for caribou.

An LPA community member specifically raised a concern about the effects of Project noise on woodland caribou (NexGen 2019a). In the Application Case, the minimum cumulative noise level (i.e., existing conditions plus the Project) during Construction and Operations in the noise RSA is predicted to be 26 dBA during the nighttime and the maximum cumulative noise level is predicted to be 45 dBA during the daytime (Section 7.3.5.1, Application Case). Effects from indirect habitat loss (i.e., sensory disturbance) in the LSA are expected to be continuous but reversible because caribou appear to be more sensitive to human activities associated with construction, traffic, and noise (Curatolo and Murphy 1986; Murphy and Curatolo 1987; Nellemann and Cameron 1998; Smith et al. 2000; Dyer et al. 2001) than to infrastructure itself. Caribou would likely be most susceptible to sensory disturbance during late-winter periods, when animals tend to be in poor physical condition, and during the reproductive season (i.e., spring / early summer) when caribou are raising young (Wolfe et al. 2000; Eftestøl et al. 2016) and may avoid the LSA.

Mitigation measures would be implemented to minimize sensory disturbance including limiting idling of vehicles and equipment to the extent practical, enclosing loud equipment in process buildings where feasible, using noise suppression on vehicles, and maintaining overflight altitudes of greater than 300 m except at landing and takeoff (Table 14.4-1). Additional mitigations related to minimizing sensory disturbances may be developed through engagement with government and Indigenous Groups during development of the Caribou Mitigation and Offsetting Plan.

Sensory disturbance effects from the Project are most likely to occur from Construction to the end of the Active Closure Stage. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible 5 years after Closure (i.e., a duration of 48 years). Effects from sensory disturbance as a result of the Project are considered certain.

14.5.1.1.2 Habitat Distribution

The Project is expected to affect caribou habitat distribution in the LSA, RSA, caribou home range, and SK2 West by causing an incremental increase in the amount of disturbance. Direct removal of caribou habitat due to the Project would be constrained to the maximum disturbance area (Figure 14.5-1), and indirect removal of caribou habitat is expected to occur within the LSA (i.e., a 500 m buffer of the maximum disturbance area). The Project is predicted to cause small changes in the arrangement and connectivity of available undisturbed caribou habitat in the caribou home range and SK2 West (Figure 14.5-1; Figure 14.5-2), commensurate with the level of change in direct and indirect disturbance between the existing conditions and the Application Case (Figure 14.3-1).

Habitat Arrangement and Connectivity

The distribution of high and moderate suitability habitat in the caribou home range would remain largely unchanged as a result of the Project because the caribou home range study area, which is centred on the proposed Project footprint (Section 14.2.3.2), is already characterized by an existing aggregation of human development features and activities including the existing exploration camp and access road, trails, Highway 955, a rough (seasonal) road, and seismic lines / cutlines (Section 14.3.1.2, Habitat Distribution; Figure 14.3-1). In addition to the 500 m buffer around existing anthropogenic disturbances considered unsuitable for caribou, four small patches of high and moderate suitability patches of caribou habitat surrounded by natural disturbance would be removed by the Project (Figure 14.3-1, Figure 14.5-1). Caribou are known to use residual habitat patches in burned areas (Skatter et al. 2017); however, the small sizes of the habitat patches that would be lost relative to caribou home range size and their proximity to existing anthropogenic disturbances make the habitat patches unlikely to be functional or ecologically meaningful for caribou in the Base Case. As a result, it is unlikely that the loss of these four patches would change caribou habitat selection across the landscape.

An LPA community member expressed concern about Project activities affecting caribou migration (NexGen 2019a), and during JWG meetings, a movement route for caribou was identified at the narrows of Patterson Lake North Arm (BNDN-JWG 2019b). In general, the movement route provides limited connectivity given the overall low suitability of surrounding habitat. Because caribou would likely avoid passing through the maximum disturbance area, the Project is predicted to change habitat connectivity in the area within and surrounding the LSA (i.e., local to regional geographic extent).

Changes in the arrangement and connectivity of habitat mostly occur at the local scale. Effects may extend beyond LSA around Patterson Lake; however, this is not expected because it is likely that caribou are already avoiding the area as a result of existing development and natural disturbances (e.g., recent burns) (Section 14.3.1.2). Changes in connectivity and distribution due to the loss of caribou habitat are reversible, though some loss (i.e., related to wetlands and permanent features) would be irreversible. Changes to caribou habitat distribution would be experienced continuously until reclamation improves the distribution of suitable caribou habitat (i.e., more than 40 years after the Active Closure Stage).

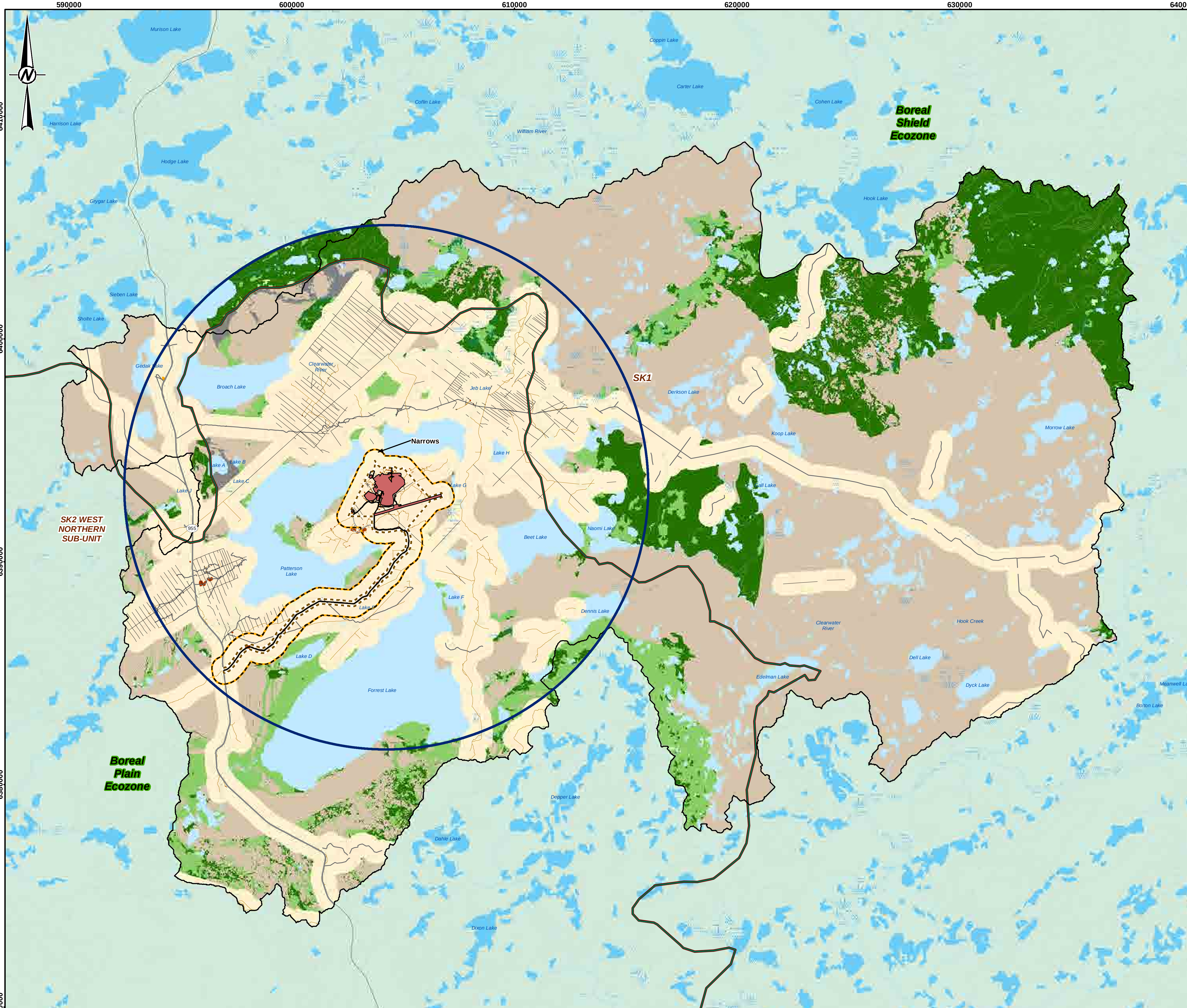
Linear Features

The Project is not expected to increase the density of linear features in the LSA, caribou home range, RSA, and SK2 West. The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Most of the existing trails in the maximum disturbance area would be upgraded for site roads and haul roads, which is expected to be avoided by caribou due to sensory disturbance and because it is likely that predators use existing trails as travel corridors. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-1). The current density of linear features in the RSA (0.6 km/km^2) is likely causing negligible adverse effects on caribou movement and population connectivity (Section 14.3.1.2). The change in activity levels on the linear features with the addition of the Project would similarly be expected to have a negligible effect on caribou movement and population connectivity.

Sensory Effects from Anthropogenic Disturbance

Under existing conditions, Indigenous Groups have commented that increased traffic volumes from mineral exploration activities on Highway 955 and the Cluff Lake Road are affecting wildlife movement patterns and distribution and are concerned that traffic related noise from the Project would exacerbate these effects (TSD II: BNDN; TSD V.2: CRDN). The Project is expected to increase the number of vehicles on Highway 955, an unpaved road, by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to relative to existing conditions (Section 14.4.2, Secondary Pathways). The increase in traffic volume could have minor effects on the movement of caribou that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect), particularly during Construction and the Active Closure Stage. The strength of the effect of Highway 955 on caribou (and other wildlife) movement and population connectivity in the Base Case was unknown (Section 14.3.1.2). However, the road is unpaved and in a remote region of the SK2 West range, particularly in the area near the Project, which is predicted to be less of a barrier to caribou movement than paved roads with higher traffic volumes (Leblond et al. 2013).

Changes to caribou habitat distribution would be experienced continuously until human activity decreases following the Active Closure Stage and reclamation improves the distribution of suitable caribou habitat (i.e., more than 40 years after the Active Closure Stage). Effects due to sensory disturbance are predicted to be certain. The strength of sensory disturbance would decrease through the Transitional Monitoring Stage and is expected to be reversible approximately five years beyond Closure.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- CARIBOU ADMINISTRATION UNIT BOUNDARY
- CARIBOU HOME RANGE ASSESSMENT AREA
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT POTENTIAL

- HIGH
- MODERATE
- LOW
- ANTHROPOGENIC DISTURBANCE
- NATURAL DISTURBANCE
- UNCLASSIFIED

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

WOODLAND CARIBOU HABITAT AT THE REGIONAL STUDY AREA, LOCAL STUDY AREA AND CARIBOU HOME RANGE, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MB	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-1**	
REVIEW	JV	2023-02-09		

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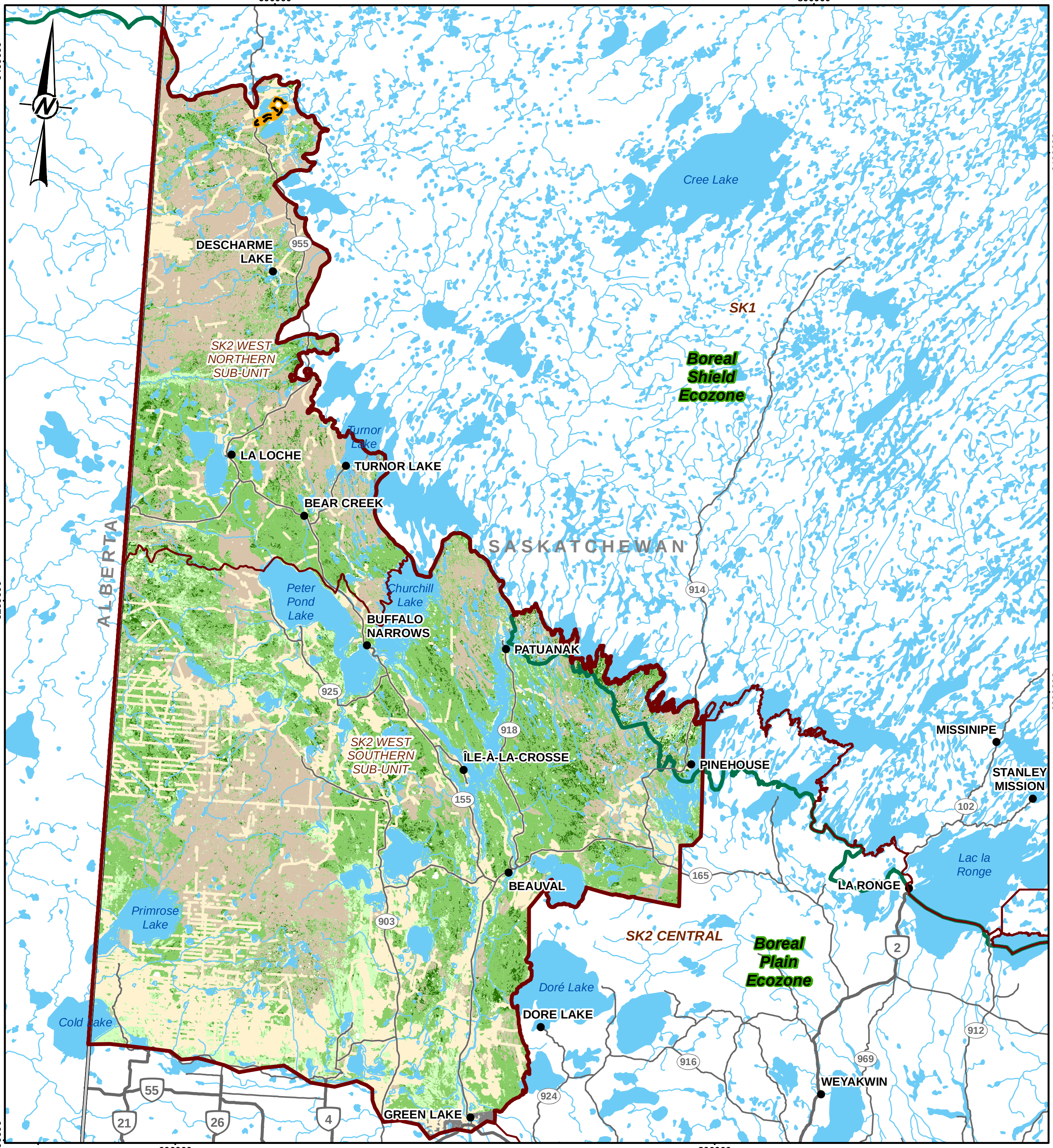

LEGEND

- POPULATED PLACE
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- ECOZONE BOUNDARY
- WATERBODY
- LOCAL STUDY AREA
- CARIBOU ADMINISTRATION UNIT BOUNDARY

HABITAT POTENTIAL

- HIGH
- MODERATE
- LOW
- ANTHROPOGENIC DISTURBANCE
- NATURAL DISTURBANCE
- UNCLASSIFIED

0 50 100
1:2,100,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
WOODLAND CARIBOU HABITAT IN THE SK2 WEST CARIBOU ADMINISTRATION UNIT, APPLICATION CASE

CONSULTANT
wsp

PROJECT		20144150	PHASE	3110 - 2
DESIGN	JS	2023-02-08	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-08	FIGURE 14.5-2	
CHECK	SM	2023-02-08		
REVIEW	JV	2023-02-08		

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14.5.1.1.3 Survival and Reproduction

The Project may affect survival and reproduction of individual caribou that use the LSA, RSA, and caribou home range but changes are expected to be non-measurable at the population level or SK2 West range.

Seasonally Important Habitat Areas

The proposed Project would remove 32.4 ha of suitable habitat (0.6% of the suitable habitat in caribou home range and less than 0.1% of suitable habitat in the SK2 West range; Section 14.5.1.1.1, Habitat Availability). Overall, the loss of habitat is much less than one annual home range for an individual caribou (435 km^2; Section 14.3.1, Woodland Caribou). The removal of caribou habitat in the LSA could affect local survival and reproduction by reducing foraging and predator refuge habitat but the estimated loss of 32.4 ha of suitable caribou habitat is unlikely to displace many individuals and is not expected to have effects on the survival and reproduction of caribou populations overlapping the RSA and SK2 West.

The Project is predicted to result in small changes in the distribution or connectivity of available undisturbed caribou habitat in the caribou home range and SK2 West relative to the level of direct and indirect disturbance under existing conditions (Section 14.5.1.1.2, Habitat Distribution). Changes in habitat connectivity are more likely to affect caribou survival and reproduction if they impede access to high-use areas such as nursery and winter use areas (which have not been delineated in Saskatchewan).

The reproductive success of females and survival of calves are negatively affected if calving and post-calving habitats are unavailable, inadequate, or degraded (McCarthy et al. 2011; ECCC 2020). As such, the loss of calving and post-calving areas, or avoidance or reduced use of these areas due to proximity to disturbance, can be detrimental for caribou survival and reproduction. Calving areas have not been delineated in Saskatchewan, but it is assumed they are linked to the high suitability areas. A reduction in local abundance is predicted to be continuous so long as individuals are displaced, but reversible 40 years after the Active Closure Stage when suitable habitat becomes available on the landscape (i.e., long-term duration). Overall, habitat loss from the Project may displace a few individual caribou but is unlikely to have a demographic effect at the population level (i.e., effect is not expected but not impossible).

Predators and Alternative Prey Dynamics

The incremental change in habitat from the Project is not expected to change the density of alternative prey (e.g., moose and deer) populations, and consequently is not expected to change the level of predation on caribou. The addition of the Project would not change the linear density (and related predation risk) in the LSA, caribou home range, RSA, or SK2 West relative to existing conditions (Section 14.5.1.1.2). The introduction of linear features can improve predator mobility, leading to a greater risk of predation for caribou when caribou are on or near these features (James 1999; Whittington et al. 2011). The Project access road and on-site roads would be located within the maximum disturbance area, which is expected to be avoided by caribou due to sensory disturbance. Further, wolves may adjust their movement and behaviour and are likely to avoid the area of the Project due to high sensory disturbance (Paquet et al. 1996; Boutin et al. 2015). Therefore, increased predation in the LSA is unlikely if caribou and wolves avoid the Project.

Sensory Disturbance

Displacement and increased wariness as a result of sensory disturbances may affect energetic expenditures, which can increase caribou vulnerability to other mortality factors (e.g., predation), particularly for young calves. Project noise levels are predicted to cause negligible increased movements by caribou (Section 14.5.1.1.1). Mitigation efforts to avoid and minimize sensory disturbances for caribou are outlined in Table 14.4-1. Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage and decrease following the Active Closure Stage (Section 7.3). However, a conservative approach was applied and sensory disturbance is predicted to occur for the 43-year lifespan of the Project and is expected to be reversible five years after Closure (i.e., duration of disturbance would be 48 years).

14.5.1.2 Reasonably Foreseeable Development Case

14.5.1.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project, the Fission Patterson Lake South Property, and ongoing forest harvest would reduce the availability of suitable caribou habitat. A total loss of 76.7 ha (1.3%) of suitable caribou habitat in the caribou home range from the Project and Fission Patterson Lake South Property would occur (Table 14.5-2). This loss includes the removal of 13.2 ha (0.5%) of high suitability habitat and 53.7 ha (2.1%) of moderate suitability habitat (Table 14.5-2). The remaining habitat loss (i.e., 12.5 ha) would occur in areas of low and unclassified habitat suitability. The combined loss represents 1.3% of the suitable habitat (including unclassified habitat) in the caribou home range. The contribution of the Project to suitable caribou habitat loss is 32.4 ha (Table 14.5-1), representing 42.3% of the quantified cumulative effect in the caribou home range.

Within SK2 West (i.e., beyond regional geographic extent), a total loss of 94.2 ha of suitable caribou habitat would occur from the Project and Fission Patterson Lake South Property (Table 14.5-2). This loss includes the removal of 17.7 ha (less than 0.1%) of high suitability habitat and 66.7 ha (less than 0.1%) of moderate suitability habitat (Table 14.5-2). The remaining habitat loss (i.e., 9.8 ha) would occur in areas of low and unclassified habitat suitability. Additional loss would occur from timber harvest as discussed below.

Similar to the Project, it is expected that the Fission Patterson Lake South Property would be required to implement a Caribou Mitigation and Offsetting Plan. The offsetting plans would provide a net increase in functional habitat for caribou. For the caribou assessment, the offsetting programs have not been included in the characterization of effects.

The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) as the Fission Patterson Lake South Property recently entered the regulatory approval processes. Loss of habitat covered by permanent features and wetlands would be irreversible.

Table 14.5-2: Changes to Woodland Caribou Habitat Availability in the Caribou Home Range, Regional Study Area, and SK2 West Caribou Administration Unit at Reasonably Foreseeable Development Case

Habitat Suitability[a,b]	Caribou Home Range				RSA				SK2 West Caribou Administration Unit[c]			
	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	2,821.0	2,807.7	-13.2	-0.5	12,641.4	12,623.7	-17.7	-0.1	322,427.2	322,409.5	-17.7	< -0.1
Moderate	2,540.9	2,487.3	-53.7	-2.1	6,015.2	5,949.8	-65.4	-1.1	1,545,421.2	1,545,354.5	-66.7	< -0.1
Low	72.5	71.1	-1.4	-1.9	182.0	180.5	-1.4	-0.8	3,459,11.2	345,909.7	-1.4	< -0.1
Unclassified[d]	421.2	412.8	-8.4	-2.0	330.5	322.1	-8.4	-2.5	23,163.5	23,155.1	-8.4	< -0.1
Water	9,140.1	9,030.9	-109.3	-1.2	15,450.9	15,340.8	-110.1	-0.7	51,0399.0	510,288.9	-110.1	< -0.1
Natural disturbances	7,448.3	7,149.1	-254.1	-3.4	43,524.3	43,171.4	-353.0	-0.8	1,062,819.5	1,062,466.6	-353.0	< -0.1
Anthropogenic disturbances[e]	21,077.3	21,517.5	440.2	2.1	29,346.4	29,902.4	556.0	1.9	1,018,584.7	1,019,142.0	557.3	<0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

a) ENV 2020a; habitat suitability designations of high, moderate, low, and unclassified contribute to undisturbed habitat for caribou.

b) Boreal shield ecosites were categorized as high, moderate, and low suitability based on results of the habitat selection of caribou in the Boreal Shield (McLoughlin et al. 2019) and a review of literature and professional judgment; habitat suitability designations of high, moderate, low, and unclassified contribute to undisturbed habitat for caribou.

c) Habitat loss associated with forestry activities in SK2 West south sub-unit have not been quantified in this assessment because information is not publicly available.

d) Characterized as unknown/unclassified in ENV (2020a) habitat suitability maps. Considered to be undisturbed habitat for caribou.

e) Anthropogenic disturbances in the RFD Case include existing disturbances, the Project, and Fission Patterson Lake South Property.

RFD = reasonably foreseeable development; < = less than; ENV = Saskatchewan Ministry of Environment; RSA = regional study area.

As described in Section 14.2.5, Assessment Cases, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 40 years when reclaimed upland habitat is expected to provide critical habitat for caribou (Section 14.5.1.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 55 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects. It is assumed that forestry activities would occur much longer into the future and beyond the temporal boundaries of the Project and Fission Patterson Lake South Property. Thus, the duration of cumulative effects from habitat would be a maximum of 73 years (i.e., amount of potential temporal overlap between the Project and forestry; Section 14.5.1.1.1).

Cumulative Effects from Forestry

Forest harvest may contribute cumulatively to influence habitat availability for caribou in SK2 West. Forestry activities have a negative effect on caribou populations through a combination of direct and functional habitat loss and development of access roads (ECCC 2020). There are two forestry operators in SK2 West, both of which operate in the southern sub-unit, which has higher levels of human-caused disturbances than the northern sub-unit (Section 14.3.1.1). Carrier Forest Products has been allocated the Term Supply Licence (TSL) for the Northwest Area for a 20-year period (2016 to 2036); the TSL for the Northwest Area land base is approximately 780,000 ha with slightly more than 300,000 ha allocated for harvest (Carrier 2016). Mistik Management Ltd. has been allocated a Forest Management Area from 2019 to 2039. The Mistik Management Ltd. Forest Management Agreement has a total land base area of almost 1.9 million ha, with 1,017,277 ha eligible for late seral stage retention (Mistik Management Ltd. 2018). The projected amount and layout of future forest harvest is not publicly available.

Current levels of forestry-related disturbance (i.e., cutblocks and forestry roads) are included in the anthropogenic disturbance calculations in the Base Case and Application Case; however, the precise details about the projected amount or spatial layout of future forest harvest in the TSL for the Northwest Area and Mistik Management Ltd. Forest Management Agreement were not available for this assessment. The magnitude of cumulative effects on caribou in the RFD Case is expected to vary depending on the amount, arrangement, and type of habitats harvested. For example, harvesting operations that take place near a peatland that is used by caribou for calving are likely to have larger effects than harvesting operations that are completed farther away. Forestry activities would reduce availability of suitable habitat for caribou relative to Base Case until areas are at least 40 years post-harvest. Forest licensees are required to mitigate negative effects on woodland caribou; Mistik Management Ltd. is implementing the natural forest pattern harvesting approach to minimize effects on caribou, and it is expected that ENV will continue to work with all parties to meet the goals of the SK2 range plan (ENV 2021). Nonetheless, it is expected that continued forest harvest would continue to reduce suitable mature forest and continue to add to the cumulative disturbance of caribou habitat in SK2 West.

Sensory Effects from Anthropogenic Disturbance

Similar to the Application Case, cumulative indirect loss of caribou habitat from sensory disturbance is likely greatest during the late winter season and during spring / early summer caribou calving and post-calving periods. The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property and forestry. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the Project and Fission Patterson Lake South Property would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects. It is assumed that forestry activities would occur much longer into the future and beyond the temporal boundaries of the Project and Fission Patterson Lake South Property. Thus, the duration of cumulative effects from sensory disturbance would be a maximum of 48 years (i.e., amount of potential temporal overlap between the Project and forestry; Section 14.5.1.1.1).

Climate Change

Climate change and associated potential increase in wildfire occurrence may contribute cumulatively to influence habitat availability for caribou. Assumptions about climate change effects on wildlife habitat are described in Section 14.2.5. Caribou select mature to old forest in peatland-dominated landscapes that have a high abundance of lichen, the animals' primary food source; typically, this habitat is in black spruce bogs and black spruce-tamarack fens (Rettie et al. 1997; Stuart-Smith et al. 1997; Anderson 1999; Schneider et al. 2000; Rettie and Messier 2001; Dunford 2003; Dyke 2008; ASRD and ACA 2010; Latham et al. 2011a; ENV 2013). Wetland ecosystem availability may be adversely affected in the RSA due to climate change, though the changes are uncertain (Section 14.2.5). A reduction in wetland ecosystem condition could reduce the quality of caribou habitat relative to the Base Case.

Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale. Wildfires have had a stronger effect on habitat availability in northern Saskatchewan than in other parts of Canada (Kansas et al. 2016). As discussed in Section 14.3.1.1, the influence of fire on caribou habitat availability is dependent on extent, frequency, and availability of alternate suitable habitat (ENV 2013). The alteration by wildfire can reduce the amount of available suitable habitat in the short term (Kansas et al. 2016) but can also be beneficial in the long term because it helps generate coniferous trees (i.e., jack pine) and prevent replacement of lichens by inedible feather mosses (Dunford 2003; COSEWIC 2014). Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale. The magnitude of habitat change induced by climate change is uncertain because of the variability in climate projection models. However, conservatively, it is assumed that climate change would reduce the availability of caribou habitat.

14.5.1.2.2 Habitat Distribution

Caribou require large, contiguous tracts of habitat to maintain low population densities across their range. Habitat fragmentation resulting in barriers to caribou movement and avoidance of anthropogenic disturbances can lead to an indirect loss of habitat (Dyer et al. 2001; Neufeld 2006; DeCesare 2012; Slater 2013; Figure 14.5-3 and Figure 14.5-4). In the RFD Case, a measurable increase in the density of linear features in SK2 West is not predicted because both the Project and the Fission Patterson Lake South Property are expected to primarily overlap existing disturbances.

In the Base Case, Highway 955 is already expected to have a negative influence on caribou movement and habitat connectivity, particularly during periods of high traffic volume (Section 14.3.1.2). Addition of the Fission Patterson Lake South Property is expected to increase the number of vehicles on Highway 955 relative to the Application Case. The increase in traffic is assumed to be similar in magnitude to that of the Project (Section 14.5.1.1.2). Incremental traffic increases could further affect the movement of caribou that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). The creation of local or regional semi-permeable movement barriers is considered possible due to future developments and would be experienced continuously until traffic from the two projects decreases.

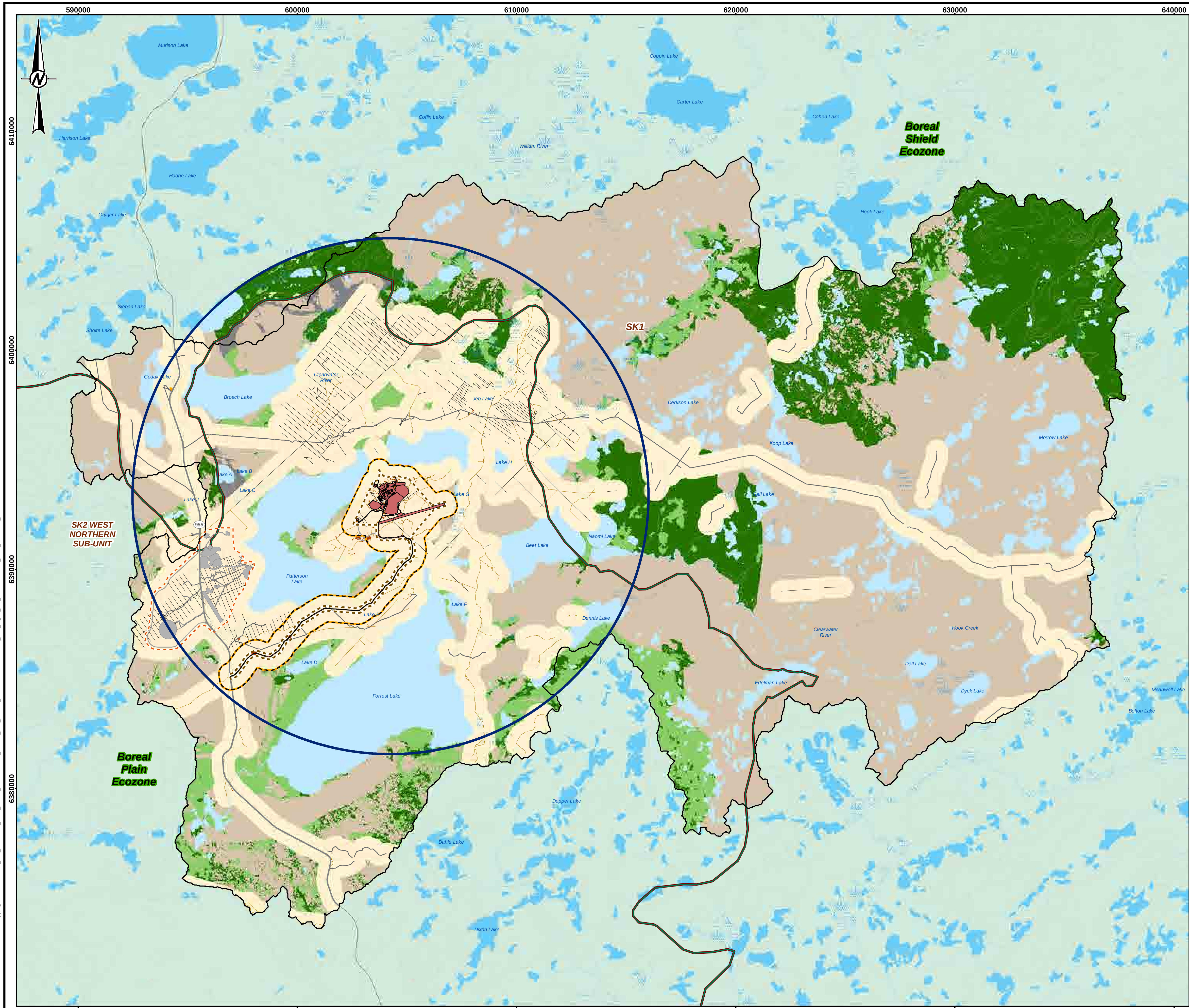
Habitat Arrangement and Connectivity

Effects from changes to habitat distribution (i.e., arrangement and connectivity) due to the Project and Fission Patterson Lake South Property are predicted to be negligible or small relative to the Base Case. The connectivity of caribou habitat in the caribou home range, RSA, and SK2 West is already restricted by existing disturbance (i.e., Highway 955, exploration camps and access road, trails, seismic lines / cutlines, and forest harvest). The scale of effects could be beyond regional if caribou movement between SK2 West and neighbouring ranges (i.e., Richardson, east side of the Athabasca, and Cold Lake Range populations) is reduced. The magnitude of effects is uncertain given the lack of knowledge about the movement of caribou within and adjacent to the RSA and location of seasonal movement corridors. However, for the assessment, it is assumed that connectivity would continue to be reduced. Implementation of offsets and mitigation measures in the SK2 range plan (ENV 2021) are expected to work towards maintaining connectivity.

There is a high degree of uncertainty about the potential effects of fragmentation that could result from future forestry operations. However, it is assumed that ongoing timber harvest will continue to increase fragmentation. The magnitude of effects on caribou from changes in habitat connectivity would depend on the spatial configuration of these disturbances. In particular, cutblocks between regionally important travel corridors and areas of high habitat suitability could constrain seasonal movements and connectivity between neighbouring caribou ranges in the RFD Case. Natural forest pattern harvest methods to reduce the amount of forestry-associated roads and create larger patches of undisturbed habitat have been adopted by Mistik Management Ltd. since 2001 and are included in a recent FMP of Carrier Forest Products for the TSL for the Northwest Area (ENV 2021). It is a licensing requirement that both operators implement mitigation plans in their respective TSL / FMP areas in SK2 West (ENV 2021).

Climate Change

As with habitat availability, climate change and the associated potential increase in wildfire may contribute to changes in the distribution of caribou habitat. An increase in the frequency and intensity of wildfires could alter the distribution and composition of upland habitat patches or reduce the size of wetlands on the landscape, which could change where suitable habitat occurs throughout the caribou home range, RSA, and SK2 West. Caribou may have to adjust seasonal movements between habitat patches if climate change alters the configuration of land cover within their home ranges. The magnitude of change to habitat distribution induced by climate change is uncertain because of the variability in climate projection models. However, it was conservatively assumed that climate change would reduce the connectivity of caribou habitat.



LEGEND

	ELEVATION CONTOUR (20 m INTERVAL)
	WATERCOURSE
	WATERBODY
	WETLAND
	WOODED AREA
	ECOZONE BOUNDARY
	CARIBOU ADMINISTRATION UNIT BOUNDARY
	CARIBOU HOME RANGE ASSESSMENT AREA
	LOCAL STUDY AREA
	REGIONAL STUDY AREA
	PROPOSED PROJECT FOOTPRINT
	FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
	PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA
	MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

	ACCESS ROAD
	CUTLINE/SEISMIC
	SECONDARY HIGHWAY
	ROUGH ROAD
	TRAIL
	NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
	OIL AND GAS DEVELOPMENT

HABITAT POTENTIAL

	HIGH
	MODERATE
	LOW
	ANTHROPOGENIC DISTURBANCE
	NATURAL DISTURBANCE
	UNCLASSIFIED

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

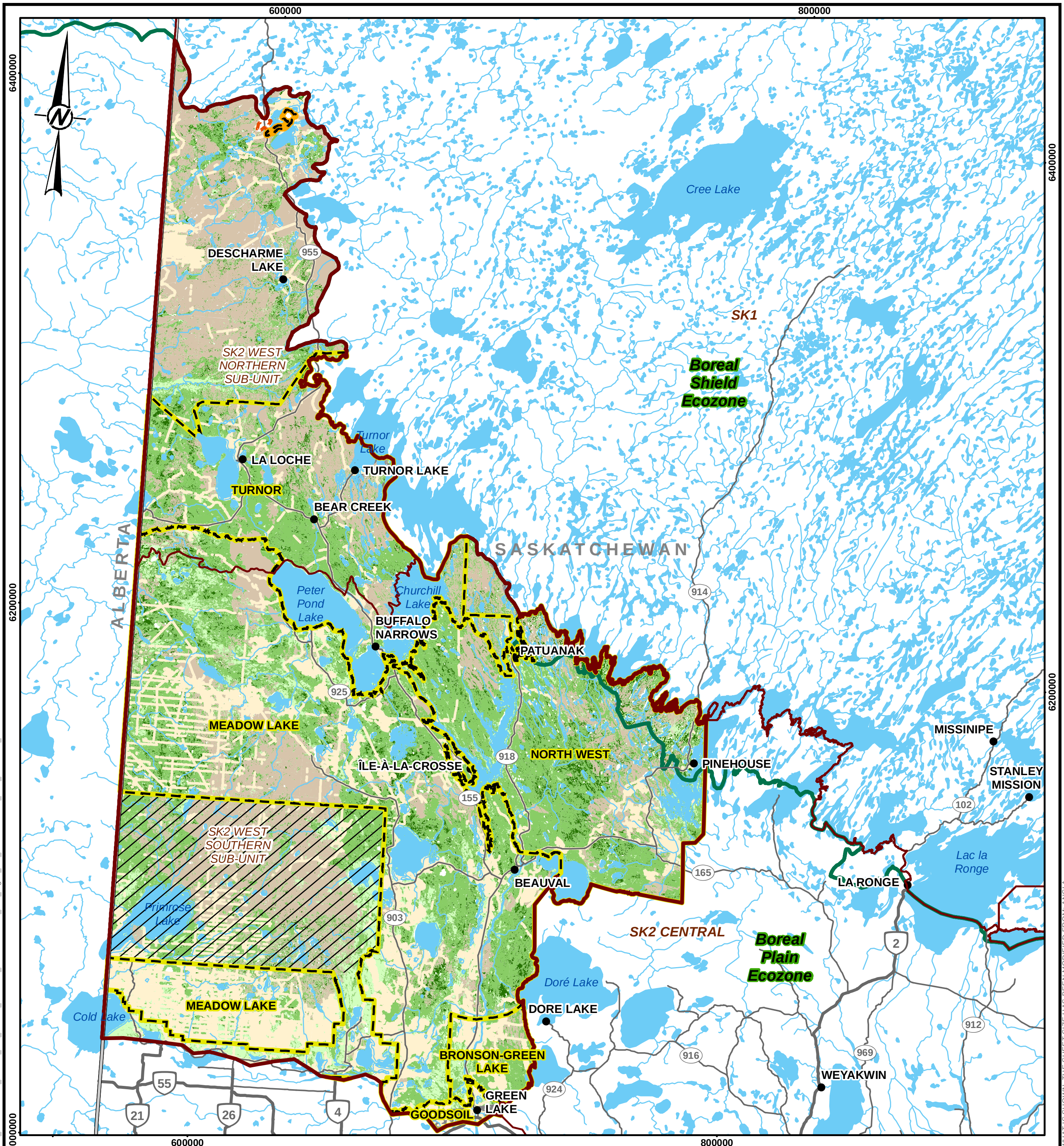
TITLE
WOODLAND CARIBOU HABITAT AT THE REGIONAL STUDY AREA, LOCAL STUDY AREA AND CARIBOU HOME RANGE, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT
wsp

PROJECT	20144150	PHASE	3314 - 6
DESIGN	MB	2020-03-13	SCALE AS SHOWN REV. 0
GIS	NO	2023-02-09	
CHECK	SM	2023-02-09	FIGURE 14.5-3
REVIEW	JV	2023-02-09	

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATE\14_Wildlife_and_Wildlife_Habitat\17x11\20144150_040_Fig14_5-3_CaribouHabitat_HRA_RFDCase_Rev0.mxd PRINTED ON: 2023-02-09 AT: 6:59:14 AM



LEGEND

- POPULATED PLACE
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- ECOZONE BOUNDARY
- WATERBODY
- LOCAL STUDY AREA
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA
- CARIBOU ADMINISTRATION UNIT BOUNDARY
- COLD AIR WEAPONS RANGE
- FOREST LICENSE AREAS

HABITAT POTENTIAL

- HIGH
- MODERATE
- LOW
- ANTHROPOGENIC DISTURBANCE
- NATURAL DISTURBANCE
- UNCLASSIFIED

0 50 100

1:2,100,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

WOODLAND CARIBOU HABITAT IN THE SK2 WEST CARIBOU ADMINISTRATION UNIT, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3110 - 2
DESIGN	JS	2023-02-08	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-08		
CHECK	SM	2023-02-08	**FIGURE 14.5-4**	
REVIEW	JV	2023-02-08		

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\14_Wildlife_and_Wildlife_Habitat\8_5x11\20144150_041_Fig14_5-4_CaribouHabitat_S2K_RFDCase_Rev0.mxd PRINTED ON: 2023-02-08 AT: 2:07:53 PM

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14.5.1.2.3 Survival and Reproduction

Seasonally Important Habitat Areas

Incremental changes to caribou survival and reproduction may occur as a result of direct and indirect effects on calving or post-calving areas or as a result of increased predation due to the Project and the Fission Patterson Lake South Property. The reproductive success of females and survival of calves are negatively affected if calving and post-calving habitats are unavailable, inadequate, or degraded (McCarthy et al. 2011; ECCC 2020). Loss of high suitability habitat areas could have negative consequences to caribou survival and reproduction if displaced females are forced to rear calves in less suitable habitats (e.g., where predation risk is higher).

The disturbance of 76.7 ha of suitable habitat from the Project and Fission Patterson Lake South Property would affect less than one annual home range for an individual caribou (435 km^2; Section 14.3.1) and represents 1.3% of available suitable in the home range, and is expected to have a negligible effect on caribou survival and reproduction.

Predator and Alternative Prey Dynamics

Linear feature density in the LSA, caribou home range, and RSA is not expected to change due to the Project and the Fission Patterson Lake South Property (based on the hypothetical maximum disturbance area used in the assessment; Section 14.2.5); physical effects of linear disturbances would remain similar to the Base Case. Ongoing forest harvest in the SK2 West would increase the density of linear features but would not likely affect the same caribou population as the Project (i.e., the Project is in the north sub-unit and forestry activities are in the south sub-unit). Therefore, resulting cumulative effects on predator and alternative prey dynamics in the RFD Case are not expected.

Sensory Disturbance

Cumulative sensory disturbance created by the Project and the Fission Patterson Lake South Property may potentially affect survival and recruitment (Section 14.5.1.1.3, Survival and Reproduction). Cumulative habitat loss due to sensory disturbance in the RFD Case should be reversible five years after closure of one of the projects or when there is no temporal overlap between projects. Additional sensory disturbance effects from forestry may also influence caribou. However, disturbances from forestry activity are well removed from the Project and Fission Patterson Lake South Property and unlikely to affect the same individuals or population (Figure 14.5-4).

Forest Harvest

Forest harvesting in the SK2 West south sub-unit could affect caribou survival and reproduction in SK2 West through habitat loss (i.e., vegetation clearing), increased predation risk, and sensory disturbances. Vegetation clearing would create early seral stage habitat, which may be more favourable for moose and deer, leading to increased predator densities (Section 14.3.1). Forestry activities in the SK2 West south sub-unit are predicted to be the main driver of this disturbance by creating large tracts of early seral stage habitat and associated access roads and would likely have a stronger effect on caribou relative to the natural disturbance regime in the north sub-unit and RSA (Section 14.3.1.1). The geographic location of disturbances determines the magnitude of effects because increased predation risk in and around high and moderate suitability habitat can have disproportionately large effects on calf recruitment and adult survival. These effects could be exacerbated if habitat conversion and changing climatic conditions allow white-tailed deer to become more abundant in the SK2 West north sub-unit (Dawe and Boutin 2016).

The magnitude of change in predation rate attributable to forest harvesting could be considerable. Possible effects on regional caribou movements are expected, particularly if forestry-related habitat loss occurs in high suitability habitat or along key travel corridors. The potential for demographic rescue and genetic diversity would be negatively affected if connectivity were constrained, or disrupted/severed, between SK2 West and other neighbouring caribou ranges (i.e., SK2 Central, SK1, Alberta ranges).

Climate Change

Effects from anthropogenic disturbances may be compounded by effects with natural factors such as climate change and associated changes in forest fire regimes and predator-prey relationships. Shank and Nixon (2014) indicated that woodland caribou have an anticipated moderate exposure and a high sensitivity to climate change, due to the species' strong association with old, low-productivity upland and peatland conifer forest. Climate change is expected to increase forest fires and insect outbreaks (e.g., mountain pine beetle) in old and low-productivity forests and open this habitat to moose and deer and consequent increases in competition, wolf predation, and meningeal brain worm (*Parelaphostrongylus tenuis*; Shank and Nixon 2014). Vulnerability to predation has been thought to increase with the extent of disturbed landscape within caribou home ranges (Courtois et al. 2007) due to disturbance-mediated apparent competition.

As discussed in Section 14.3.1.3, Survival and Reproduction, recent research indicates that for ecosystems with low primary productivity (e.g., Boreal Shield), caribou population declines due to natural disturbance may be not well linked or decoupled (DeMars et al. 2019; Neufeld et al. 2020), which could moderate the potential effects from climate change. Caribou populations in the northern extent of the Boreal Plain and SK2 West north sub-unit may exhibit similar responses to fire disturbance and lower net primary productivity relative to more southern latitudes. As a result of a longer, warmer growing season, forest productivity may increase in the future and alter ecological succession (Sauchyn et al. 2009). As forest productivity increases, moose and wolf abundance may also increase in northern latitudes (Thompson et al. 1998; Murray et al. 2006), which may negatively affect caribou populations and distributions through higher predation risk or the spread of disease such as meningeal brain worm or chronic wasting disease (CWD; Thompson et al. 1998; Sharma et al. 2009; Murray et al. 2012).

The CRDN expressed concern about CWD in moose and caribou and the effect of industrial activity on the spread of this disease (CRDN-JWG 2020a). Chronic wasting disease is a fatal, prion neurodegenerative, transmissible spongiform encephalopathy that affects cervids (i.e., animals in the deer family) and has the potential to reduce cervid populations in the long term (Bollinger et al. 2004). Meningeal brain worm is a parasitic roundworm that also affects cervids. While most commonly carried by white-tailed deer, which is not affected, moose, elk, caribou, and mule deer are susceptible, and the worm can affect the nervous system of these species, causing eventual death of the animal (Government of Saskatchewan 2021b). An increase in white-tailed deer in the RSA and SK2 West north sub-unit could lead to spread of diseases (Murray et al. 2012) and elevated predation on caribou and declines in caribou survival (Dawe and Boutin 2016). Invasion of white-tailed deer into larger portions of the boreal forest could reduce caribou survival through competition and changes to the predator-prey dynamics in these systems (i.e., increased prey availability could lead to larger wolf populations).

Overall, climate change was assumed to potentially put additional pressure on caribou survival and reproduction from habitat transformations due to climate-induced forest fires and increased disease related to changing ungulate distributions.

Summary

The effects of the RFDs on caribou survival and reproduction would be largely dependent on how caribou adjust to ongoing landscape change (i.e., to the spatial shift in available habitat) and the degree of predation risk within occupied future habitats. A small, measurable change in caribou abundance and distribution in SK2 West north sub-unit may be associated with the Project and Fission Patterson Lake South Property. A relatively larger change in abundance and distribution would likely occur from forestry activities for caribou occupying the SK2 West south sub-unit. Cumulative effects from the Project, Fission Patterson Lake South Property, and forestry:

- would increase the amount of disturbance in SK2 West, which is already below the critical habitat threshold of undisturbed habitat for a self-sustaining caribou population;
- are mainly located in areas already constrained by existing disturbance (e.g., Highway 955, exploration sites, and trails);
- occur predominantly within and surrounded by existing disturbance not considered suitable caribou habitat, which may reduce the cumulative effects (Figure 14.5-3 and Figure 14.5-4);
- could change predator-prey dynamics and increase predation risk if habitat conversion leads to an increase in the availability of prey, leading in turn to an increase in wolf abundance;
- could disrupt connectivity between caribou in the south and north sub-units of the SK2 West range and adjacent ranges; and
- could interact with climate change, which may improve conditions for further white-tailed deer expansion and alter the risk of disease and predation.

14.5.1.3 Residual Effects Classification and Determination of Significance

14.5.1.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of effective mitigation (Table 14.5-3). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on caribou. Following the summary of residual effects, significance of residual effects for the Application Case and the RFD Case were determined according to the methods described in Section 14.2.9.

Table 14.5-3: Classification of Residual Effects on Woodland Caribou Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 7.5 ha removal of high suitability habitat, representing a <0.1% reduction in SK2 West (i.e., high magnitude as habitat loss in the Base Case exceeds disturbance threshold) ▪ 24.6 ha removal of moderate suitability habitat, representing a <0.1% reduction in SK2 West (i.e., moderate magnitude as habitat loss in the Base Case exceeds disturbance threshold) ▪ 0.3 ha removal of low suitability habitat, representing a <0.1% reduction in SK2 West (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 17.7 ha removal of high suitability habitat, representing a <0.1% reduction in SK2 West (i.e., high magnitude as habitat loss in the Base Case exceeds disturbance threshold) ▪ 66.7 ha removal of moderate suitability habitat, representing a <0.1% reduction in SK2 West (i.e., moderate magnitude as habitat loss in the Base Case exceeds disturbance threshold) ▪ 1.4 ha removal of low suitability habitat, representing a <0.1% reduction in SK2 West (i.e., low magnitude) ▪ 8.4 ha removal of unclassified, suitable habitat, representing a <0.1% reduction in SK2 West (i.e., low magnitude) ▪ Disturbance created by forestry in SK2 West south sub-unit may result in moderate loss of functional habitat relative to SK2 West north sub-unit and RSA ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (500 m buffer beyond maximum disturbance area)	▪ Beyond regional (Project, Fission Patterson Lake South Property [with 500 m buffer], and forestry) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 73 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus at least 40 years to establish critical caribou habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 55 years, depending on extent of temporal overlap between the Project, Fission Patterson Lake South Property, and forestry ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project, the Fission Patterson Lake South Property, and forestry
	Reversibility	▪ Reversible (reclaimed habitat and sensory disturbance) ▪ Irreversible (habitat covered by permanent features [e.g., WRSAs] and wetlands)	▪ Reversible (reclaimed habitat and sensory disturbance) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project, Fission Patterson Lake South Property, and forestry) ▪ Possible (climate change)

Table 14.5-3: Classification of Residual Effects on Woodland Caribou Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small changes to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude; LSA and Highway 955 expected to be partial barrier to caribou movement in the Base Case)	▪ Landscape disturbance created by the Project and Fission Patterson Lake South Property would create small loss in habitat connectivity relative to Base Case (i.e., low magnitude) ▪ Disturbance created by forestry in SK2 West south sub-unit may result in moderate loss of habitat connectivity relative to SK2 West north sub-unit and RSA
	Geographic extent	▪ Local to regional (LSA and movement route at Patterson Lake narrows) ▪ Beyond regional (Highway 955) including SK2 West	▪ Beyond regional (Project, Fission Patterson Lake South Property, Highway 955, and forestry) ▪ Beyond regional (climate change)
	Duration	▪ Long-term (direct habitat loss): 73 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus at least 40 years to establish critical caribou habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 55 years, depending on extent of temporal overlap between the Project, Fission Patterson Lake South Property, and forestry ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project, the Fission Patterson Lake South Property, and forestry
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project, Fission Patterson Lake South Property, and forestry) ▪ Possible (climate change)

Table 14.5-3: Classification of Residual Effects on Woodland Caribou Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Combined loss of suitable habitat (32.4 ha) represents 0.6% of available habitat and a small portion of one home range (i.e., low magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ Combined loss of 76.7 ha suitable habitat by Project and Fission Patterson Lake South Property represents 1.3% of available habitat and a small portion of one caribou home range (i.e., low magnitude) ▪ Small change in abundance and distribution from the Project and Fission Patterson Lake South Property relative to Base Case ▪ Forestry in SK2 West south sub-unit is predicted to contribute to a larger change in abundance and distribution relative to SK2 West north sub-unit and RSA
	Geographic extent	▪ Beyond regional (Highway 955) including SK2 West	▪ Beyond regional including SK2 West (Project, Fission Patterson Lake South Property, Highway 955, and forestry) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features and wetlands ▪ Long-term (direct habitat loss): 73 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus at least 40 years to establish caribou habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent for habitat covered by permanent features, wetlands ▪ Permanent (climate change) ▪ Long-term(direct habitat loss): maximum of 55 years, depending on extent of temporal overlap between the Project, Fission Patterson Lake South Property, and forestry ▪ Long-term(sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project, the Fission Patterson Lake South Property, and forestry
	Reversibility	▪ Reversible	▪ Reversible (Project, Fission Patterson Lake South Property, and forestry) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Probable (forestry) ▪ Possible (climate change)

RSA = regional study area; LSA = local study area; WRSAs = waste rock storage areas; < = less than; RFD = reasonably foreseeable development.

14.5.1.3.2 Significance Determination

Habitat Availability and Distribution

Woodland caribou, boreal population, is listed as vulnerable/rare to uncommon (S3) in Saskatchewan (SKCDC 2021; SKCDC 2020) and as Threatened under Schedule 1 of the federal SARA (Government of Canada 2023). Under existing conditions, caribou populations in the SK2 caribou conservation unit are ranked “as likely as not self-sustaining” (ECCC 2020). The SK2 West Caribou Administration Unit does not meet the minimum 65% critical habitat threshold necessary to support a self-sustaining population (ECCC 2020). In the SK1 caribou conservation unit, ECCC’s critical habitat assessment found that the caribou population(s) were considered to be self-sustaining (McLoughlin et al. 2019; ECCC 2020). While the Project would be located in the SK2 West north sub-unit, the Project’s caribou home range and RSA overlap both the SK1 and SK2 West administration units.

McLoughlin et al. (2019) found that caribou in SK1 are resilient to fire disturbance and that the predator-prey system differs from more southern human-influenced regions where a higher abundance of alternative prey (i.e., deer, moose, beaver) maintain high predator numbers and associated encounter rates with caribou. Another study showed that caribou can remain self-sustaining in fire-driven landscapes but are sensitive to effects from anthropogenic disturbance (Stewart et al. 2020). Konkolics et al. (2021) also found that burned habitats did not lower adult female survival. In ecosystems such as in SK1 and the SK2 West north sub-unit, low net primary productivity supports lower densities of prey and predators and natural disturbance may not be strongly linked to the population growth of caribou (DeMars et al. 2019; Neufeld et al. 2020). In other words, the relationship between disturbance, prey biomass and predator numbers, and risk of predation on caribou (i.e., disturbance-mediated apparent competition; Section 14.3.1) weakens in ecosystems of low primary productivity with limited availability of deciduous browse for ungulates. Fire disturbance, net primary productivity, and predator-prey relationships in the northern extent of the Boreal Plain and SK2 West north sub-unit are expected to be more similar to SK1 than more southern latitudes (Section 14.3.1.1). Caribou populations overlapping the SK2 West north sub-unit and the RSA may be more resilient to disturbance, particularly fire disturbance, than populations inhabiting areas with higher diversity and abundance of alternative prey and anthropogenic disturbance. As such, there is uncertainty about whether caribou populations overlapping the northern extent of the SK2 West north sub-unit and the RSA are actually unlikely to be self-sustaining, as they are currently designated (ECCC 2020).

In the Base Case, existing disturbance is low (0.4%) and aggregated in the northwest portion of the caribou home range and RSA. Existing disturbances include Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. A seasonal trail (i.e., rough road) also passes through the caribou home range and RSA east from Highway 955 and likely provides a travel corridor for predators and hunters, which could increase encounter rates with caribou and contribute to mortality in the population. Highway 955, and perhaps the existing access road, likely influences animal movement and habitat connectivity during periods of high traffic volume, but narrower linear features are predicted to have little effect on caribou distribution.

In the Application Case, the Project is expected to result in a loss of 32.4 ha of suitable caribou habitat, representing less than 0.1% of available habitat in SK2 West and 0.6% of available habitat in the caribou home range study area. The geographic extent of habitat loss from the Project, plus the 500 m buffer, is limited to the LSA. Most of the decrease in habitat availability would occur in moderate suitability habitat (i.e., 24.6 ha). The amount of habitat loss is much less than one caribou home range (435 km^2; Section 14.3.1). Habitat loss from the Project may displace a few individual caribou but is unlikely to have a demographic effect at the population level (i.e., effect is not expected but not impossible). Effects from habitat loss are predicted to be reversible 40 years after the Active Closure Stage when reclaimed areas have reached defined critical habitat for caribou (Environment Canada 2011; ENV 2021). Over the long term, reclamation, in conjunction with measures undertaken as part of the Caribou Mitigation and Offsetting Plan, would likely reduce the effects from changes to caribou habitat availability caused by the Project and would be targeted provide a net increase in functional habitat for caribou.

In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable caribou habitat in SK2 West by less than 0.1%. Additional disturbance of habitat in the SK2 West south sub-unit would result from forestry. Overall, the combined amount of suitable habitat loss due to the Project and the Fission Patterson Lake South Property (i.e., 76.7 ha) is predicted to have a negligible effect on the caribou population using the SK2 west north sub-unit and the RSA as it accounts for much less than one caribou home range.

In the Base Case, Highway 955 is already expected to have a negative influence on caribou movement and habitat connectivity, particularly during periods of high traffic volume. The strength of the effect of Highway 955 on caribou (and other wildlife) movement and population connectivity in the Base Case is unknown. However, the road is unpaved and in a remote region of the SK2 West range, particularly in the area near the Project, which could be inferred to have a low magnitude influence on caribou.

In the Application Case, the Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (Section 14.4.2). In the RFD Case, addition of the Fission Patterson Lake South Property is expected to increase the number of vehicles on Highway 955 by a similar volume projected for the Project. The increase in traffic volume could have minor effects on the movement and habitat connectivity of caribou that use habitat within and outside the western portion of the RSA and SK2 West, particularly during construction and active closure activities of both projects. Changes in movement across Highway 955 may also decrease connectivity between populations. The strength of the effect would likely depend on the whether peak traffic volumes for the projects (i.e., construction phase and/or active closure stages) overlapped.

Survival and Reproduction

The density of linear features, such as roads and trails, can alter the movement and connectivity of caribou populations and increase the travel efficiency of predators, which can adversely affect caribou survival and reproduction. The Project would be in a portion of SK2 West north sub-unit, caribou home range study area, and RSA that contains an aggregation of existing linear and non-linear features around Highway 955. The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Because caribou would likely avoid passing through the maximum disturbance area, an existing movement route identified by Indigenous Knowledge may be affected by the Project and alter habitat connectivity in the area of the north arm of Patterson Lake. However, the Project would not increase the overall density of linear features in the caribou study areas. Existing linear feature densities in SK2 West (0.22 km/km^2 to 0.39 km/km^2) and the RSA (0.6 km/km^2) are lower than the density threshold that has been suggested to reduce predation effects on caribou (1 km/km^2; Section 14.3.1.2). Linear feature density in the caribou home range (1.17 km/km^2) is slightly greater than the predicted threshold density for reducing predation on caribou. The Project footprint is not expected to change caribou population connectivity, travel efficiency of predators, and caribou-predator encounter rates. As such, these indirect effects from the Project are predicted to have a negligible influence on caribou population survival and reproduction rates, abundance, and distribution.

Wolf numbers are linked to the abundance of alternate prey (e.g., moose), which can increase with an increase in availability of early seral-stage vegetation and adversely affect caribou survival and reproduction. Early- to late-stage regenerating (6 to 40 years old) jack pine ecosites represent 64% of the LSA and 52% of the RSA in the Base Case (Section 14.3.1.1) and constitute high and moderate suitability moose habitat (Section 14.3.2.1; Appendix 14B). Moose (an alternative prey species) habitat is not limiting in the caribou home range or RSA and the amount of early- to late-stage regenerating habitat that would be disturbed and subsequently reclaimed by the Project and RFDs is predicted to have a negligible influence on the abundance and distribution of moose (Section 14.5.2.1.3, Survival and Reproduction). Therefore, the Project should not increase the abundance of alternate prey and predators and is expected to have no measurable contribution to predation rates on caribou.

Other Project-wildlife interactions, such as increased access for people and predators, higher risk of injury/mortality from wildlife-vehicle collisions, and the attraction of animals to site, were determined to have negligible effects on the woodland caribou population (Section 14.4.2). The Project would not increase access for humans and predators as an access road to the site already exists and upgrades to the access road for the Project are expected to result in no measurable change to existing access for hunting/trapping. Several trails also exist in the Fission Patterson Lake South Property, and increased access to harvest woodland caribou is not anticipated. Implementation of mitigation measures at the Project including staff, contractor, and visitor orientations, giving wildlife the right of way, identification of wildlife crossings, gaps in road berms and snowbanks, and speed limit adjustments are expected to result in a minor increase in injury or mortality to individual animals from vehicle-wildlife collisions. Environmental design features and management plans (e.g., Conventional Waste Management Plan) could limit attractants to the Project and result in a minor influence on predator numbers. It is expected that similar mitigation policies and practices would be implemented at the Fission Patterson Lake South Property to avoid and limit potential adverse cumulative effects on woodland caribou. As such, the combined effects of these pathways are predicted to not measurably influence the abundance and distribution of the woodland caribou population overlapping the RSA.

The Project and the Fission Patterson Lake South Property, though limited in size and located predominantly in areas of existing disturbance not considered suitable habitat for caribou, would contribute to an increase in disturbance within the caribou home range, RSA, and SK2 West north sub-unit. It is possible that caribou in the SK2 West north sub-unit may be sensitive to small increases in anthropogenic disturbances given the similarity to SK1 in landscape-scale disturbance regimes (McLoughlin et al 2019; ECCC 2020). However, the combined amount of suitable habitat loss due to the Project and the Fission Patterson Lake South Property (i.e., 94.2 ha) is predicted to have a negligible effect on survival and reproduction in the SK2 West north sub-unit. Although connectivity is already affected in the caribou home range, the habitat would still be well connected in the RSA and SK2 West north sub-unit, which indicates that changes to survival and reproduction of caribou from associated predation risk is not likely to be measurable at the population level.

Current and future forest harvesting in the SK2 West south sub-unit is expected to affect caribou survival and reproduction in SK2 West through habitat loss, increased predation risk, and sensory disturbance. Vegetation clearing would create early seral stage habitat, which would be more favourable for moose and deer. Increased alternate prey densities can increase predator numbers and predation risk for caribou. Sensory disturbance can have a large influence on caribou survival and reproduction during sensitive periods such as calving and late winter. Forestry activities are predicted to be the main driver of these types of disturbances by creating large tracts of early seral stage habitat and associated access roads in the SK2 West south sub-unit and likely would have a stronger effect on caribou populations in SK2 West as a whole relative to the two proposed developments in the SK2 West north sub-unit.

Climate Change

Effects from anthropogenic disturbances may be compounded by effects from natural factors such as climate change and associated changes to forest fire regimes and predator-prey relationships. Wildfires convert mature to old growth coniferous forests with abundant terrestrial lichen forage (caribou food) to early seral-stage habitats, reducing the amount of available suitable habitat for caribou. However, post-fire communities of lichen-rich forest or peatland complexes can develop in the long term. Changes to upland and wetland habitat composition and distribution may also affect caribou habitat availability and distribution. The expansion of white-tailed deer into the region could have negative consequences for caribou survival if wolf numbers increase or the spread of disease (e.g., CWD) between ungulates becomes more frequent. Although the magnitude of effects from these natural factors is uncertain, it is assumed that climate change would continue to reduce caribou habitat. These factors would be considered in developing mitigation, restoration, and management measures for the Project.

Summary of Significance Determination

Caribou in SK2 West in the Base Case are designated as unlikely to be self-sustaining because the amount of critical habitat available does not meet the threshold of 65% undisturbed habitat (ECCC 2020). As such, cumulative effects from habitat loss associated with fire and anthropogenic disturbances are considered significant. The availability of critical habitat for caribou is expected to remain less than the threshold of 65% undisturbed habitat to maintain a self-sustaining population in SK2 West in the Application Case. Because the caribou population in the Base Case is designated as unlikely to be self-sustaining, even the incremental effects due to the small amount of habitat loss from the Project in SK2 West are predicted to result in a significant adverse effect on caribou in the Application Case. However, the weight of evidence predicts that the Project would contribute no to little cumulative effects and is unlikely to result in a measurable adverse effect on the population growth of woodland caribou in SK2 West.

Cumulative effects from the Project, Fission Patterson Lake Property, and forest harvest activities are similarly predicted to result in a significant adverse effect on caribou in the RFD Case, since any incremental increase in disturbance would be considered significant. The effects related to climate change are uncertain but are mostly assumed to have an adverse influence on caribou.

NexGen is committed to reclaiming habitat disturbed by the Project footprint and offsetting the incremental loss of caribou habitat to help achieve self-sustaining and ecologically effective caribou populations. Trial reclamation to restore caribou habitat along linear features has begun, which demonstrates this commitment. In addition, the implementation of a Caribou Mitigation and Offsetting Plan is expected to result in a net increase in functional caribou habitat. With the implementation of the Caribou Mitigation and Offsetting Plan, the contribution of Project-specific adverse residual effects to woodland caribou are predicted to be **not significant**.

It is also anticipated that other future developments, such as the Fission Patterson Lake South Property, would implement similar mitigation actions to support a trajectory towards conserving caribou in keeping with the provincial government's SK2 range plan (ENV 2021).

14.5.2 Moose

14.5.2.1 Application Case

The residual effects analysis for moose focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of moose habitat and affect moose abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect moose habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter moose movement and behaviour and adversely affect moose habitat availability and moose abundance and distribution.

14.5.2.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Construction of Project infrastructure would reduce the availability of suitable moose habitat. A loss of 56.7 ha of high suitability habitat is predicted in the LSA, which represents a change of 0.5% of high suitability habitat at the scale of the RSA and 12,500.1 ha of high suitability habitat would remain in the RSA (Table 14.5-4). A loss of 732.0 ha (1.2% of the RSA) of moderate suitability habitat is predicted. Loss of low suitability habitat is estimated at 26.5 ha, representing 0.2% of its availability in the RSA. Overall, the Project would disturb 815.2 ha (1.0%) of suitable moose habitat in the RSA relative to the Base Case. The predicted habitat losses are associated with a corresponding increase in the amount of poor suitability habitat (Table 14.5-4). The magnitude of habitat loss has been conservatively overestimated to account for potential changes in Project design within the maximum disturbance area used in the assessment. The effect of direct habitat loss is certain, expected to be confined to the maximum disturbance area, and continuous from Construction through Closure.

Table 14.5-4: Changes to Moose Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	12,556.8	12,500.1	-56.7	-0.5
Moderate	58,996.2	58,264.2	-732.0	-1.2
Low	12,655.0	12,628.5	-26.5	-0.2
Poor	23,282.7	24,097.9	815.2	3.5

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

The direct loss of available moose habitat is primarily associated with clearing of vegetation for the Project. Boutin et al. (2015) found that radio-tracked moose would maintain home ranges in proximity to mine sites but would avoid the physical mine footprints and their associated infrastructure. While some forms of habitat disturbance can be beneficial to moose (Section 14.3.2.1), the disturbance associated with the Project is expected to remove the majority of vegetation from the Project footprint, making it unlikely that moose would use the converted habitat in the maximum disturbance area.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the upland ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Reclamation is predicted to reverse effects on disturbed ELC units and to provide adequate material for the development of productive soils and support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project. However, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those not affected by the Project (Section 13.5.1). In upland habitats, functional habitat for moose is expected to become available 6 to 10 years after fire disturbance (i.e., after the development of a shrub layer), and resulting optimal moose habitat occurs at 10 to 26 years post-fire, with subsequent declines in moose population density occurring as tree stands mature (Nelson et al. 2008). In a study by Maier et al. (2005) in Alaska, high density moose populations occurred in areas where fire had occurred between 11 years and 30 years previously and this finding was supported by a later report by Joly et al. (2017). Although functional habitat for moose is predicted to become available 6 to 10 years after the end of the Active Closure Stage (i.e., a duration of 43 years), functional habitat for moose may take longer to establish given that forests in the RSA are likely similar to less productive forests in the Boreal Shield (Section 14.3.2.1; Neufeld et al. 2020).

Sensory Disturbance

The maximum disturbance area and associated sensory disturbance would remove suitable moose habitat in the LSA (i.e., local geographic extent; Figure 14.5-5). Suitable habitats that are within 500 m of human developments with high levels of activity were assigned a suitability rank of poor based on scientific and Indigenous Knowledge and as a precautionary approach (Appendix 14B). Indigenous Groups have observed that moose move away from anthropogenic disturbance, including mineral exploration activities in the Patterson Lake area, and expressed concerns about Project activities affecting the movement and abundance of wildlife, including moose populations (TSD II: BNDN; TSD IV: MN-S; TSD V.2: CRDN; TSD VI: YNLR; MN-S-JWG 2020b; NexGen 2019a). However, a member of the BRDN noted that moose are generally less sensitive to noise disturbance than other wildlife (i.e., caribou; BRDN-JWG 2020a). Moose may use roads to avoid predation risk and for travelling, browsing, mineral salts, or relief from insects (Laurian et al. 2012; Government of Newfoundland and Labrador 2017). Moose may also adapt to anthropogenic disturbance by using habitats near development during periods of lower human activity (Lykkja et al. 2009). For example, the MN-S indicated that at the Cluff Lake Mine, some moose moved into the mine site for protection (MN-S-JWG 2020b).

Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage. Sound levels above about 90 dBA are likely to be aversive to mammals, resulting in potential retreat from the sound source, freeze response, or a strong startle response (Manci et al. 1988). Lower levels of noise may result in unobserved internal reactions such as increased heart rate that are energetically costly (Herrero et al. 2005). According to noise modelling results for the Project, cumulative noise contributions resulting from background and Project Construction or Operations are not expected to exceed 45 dBA within 10 km of the maximum disturbance area (Section 7.3.5.1). Therefore, noise from the Project is not expected to result in strong avoidance and not affect energetics of moose in the LSA or RSA.

Any habitat loss that may occur due to sensory disturbance is expected to end following the Active Closure Stage. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible 5 years after Closure (i.e., a duration of 48 years). Moose would likely be most susceptible to sensory disturbance during the calving season (i.e., spring / early summer).

14.5.2.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

During JWG meetings, the BNDN identified a movement route for moose at the narrows of the North Arm of Patterson Lake (BNDN-JWG 2019b). Poor suitability habitat is located north, west, and south of the LSA, associated primarily with Patterson Lake and Forrest Lake (Figure 14.5-5, Figure 14.5-6). Low suitability habitat is located east of the LSA, associated with recent burn habitat from the 2017 fire (SPSA 2019). The movement route identified by the BNDN may provide connectivity between moderate suitability habitat north and south of Patterson Lake (Figure 14.5-6). Because moose would likely avoid passing through the maximum disturbance area, the Project is predicted to change habitat connectivity in the area within and surrounding the LSA (i.e., local to regional geographic extent).

Suitable moose habitat is well distributed and connected in the RSA (Figure 14.5-6), and the Project is predicted to have a small effect on the regional moose movements and distribution. Effects from changes to moose habitat distribution would be continuous and occur from Construction to beyond the Active Closure Stage until functional moose habitat is regenerated on reclaimed areas and sensory disturbance is no longer expected to influence moose behaviour (14.5.2.1.1, Habitat Availability).

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MOOSE HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

CONSULTANT

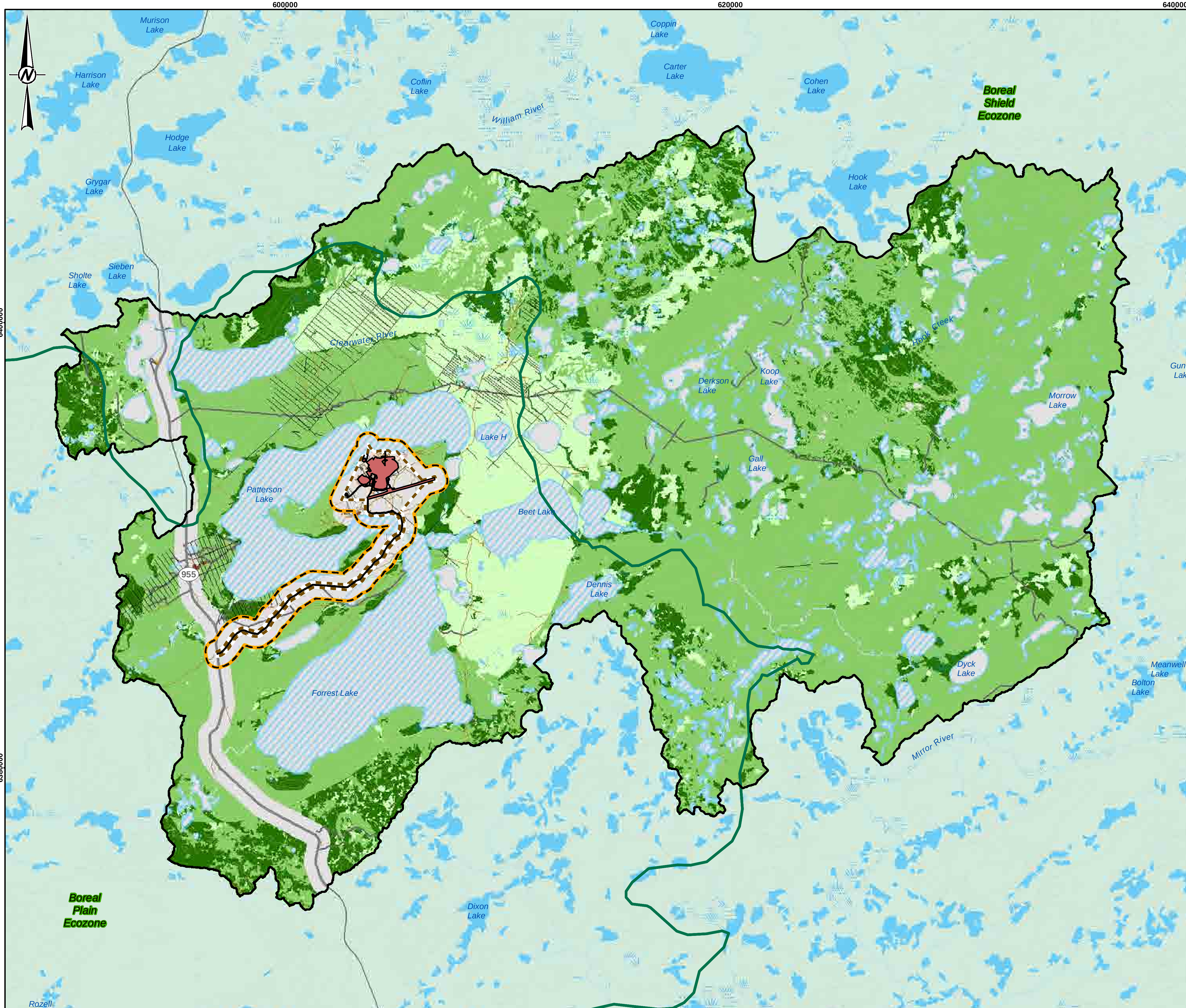
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-5**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATED\14_Wildlife_and_Wildlife_Habitat\17x11\20144150_042_Fig14_5-5_Moose_LSA_AppCase_Rev0.mxd PRINTED ON: 2023-02-09 AT: 6:59:58 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MOOSE HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-6**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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Linear Features

The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Most of the existing trails would be upgraded for site roads and haul roads within the maximum disturbance area. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-6). The current density of all linear features in the RSA (0.6 km/km^2) is likely causing negligible adverse effects on moose (Section 14.3.2.2, Habitat Distribution), and the Project would not change the density of linear features in the LSA and RSA.

Sensory disturbance from traffic along the access road is expected to reduce habitat connectivity for moose within and just beyond the LSA. Indigenous Groups have commented that increased traffic volumes from mineral exploration activities on Highway 955 and the Cluff Lake Road are affecting wildlife movement patterns and distribution, including of moose, and are concerned that traffic related noise from the Project would exacerbate these effects (TSD II: BNDN; TSD V.2: CRDN). In the Base Case, Highway 955 is predicted to have a negative influence on moose movement and habitat connectivity, particularly during periods of high traffic volume (Section 14.3.2.2). Some studies have found that moose avoided areas of 100 to 500 m from major (i.e., paved, two-laned) highways and reduced crossing frequency by up to 16 times lower than expected (Laurian et al. 2008, 2012); however, these effects on movement are anticipated to be less pronounced on Highway 955, which is a gravel highway. The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (Section 14.4.2). The increase in traffic volume could increase avoidance of the highway and a minor change on the movement of moose that use habitat within and outside the western portion of the RSA, particularly during Construction and the Active Closure Stage (i.e., regional to beyond regional effect).

14.5.2.1.3 Survival and Reproduction

Home Range and Vital Rates

A loss of approximately 815.2 ha (8.2 km^2) of suitable habitat (Table 14.5-4) would affect about 8.4% of a moose home range (based on an anticipated home range of 97 km^2; Section 14.3.2.2) or one to two moose based on an expected density of 0.1 to 0.2 moose per km^2 (Section 14.3.2.3, Survival and Reproduction). The loss of potential suitable habitat may affect reproduction if individuals are displaced into poor suitability habitat. Most of the LSA is already considered poor suitability habitat due to existing disturbance (Figure 14.3-2) and suitable habitat would remain abundant and well connected and distributed across the RSA relative to Base Case (Figure 14.5-6). Moose have high mobility and are habitat generalists, capable of utilizing a variety of land cover types. Because habitat availability is not limiting, moose are expected be able to shift or alter their home ranges to exclude areas of high disturbance or use them less frequently when human activity levels are lower. Overall, the anticipated loss of suitable habitat within the LSA is unlikely to have a measurable effect on survival and reproduction and abundance of the moose population overlapping the RSA (probability of effect is not expected but is not impossible).

14.5.2.2 Reasonably Foreseeable Development Case

14.5.2.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable moose habitat. This loss includes the removal of 308.9 ha (2.5%) of high suitability habitat, 2,085.2 ha (3.5%) of moderate suitability habitat, and 56.7 ha (0.4%) of low suitability habitat (Table 14.5-5). Together, these represent a loss of 2,450.8 ha (2.9%) of suitable moose habitat in the RSA (i.e., regional geographic extent). Approximately 81,700 ha of suitable moose habitat would remain in the RFD Case. The predicted losses of low to high habitat suitability are reflected in the corresponding increase in the amount of poor suitability habitat (Table 14.5-5). The Project contribution to future habitat loss is 815.2 (Table 14.5-4), representing 33.3% of the quantified cumulative effect.

The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Loss of moose habitat would be irreversible for permanent features and wetlands.

Table 14.5-5: Changes to Moose Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	12,556.8	12,247.9	-308.9	-2.5
Moderate	58,996.2	56,911.0	-2,085.2	-3.5
Low	12,655.0	12,598.3	-56.7	-0.4
Poor	23,282.7	25,733.5	2,450.8	10.5

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 10 years when reclaimed upland habitat is expected to provide forage for moose (i.e., early-stage upland ecosites; Section 14.5.2.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 25 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As discussed in Section 14.5.2.1.1, cumulative noise levels from existing and Project-related noise during Construction and Operations are not predicted to exceed a maximum of 45 dBA within 10 km of the maximum disturbance area. Similar noise levels (low magnitude and local spatial extent) are predicted for combined changes from the Project and the Fission Patterson Lake South Property (Section 7.3.5.2, Reasonably Foreseeable Development Case). The cumulative changes to moose habitat from sensory disturbance may constrain movement of moose in proximity to the immediate areas around the Project and Fission Patterson Lake South Property. Moose are able to shift or alter their home ranges to exclude areas of high disturbance around mine sites or use them less frequently when human activity levels are lower. Noise associated with heavy equipment and general human presence and activity is expected to result in a small change in the movement of moose around Patterson Lake but is not predicted to affect habitat connectivity and access to food and refuge habitat at the RSA scale.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

Climate change may alter the processes that influence the availability and condition of moose habitat, with effects occurring beyond the RSA (i.e., beyond regional geographic extent). Wetland ecosystem availability and condition may be adversely affected by climate change in the RFD Case (Section 14.2.5). Wetlands are considered one of the ecosystems most sensitive to predicted changes in temperature and to the resultant changes in precipitation and timing and volume of snowmelt. Climate change effects on wetlands are anticipated to occur within the natural variability and resilience of wetlands ecosystems and would not affect overall ecosystem availability (Section 13.5.2.2.1). Consequently, the direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. Wetland ecosystem condition could be reduced in the RSA due to climate change, though the magnitude of change is uncertain (Section 13.5.2.2.3, Ecosystem Condition). Because moose occupy both bogs and wetland margins during various times of the year, changes to land cover due to climate change could increase or decrease overall moose habitat quality in the RSA.

With potential increased fire frequency due to climate change, it is anticipated that the availability of deciduous ELC units (e.g., BP06, BP07) would increase as black spruce dominant stands become less common (Hart et al. 2019). However, the decrease in conifer stands may decrease moose habitat availability in winter as moose tend to prefer coniferous stands where snow depths are lower than in deciduous stands (LeResche et al. 1974; Hauge and Keith 1981).

Overall, effects from climate change on habitat availability are possible for moose, but the direction and magnitude of habitat change induced by climate change are uncertain. Therefore, because of the uncertainty in direction and magnitude, it was conservatively assumed that climate change would have a negative cumulative effect on habitat availability.

14.5.2.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

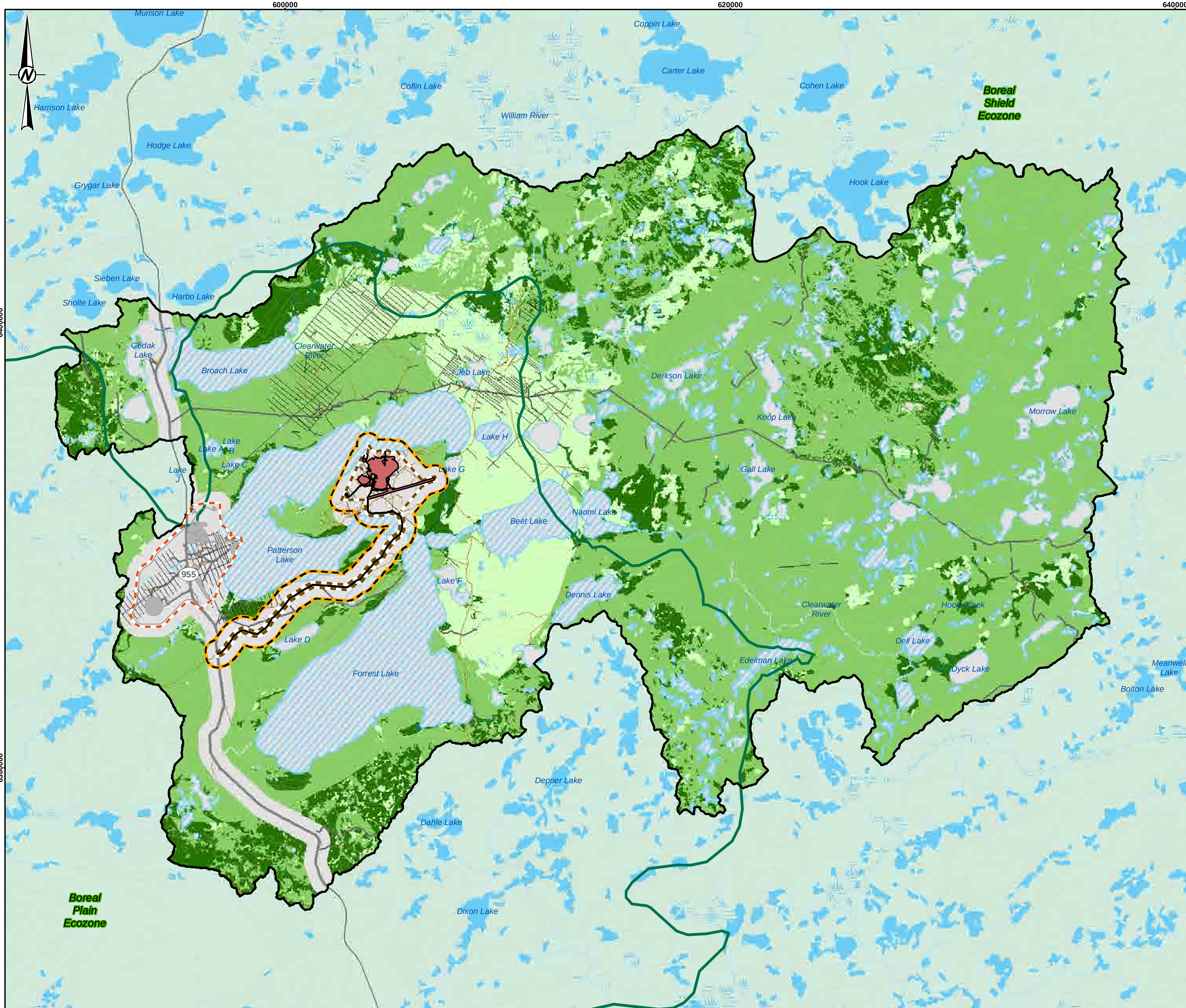
Addition of the Fission Patterson Lake South Property would result primarily in a reduction of moderate and high suitability habitat adjacent to unsuitable habitat associated with the existing Fission Patterson Lake South Property exploration footprint and Patterson Lake. The distribution of suitable habitat in the RSA would remain largely unchanged; moose habitat would remain common and well connected throughout the RSA (Figure 14.5-7).

Linear Features

Linear feature density in the RSA is not expected to change due to the Project and the Fission Patterson Lake South Property (based on the hypothetical maximum disturbance area used in the assessment; Section 14.2.5); physical effects of linear disturbances would remain similar to the Base Case. Highway 955 is already expected to have a negative influence on moose movement and habitat connectivity, particularly during periods of high traffic volume (Section 14.3.3.2, Habitat Distribution). Addition of the Fission Patterson Lake South Property is expected to increase the number of vehicles on Highway 955 relative to the Application Case. The increase in traffic was assumed to be similar in magnitude to that of the Project. Incremental traffic increases could further affect the movement of moose that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). The creation of local or regional semi-permeable movement barriers is considered possible due to future developments and would be experienced continuously until traffic from the two projects decreases the two sites are reclaimed. However, moose have high mobility and habitat would remain well connected in the RFD Case. Overall, small changes in movement and habitat connectivity are predicted in the RFD Case, particularly around Patterson Lake.

Climate Change

Climate change and potential associated wildfire may contribute to changes in the distribution of moose habitat. An increase in the frequency and intensity of wildfires could alter the distribution and composition of upland habitat patches or reduce the size of wetlands on the landscape, which could change where suitable habitat occurs throughout the RSA. Moose may have to adjust seasonal movements between habitat patches if climate change alters the configuration of land cover within their home ranges. Future climate change scenarios indicate that the RSA may experience increased precipitation and temperatures (Section 14.2.5), which could potentially lead to increased net primary production and an increase in the coverage of deciduous forest cover on the landscape, which may in turn increase moose habitat, but the changes are uncertain. Therefore, because of the uncertainty in direction and magnitude, it was conservatively assumed that climate change would have a negative cumulative effect on habitat distribution in the RFD Case.



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)	
WATERCOURSE	
OPEN WATER (WITHIN THE RSA)	
WATERBODY (WITHIN THE RSA)	
WATERBODY (OUTSIDE OF RSA)	
WETLAND	
WOODED AREA	
ECOZONE BOUNDARY	
LOCAL STUDY AREA	
REGIONAL STUDY AREA	
FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT	
PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA	
PROPOSED PROJECT FOOTPRINT	
MAXIMUM DISTURBANCE AREA	

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

ROOK I PROJECT

TITLE

MOOSE HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

PROJECT		20144150	PHASE 3314 - 6	
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-7**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

14.5.2.2.3 Survival and Reproduction

Home Range and Vital Rates

The cumulative loss of potential suitable habitat in the RFD Case may affect reproduction if individuals are displaced into poor suitability habitat or increase travel and energetic costs to find more suitable habitats. Following the approach in Section 14.5.2.1.3, a loss of approximately 2450.8 ha (24.5 km^2) of suitable habitat (Section 14.5.2.2.1, Habitat Availability) would affect about 25.3% of a moose home range or two to five moose. The cumulative loss of suitable habitat in the RFD Case may possibly influence survival and reproduction and result in a small measurable change to the abundance and distribution of the moose around Patterson Lake (probability of effect may occur but is not likely). However, approximately 81,700 ha of suitable habitat remains well connected and distributed across the RSA, and measurable changes to demographic rates of the moose population are unlikely (i.e., effect is not expected but not impossible).

Climate Change

Climate change may potentially contribute to cumulative changes in the survival and reproduction of moose. The ability of moose to lose body heat has been postulated as a demographic constraint of their large body size and as an explanation for selection of wetland and mature forest that provide thermal relief (Renecker and Hudson 1986; Street et al. 2015b; Laforge et al. 2016). A reduction in the abundance or distribution of these habitats from climate change may reduce moose survival and reproduction rates due to increased energy expenditure from intraspecific competition to acquire these important habitats.

Climate change is predicted to result in greater overlap between moose and white-tailed deer (Thompson et al. 1998; Murray et al. 2006), which may increase moose mortality through higher predation risk or the increased spread of disease such as meningeal brain worm or CWD; Thompson et al. 1998; Murray et al. 2012). The CRDN expressed concern about the potential for CWD in moose and caribou and the effect of industrial activity on the spread of this disease (CRDN-JWG 2020a). Chronic wasting disease is a fatal, prion neurodegenerative, transmissible spongiform encephalopathy that affects cervids and has the potential to reduce cervid populations in the long term (Bollinger et al. 2004). However, CWD has not been detected in the WMZs near or surrounding the proposed Project.

Meningeal brain worm is a parasitic roundworm that affects cervids. While most commonly carried by white-tailed deer (which is not affected), moose and caribou are also susceptible, and the worm can affect the nervous system of these species causing eventual death of the animal (Government of Saskatchewan 2021c). Meningeal brain worm is of low concern for moose in Saskatchewan (Government of Saskatchewan 2017). An increased population of white-tailed deer in the RSA could lead to increased spread of disease (Murray et al. 2012), which could lead to declines in moose survival (Dawe et al. 2014). Indigenous Groups have identified that white-tailed deer are harvested or used by members (TSD II: BNDN; TSD III: BRDN; TSD IV: MN-S; TSD V.1: CRDN; TSD VI: YNLR), indicating the presence of deer in the RSA. White-tailed deer were also observed during remote camera monitoring in the RSA (Annex VIII.1). With an increase in deer present in the region, moose may be subject to increased pressure from parasites and pathogens. However, there are insufficient data to determine if moose are being affected by parasites related to climate change in the RSA. It has been assumed the cumulative risk from increased parasites in the RSA is low.

Winter ticks (*Dermacentor albipictus*) are present in moose and can affect their health and survival rate. Tick populations increase when there is an absence of snow in April, which can result in an increased tick load and affect survival in the subsequent winter (Samuel 2007); however, the effect from ticks on moose in the RSA is unknown.

Expansion of white-tailed deer into larger portions of the boreal forest could also reduce moose survival through competition and changes to the predator-prey dynamics in these systems. An increased population of deer in the RSA could lead to an increase in wolf numbers, which could cause declines in moose survival (Dawe et al. 2014). However, the magnitude of changes to moose abundance is uncertain and would depend on the interactions among climate change, habitat, and predator and prey populations.

Overall, due to uncertainties, it was assumed that climate change would add additional negative pressures on the survival and reproduction of moose in the RSA.

14.5.2.3 Residual Effects Classification and Determination of Significance

14.5.2.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of mitigation (Table 14.5-6). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on moose. Following the summary of residual effects, significance of residual effects for the Application Case and the RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-6: Classification of Residual Effects on Moose Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 56.7 ha removal of high suitability habitat, representing a 0.5% reduction in the RSA (i.e., low magnitude) ▪ 732.0 ha removal of moderate suitability habitat, representing a 1.2% reduction in the RSA (i.e., low magnitude) ▪ 26.5 ha removal of low suitability habitat, representing a 0.2% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 308.9 ha removal of high suitability habitat, representing a 2.5% reduction in the RSA (i.e., low magnitude) ▪ 2,085.2 ha removal of moderate suitability habitat, representing a 3.5% reduction in the RSA (i.e., low magnitude) ▪ 56.7 ha removal of low suitability habitat, representing a 0.4% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (up to 500 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [with 500 m buffer]) ▪ Beyond regional (climate change)

Table 14.5-6: Classification of Residual Effects on Moose Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	**RFD Case**
Habitat availability	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetlands ▪ Long-term (direct habitat loss): 43 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 6 -10 years to establish moose habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small changes to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility of species)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local to regional (LSA and movement route at Patterson Lake narrows) ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features and wetlands ▪ Long-term (i.e., direct habitat loss): 43 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish moose habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

Table 14.5-6: Classification of Residual Effects on Moose Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	**RFD Case**
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 815.2 ha loss of suitable habitat represents small portion of one home range (8.4%; i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ A combined loss of 2,450.8 ha of suitable habitat represents approximately 25.3% of one home range (i.e., low magnitude) ▪ Small measurable change in moose abundance and distribution around Patterson Lake due to development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features and wetlands ▪ Long-term (direct habitat loss): 43 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 6 -10 years to establish moose habitat ▪ Long-term (sensory disturbance): 48 years =43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and wetlands ▪ Permanent (climate change) ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; LSA = local study area; RSA = regional study area; WRSAs = waste rock storage areas.

14.5.2.3.2 Significance Determination

Habitat Availability and Distribution

In the Application Case, the Project is expected to result in a loss of 56.7 ha of high suitability habitat, representing 0.5% of this habitat in the RSA. Most of the habitat loss would occur in moderate suitability habitat (732.0 ha, 1.2% of this habitat's availability in the RSA). Low suitability habitat would decline by 26.5 ha (0.2%). Changes to habitat availability are predicted to have a negligible influence on moose abundance and distribution as habitat is not limited in the RSA; approximately 99% of suitable habitat would remain intact within the RSA. Moose may avoid the Project, particularly during Construction and the Active Closure Stage when maximum sensory disturbance is expected to occur. Habitat loss from the Project may displace a few individual moose but is predicted to have no measurable demographic effect at the population level.

In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable habitat in the RSA by 2450.8 ha (2.9%). The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and the distribution of suitable habitat in the RSA remains largely unchanged. Cumulative effects from the two projects are likely but uncertain since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Functional habitat for moose is predicted to become available 6 to 10 years after the end of the active closure or decommissioning. However, given that forests in the RSA are likely similar to less productive forests in the Boreal Shield, functional habitat for moose may take longer to establish.

The distribution of available suitable habitats in the RSA indicates that moose habitat is common and well connected at the regional scale in the Base Case. Existing disturbance is low (0.4%) and aggregated in the northwest portion of the RSA, and includes Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. A seasonal trail (i.e., rough road) also passes through the RSA east from Highway 955 and likely provides a travel corridor for predators and hunters, which could increase encounter rates with moose and contribute to mortality in the population. Highway 955, and perhaps the existing access road, likely influence moose movement and habitat connectivity during periods of high traffic volume, but narrower linear features are predicted to have little effect on moose distribution.

The Project is not expected to change the density of linear features in the RSA. The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Changes to moose movement and habitat connectivity are expected to be small and localized to specific areas of the LSA and RSA. Because moose would likely avoid passing through the maximum disturbance area, an existing movement route identified by Indigenous Knowledge may be affected by the Project and alter habitat connectivity in the area within and surrounding the LSA.

In the Base Case, Highway 955 is likely having a negative influence on moose movement and habitat connectivity, particularly during periods of high traffic volume. The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could affect the movement of moose that use habitats within and outside the western portion of the RSA, particularly during Construction and the Active Closure Stage. However, remaining patches of contiguous, undisturbed habitat would remain in areas surrounding the projects and in the RSA and should continue to provide landscape connectivity for moose movement within the region. Moose display life history traits (e.g., large home ranges, high reproductive rates, ability to eat many types of plants) that possess flexibility to adapt to different types of disturbances.

Survival and Reproduction

The Project is not expected to have a measurable effect on moose survival and reproduction and abundance. The loss of suitable habitat is predicted to affect a small portion (8.4%) of one moose home range and perhaps one to two moose. Similarly, the cumulative loss of suitable habitat in the RFD Case may possibly influence survival and reproduction and result in a small measurable change to the abundance and distribution of the moose around Patterson Lake (probability of effect may occur but is not likely). However, measurable changes to demographic rates of the moose population in the RSA are unlikely (i.e., not expected but not impossible). The loss of suitable habitat from the Project and Fission Patterson Lake South Property would affect about 25.3% of one moose home range or two to five moose. Approximately 81,700 ha of suitable habitat remains well connected and distributed across the RSA relative to the Base Case. Moose have high mobility and are habitat generalists, capable of utilizing a variety of land cover types. Incremental and cumulative changes to habitat availability, habitat distribution, and survival and reproduction from the Project and Fission Patterson Lake South Property are expected to remain within the resilience and adaptability limits of the moose population overlapping the RSA.

Other Project-wildlife interactions, such as increased access for people and predators and higher risk of injury/mortality from wildlife-vehicle collisions and attracting animals to site, were determined to have negligible effects on the moose population (Section 14.4.2). The Project would not increase access for humans and predators as an access road to the site already exists and upgrades to the access road for the Project are expected to result in no measurable change to existing access for hunting/trapping. Several trails also exist in the Fission Patterson Lake South Property, and increased access to harvest moose is not anticipated. Implementation of mitigation measures at the Project including staff, contractor, and visitor orientations, giving wildlife the right of way, identification of wildlife crossings, gaps in road berms and snowbanks, and speed limit adjustments should limit effects on minor increases in injury or mortality to individual animals from vehicle-wildlife collisions. Environmental design features and management plans (e.g., Conventional Waste Management Plan) could limit attractants to the Project, producing only minor influences on predator numbers. It is expected that similar mitigation policies and practices would be implemented at the Fission Patterson Lake South Property to avoid and limit potential adverse cumulative effects on moose. As such, the combined effects of these pathways are predicted to not significantly influence the abundance and distribution of the moose population overlapping the RSA.

The effects of climate change on moose habitat may include a reduction in moose habitat availability and condition. In particular, climate change may negatively affect the availability or condition of bogs and wetland margins, which moose use during various times of the year. Wildfires may also convert mature forest stands to early seral habitats, which may benefit moose by providing browse. The expansion of white-tailed deer into the region as a result of climate change could have negative consequences for moose survival if wolf predation rates increase or the spread of disease (e.g., CWD) between ungulates becomes more frequent. Given the level of uncertainty associated with climate change predictions, a precautionary approach was applied, and the assessment assumed that climate change effects would have predominantly negative effects on moose.

Summary of Significance Determination

Based on several lines of evidence, the incremental and cumulative effects from the Project, other previous and existing developments and activities, and the Fission Patterson Lake South Property on moose are predicted to be not significant. In the Application Case and RFD Case, changes in habitat availability, habitat distribution, and survival and reproduction from planned developments are unlikely to affect the ability of moose to remain self-sustaining and ecologically effective. The effects related to climate change are uncertain and could have either positive or adverse influences on moose in the RSA. However, climate change is not expected to significantly influence the abundance and distribution of moose and does not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.3 Grey Wolf

14.5.3.1 Application Case

This subsection presents the results of the residual effects analysis for wolf and wolf habitat from the primary pathways identified in Section 14.4.3. Mitigation measures have been incorporated into the Project (Table 14.4-1), where feasible, to limit potential effects on grey wolf from Project components or activities. The residual effects analysis for grey wolf focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of grey wolf habitat and affect wolf abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect grey wolf habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter grey wolf movement and behaviour and adversely affect wolf habitat availability and wolf abundance and distribution.

14.5.3.1.1 Habitat Availability

Direct Habitat Loss and Alteration

The direct loss of wolf habitat is primarily associated with clearing of vegetation during Construction of the Project. The effect from direct habitat loss would be certain and is expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure. During the snow-free period, a loss of 146.8 ha and 68.1 ha of high and moderate suitability habitat, respectively, is predicted in the LSA, which represents a change of 0.4% and 1.4% of high and moderate suitability habitat, respectively, at the scale of the RSA (Table 14.5-7). Most of the habitat loss would occur in low suitability habitat. Loss of low suitability habitat is estimated at 731.9 ha, representing 1.5% of its availability in the RSA (Table 14.5-7). Overall, the Project would disturb 946.8 ha (1.1%) of suitable habitat during the snow-free period in the RSA relative to the Base Case. A total of 87,530.6 ha of suitable habitat would remain in the RSA for the snow-free period (Table 14.5-7).

Table 14.5-7: Changes to Grey Wolf Habitat Availability in the Regional Study Area at Application Case during the Snow-Free Period

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	36,245.2	36,098.4	-146.8	-0.4
Moderate	4,716.3	4,648.2	-68.1	-1.4
Low	47,515.9	46,784.0	-731.9	-1.5
Poor	19,013.4	19,960.2	946.8	5.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

During the winter, a loss of 82 ha of high suitability habitat is predicted in the LSA, which represents a change of 0.7% of high suitability habitat at the scale of the RSA (Table 14.5-8). A total of 11,473.4 ha of high suitability habitat would remain in the RSA (Table 14.5-8). A loss of 32.3 ha of moderate suitability habitat is predicted, occurring within the LSA and representing a change of 0.9% at the scale of the RSA (Table 14.5-8). Most of the winter habitat loss would occur in low suitability habitat (Table 14.5-8). Loss of low suitability habitat is estimated at 731.9 ha, representing 1.3% of its availability in the RSA (Table 14.5-8). Overall, the Project would disturb 846.2 ha (1.2%) of suitable habitat during the winter in the RSA relative to the Base Case. A total of 68,756.2 ha of suitable habitat would remain in the RSA for the winter (Table 14.5-8). The predicted habitat losses during the snow-free period and winter are associated with a corresponding increase in the amount of poor suitability habitat (Table 14.5-8).

Table 14.5-8: Changes to Grey Wolf Habitat Availability in the Regional Study Area at Application Case during the Winter

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	11,555.4	11,473.4	-82.0	-0.7
Moderate	3,408.7	3,376.4	-32.3	-0.9
Low	54,638.4	53,906.4	-731.9	-1.3
Poor	37,888.3	38,734.5	846.2	2.2

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the terrestrial ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1.1). Wolves are strongly associated with their prey. Although moose, a primary prey item of wolves in the RSA, is not predicted to be able to use reclaimed habitat until 6 to 10 years after the Active Closure Stage (Courtois et al. 2002; Nelson et al. 2008), reclaimed habitat is predicted to provide suitable habitat for grey wolf approximately five years following the Active Closure Stage because other prey items (e.g., small mammals) are expected to inhabit the area once early seral stage vegetation such as grasses and shrubs are established (i.e., a duration of 38 years).

Sensory Disturbance

The conversion of forested habitats to open, disturbed habitats during Construction would likely have the greatest effect on grey wolves because wolves avoid areas of higher sensory disturbance associated with humans (Paquet and Darimont 2010). Grey wolves are more likely to avoid human-modified land cover when human activity is highest in these areas (i.e., during daylight hours; Hebblewhite and Merrill 2008), so most of the Project footprint would likely be avoided by wolves over the Project's lifespan. Unconverted habitats adjacent to the Project footprint (i.e., within the LSA) may also be avoided by wolves. Wolves tend to exclude mine footprints from their home ranges, are wary of human-modified land cover, and avoid areas associated with human activity (Hebblewhite et al. 2005; Paquet and Darimont 2010; Neilson and Boutin 2017). However, wolves also appear to be capable of adapting to the presence of humans and may select areas closer to human activity (Mech et al. 1995; Thiel et al. 1998; Boitani 2000; Hebblewhite and Merrill 2008).

Sound levels above about 90 dBA are likely to be aversive to mammals, resulting in potential retreat from the sound source, freeze response, or a strong startle response (Manci et al. 1988). According to noise modelling results for the Project, cumulative noise contributions resulting from background and Project Construction or Operations are not expected to exceed 45 dBA within 10 km of the maximum disturbance area (Section 7.3.5.1). Therefore, noise from the Project is not expected to result in strong avoidance of wolves in the LSA or RSA.

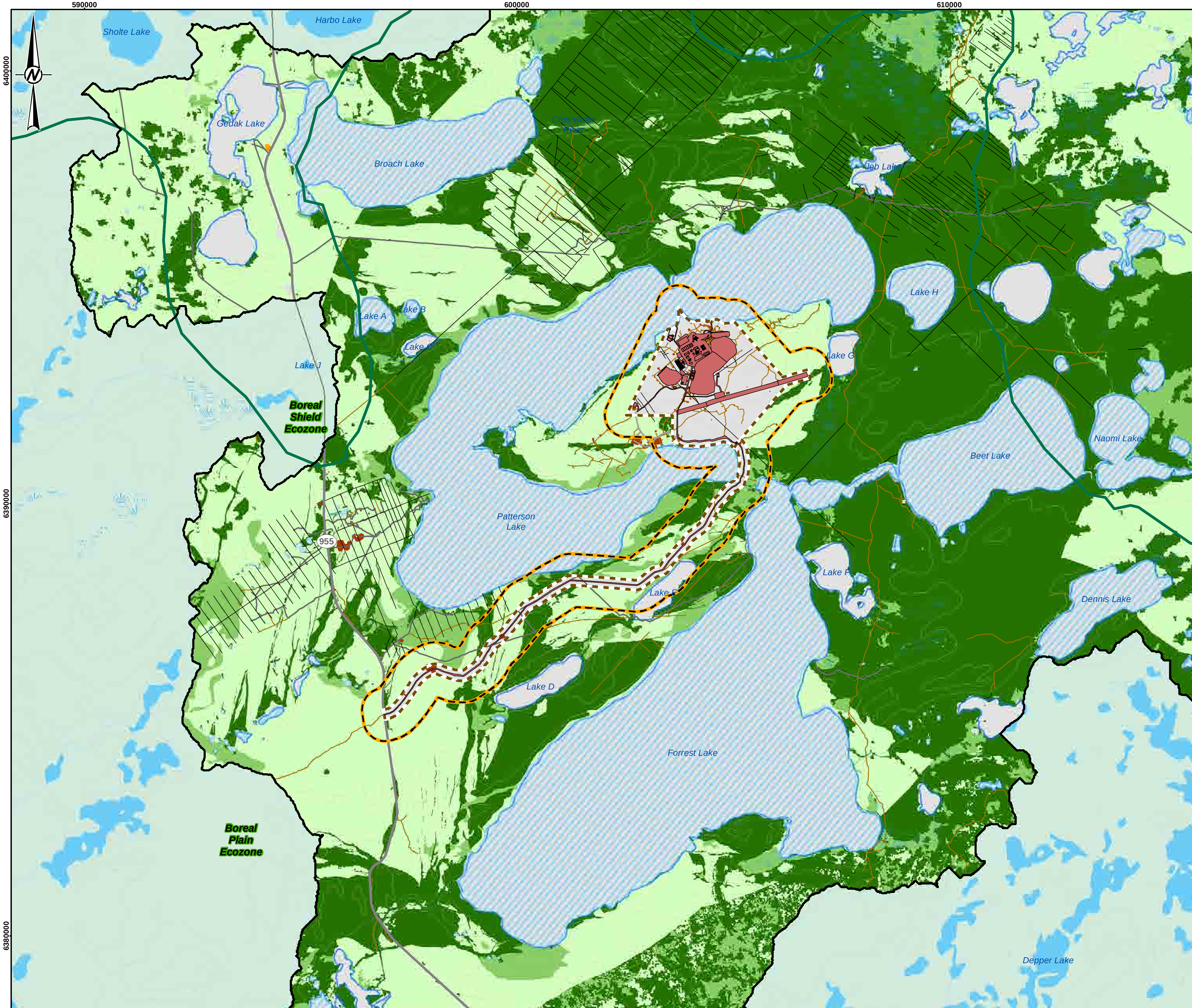
Sensory disturbance effects from the Project would most likely occur from Construction to end of the Active Closure Stage. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., a duration of 48 years). The likelihood for sensory disturbance effects on grey wolf are uncertain given that studies have shown that wolves in North America can become habituated to human-caused sensory disturbance on the landscape (McNay 2002). Overall, wolves are expected to exhibit some avoidance of habitat near the Project from Construction through Closure due to sensory disturbance, particularly during high activity periods, but are also predicted to habituate to disturbance during Operations (i.e., effects are possible and continuous).

14.5.3.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

The maximum disturbance area would remove suitable grey wolf habitat in the LSA (i.e., local geographic extent; Figure 14.5-8 and Figure 14.5-9) and Project activities would likely cause some wolves to avoid the LSA. The Project could affect grey wolf habitat distribution if it prevents or discourages animals from moving through the landscape or from accessing desirable habitat patches (e.g., areas with high ungulate density). While the Project is expected to reduce habitat availability for grey wolves, it is unlikely to influence habitat distribution in the RSA because the species is highly mobile and capable of dispersing large distances (Hervieux et al. 2014; Boutin et al. 2015). Accordingly, changes in habitat distribution from the Project are expected to alter local movements of wolves in and around the maximum disturbance area but not much beyond the LSA.

The distribution of suitable habitat in the RSA during both the snow-free period and winter would remain largely unchanged as a result of the Project. The primary effect of the Project on habitat distribution and connectivity would be in the maximum disturbance area, which is mostly located within low suitability habitat due to previous burns (i.e., early and late-stage regeneration habitats) (Figure 14.5-10 and Figure 14.5-11). Although the Project footprint would likely expand the area of perceived barriers to movement in the LSA (i.e., wolves may avoid crossing the Project footprint), large tracts of suitable habitat would remain common and well-connected in the RSA (Figure 14.5-10 and Figure 14.5-11). These large tracts of undisturbed habitat should maintain wolf movement through the landscape.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- SECONDARY HIGHWAY
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4
1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

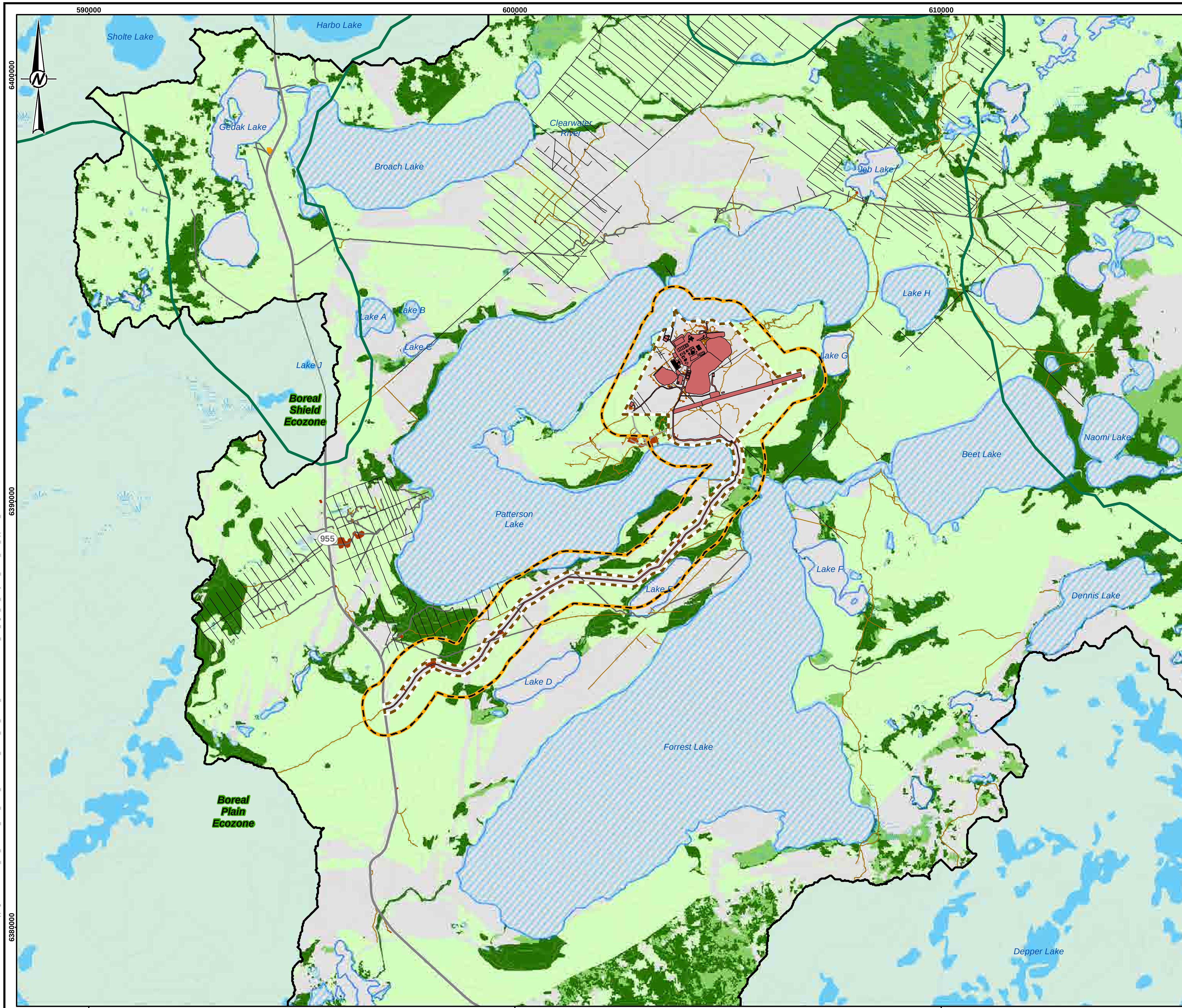
GREY WOLF HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE DURING THE SNOW-FREE PERIOD

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-8**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)	**DISTURBANCE CLASS**
SECONDARY HIGHWAY	ACCESS ROAD
WATERCOURSE	CUTLINE/SEISMIC
OPEN WATER (WITHIN THE RSA)	SECONDARY HIGHWAY
WATERBODY (WITHIN THE RSA)	ROUGH ROAD
WATERBODY (OUTSIDE OF RSA)	TRAIL
WETLAND	NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
WOODED	OIL AND GAS DEVELOPMENT
ECOZONE BOUNDARY	**HABITAT SUITABILITY INDEX**
LOCAL STUDY AREA	HIGH
REGIONAL STUDY AREA	MODERATE
PROPOSED PROJECT FOOTPRINT	LOW
MAXIMUM DISTURBANCE AREA	POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

GREY WOLF HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE DURING WINTER

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-9**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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25mm

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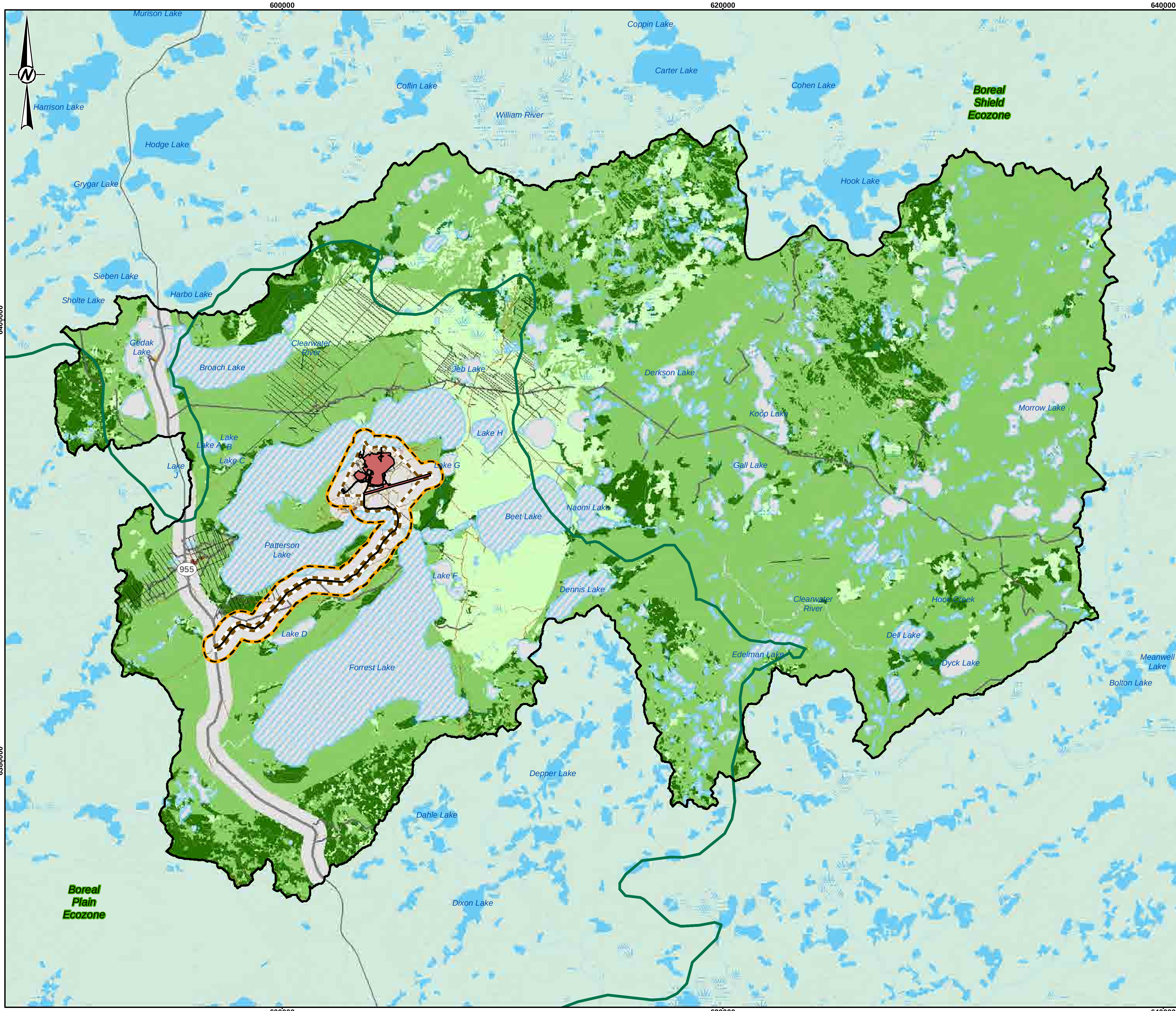


LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

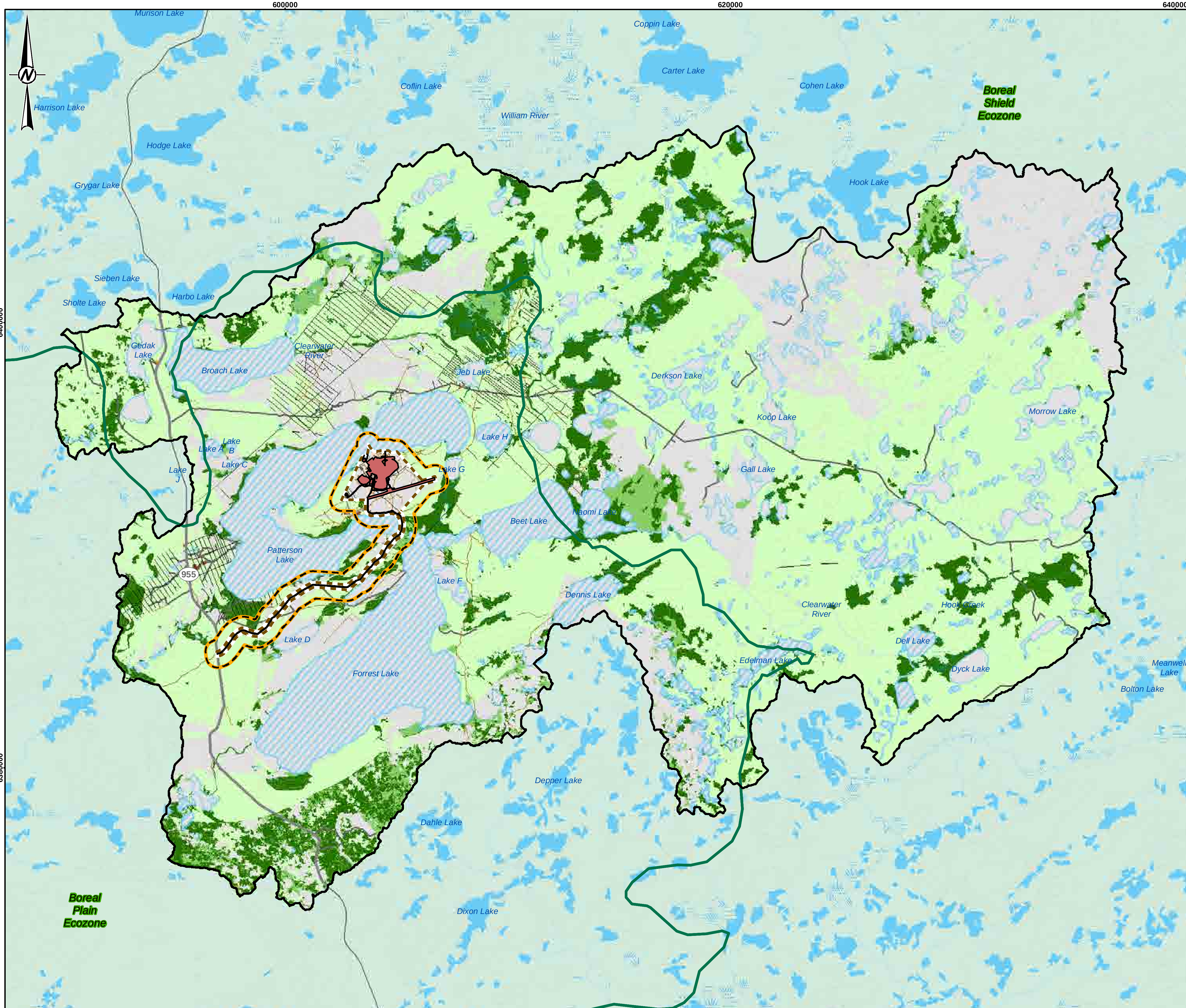
TITLE

GREY WOLF HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE DURING THE SNOW-FREE PERIOD

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-10	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
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- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
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- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
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- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
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HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
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0 5 10

1:175,000 KILOMETRES

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

GREY WOLF HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE DURING WINTER

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-11**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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Sensory Disturbance

Sensory disturbance during Construction and Operations, and the Active Closure Stage may constrain movement of wolves in proximity to the LSA because wolves are known to adjust their movement and behaviour and often avoid areas of high sensory disturbance, such as mine sites (Paquet et al. 1996; Boutin et al. 2015). Noise associated with heavy equipment and general human presence and activity in the maximum disturbance area could discourage wolves from moving through areas near the Project footprint. Sensory disturbance may affect grey wolf movement at a local scale (i.e., within the LSA) but is not expected to influence habitat connectivity and access to resources at the RSA scale. Wolves move around with prey availability, and sensory disturbance could also drive prey items, such as moose and woodland caribou out of the LSA, leading to movement of wolf outside of the affected areas to where food is more abundant and more readily accessible.

Linear Features

The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Most of the existing trails in the maximum disturbance area would be upgraded for site roads and haul roads. The Project would be in a portion of the RSA that contains an aggregation of existing linear features and other disturbance near Highway 955 (Figure 14.5-8). The current density of linear features in the RSA (0.6 km/km^2) is not expected to cause a functional change in habitat connectivity or how wolves travel within and beyond the study area (Section 14.3.3.2), and the Project would not change the density of linear features in the LSA and RSA.

In the Base Case, Highway 955 is predicted to be a partial barrier to wolf movement, particularly during periods of high traffic volume (Section 14.3.3.2). Wolves have been shown to avoid busy roadways (Hebblewhite et al. 2005; Ehlers et al. 2014), which could change movement patterns for this species if individuals are unwilling to cross the highway to reach habitat on the opposite side. Indigenous Groups have commented that increased traffic volumes from mineral exploration activities on Highway 955 and the Cluff Lake Road are affecting wildlife movement patterns and distribution and are concerned that traffic related noise from the Project would exacerbate these effects (TSD II: BNDN; TSD V.2: CRDN). Disturbances along roads can demonstrably lead to behavioural change for wolves (Hebblewhite and Merrill 2008; Dickie et al. 2016) and their prey, including caribou (Frair et al. 2008; Laurian et al. 2008; review in Dabros et al. 2018), which may result in alteration of habitat use by some wolves. On-site roads would be located within the maximum disturbance area, which is expected to be avoided by grey wolf due to sensory disturbance.

The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (Section 14.4.2). The increase in traffic volume could have minor effects on the movement of wolf that use habitat within and outside the western portion of the RSA, particularly during Construction and the Active Closure Stage (i.e., regional to beyond regional effect). Overall, the Project is predicted to result in a small change to the distribution and movement of wolves around Patterson Lake but is unlikely to have a measurable effect on wolf habitat connectivity and movement in the RSA.

14.5.3.1.3 Survival and Reproduction

Home Range and Vital Rates

Literature reports large annual home ranges for grey wolf (e.g., mean annual core home range of wolves in Saskatchewan Boreal Shield is 660 km^2 and annual home range is 2,865 km^2; Section 14.3.3.2). Conservatively assuming that the entire maximum disturbance area (980.8 ha) becomes unsuitable for grey wolves, the loss of habitat would remove approximately 1.5% (981 ha / 66,000 ha) of a core home range. Project-related losses to available grey wolf habitat are unlikely to influence survival and reproduction and abundance of the grey wolf population overlapping the RSA (probability of effect is not expected but is not impossible). Suitable habitat would remain abundant and well connected and distributed across the RSA relative to Base Case. Because habitat availability is not limiting, grey wolves are expected to be resilient to Project-related changes in habitat shift or alter their home ranges to exclude areas of high disturbance or use these areas less frequently when human activity levels are higher. A change in prey availability could affect grey wolf survival and reproduction. However, significant changes to moose or beaver (i.e., two important prey species) abundance and distribution are not predicted (Sections 14.5.2.3 and 14.5.5.3, Residual Effects Classification and Determination of Significance).

14.5.3.2 Reasonably Foreseeable Development Case

14.5.3.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable grey wolf habitat in both the snow-free period and winter. An increase in the level of sensory disturbance in the RSA could also lead to additional indirect losses to grey wolf habitat if individuals avoid areas with high human activity.

In the RSA, removal of 389.1 ha (1.1%) of high suitability habitat, 217.5 ha (4.6%) of moderate suitability habitat, and 1,847.4 ha (3.9%) of low suitability habitat during the snow-free period is predicted (Table 14.5-9). Together, these habitat losses represent a total loss of 2,454.0 ha (2.8%) of suitable grey wolf habitat (i.e., regional geographic extent). Approximately 86,023 ha of suitable habitat would remain in the RSA for the snow-free period.

During winter, the removal of 231.4 ha (2.0%) of high suitability habitat, 61.0 ha (1.8%) of moderate suitability habitat, and 1,847.4 ha (3.4%) of low suitability habitat in the RSA is predicted, for a total loss of 2,139.8 ha (3.1%) of suitable habitat in the RSA (Table 14.5-10). Approximately 67,463 ha of suitable habitat would remain in the RSA for the winter period. The predicted habitat losses for the snow-free period and winter are reflected by a corresponding increase in the amount of unsuitable habitat (Table 14.5-9 and Table 14.5-10).

Overall, losses of high and moderate suitability grey wolf habitat associated with the Project are anticipated to represent less than half of the total cumulative effects described in the RFD Case. The Project contribution to future loss of suitable habitat during the snow-free period is predicted to be 946.8 ha (Table 14.5-7), representing 38.6% (946.8 ha / 2,454.0 ha) of the cumulative loss of suitable habitat. The Project contribution to future suitable habitat loss during winter is predicted to be 846.2 ha (Table 14.5-8), representing 39.5% (846.2 ha / 2,139.8 ha) of the cumulative loss of suitable habitat.

Cumulative effects from the two projects are likely but uncertain (i.e., probable) as the Fission Patterson Lake South Property has recently entered the formal regulatory process. Loss of habitat is continuous and reversible for reclaimed areas and irreversible for permanent features and wetlands.

Table 14.5-9: Changes to Grey Wolf Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case during the Snow-Free Period

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	36,245.2	35,856.1	-389.1	-1.1
Moderate	4,716.3	4,498.8	-217.5	-4.6
Low	47,515.9	45,668.5	-1,847.4	-3.9
Poor	19,013.4	21,467.4	2,454.0	12.9

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

Table 14.5-10: Changes to Grey Wolf Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case during Winter

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	11,555.4	11,324.0	-231.4	-2.0
Moderate	3,408.7	3,347.7	-61.0	-1.8
Low	54,638.4	52,791.0	-1,847.4	-3.4
Poor	37,888.3	40,028.1	2,139.8	5.6

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 5 years when reclaimed upland habitat is expected to provide forage for grey wolf (i.e., early-stage upland ecosites; Section 14.5.3.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 20 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As discussed in Section 14.5.3.1.1, cumulative noise levels from existing and Project-related noise during Construction and Operations are not predicted to exceed a maximum of 45 dBA within 10 km of the maximum disturbance area. Similar noise levels (low magnitude and local spatial extent) are predicted for combined changes from the Project and the Fission Patterson Lake South Property (Section 7.3.5.2). The cumulative indirect loss of grey wolf habitat from sensory disturbance may constrain movement of wolves in proximity to the immediate areas around the Project and Fission Patterson Lake South Property. Wolves are known to adjust their movement and behaviour and often avoid areas of high sensory disturbance, such as mine sites. Noise associated with heavy equipment and general human presence and activity is expected to result in a small change in the movement of wolves around Patterson Lake but is not predicted to affect habitat connectivity and access to prey and refuge habitat at the RSA scale.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

Climate change may alter the processes that influence the availability and quality of grey wolf habitat, with effects occurring beyond the RSA (i.e., beyond regional geographic extent). Climate change may result in increased warm nights, reduced ice and frost days, increasing levels of precipitation, and changes in fire regime (i.e., intensity, interval; Section 22). Assumptions about climate change influences on wildlife habitat are described in Section 14.2.5. Because wolves select for open muskeg during the snow-free period and winter, the reduction in wetland ecosystem availability could decrease grey wolf habitat availability in the RSA. Further, because moose occupy both bogs and wetland margins during various times of the year, changes to land cover because of climate change could decrease moose habitat availability in the RSA, which would change the abundance and distribution of prey available for wolves.

Increased forest fires may reduce habitat suitability for wolf during the snow-free period as mature jack pine stands are replaced with early successional jack pine forests. However, as fire frequency increases, it is anticipated that the availability of deciduous ELC units (e.g., BP06, BP07) would increase as black spruce dominant stands become less common (Hart et al. 2019), which may result in an increase of suitable wolf habitat. Further, this change may increase the amount of deciduous shrub available to moose (Section 14.5.2.2.1), a primary prey item of wolves and increase habitat suitability for wolves. Effects from climate change on habitat availability and wolf abundance and distribution are possible, but the direction and magnitude of habitat change induced by climate change is uncertain because of the variability in climate projection models. It was conservatively assumed that climate change would have a negative cumulative effect on habitat availability.

14.5.3.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

The Project and the Fission Patterson Lake South Property are expected to convert forested habitat to disturbed, unvegetated habitat, and grey wolves are expected to avoid these areas due to sensory disturbance, particularly during overlapping periods of high activity. Addition of the Fission Patterson Lake South Property would result primarily in a reduction of habitat considered low suitability during both the snow-free period and winter adjacent to other low suitability habitat patches, with poor suitability habitat associated with Patterson Lake to the east (Figure 14.5-12 and Figure 14.5-13). The distribution of high and moderate suitability habitat in the RSA would remain largely unchanged as a result of the Project and the Fission Patterson Lake South Property. Overall, suitable habitat for wolves would remain abundant and well connected in the RFD Case.

Linear Features

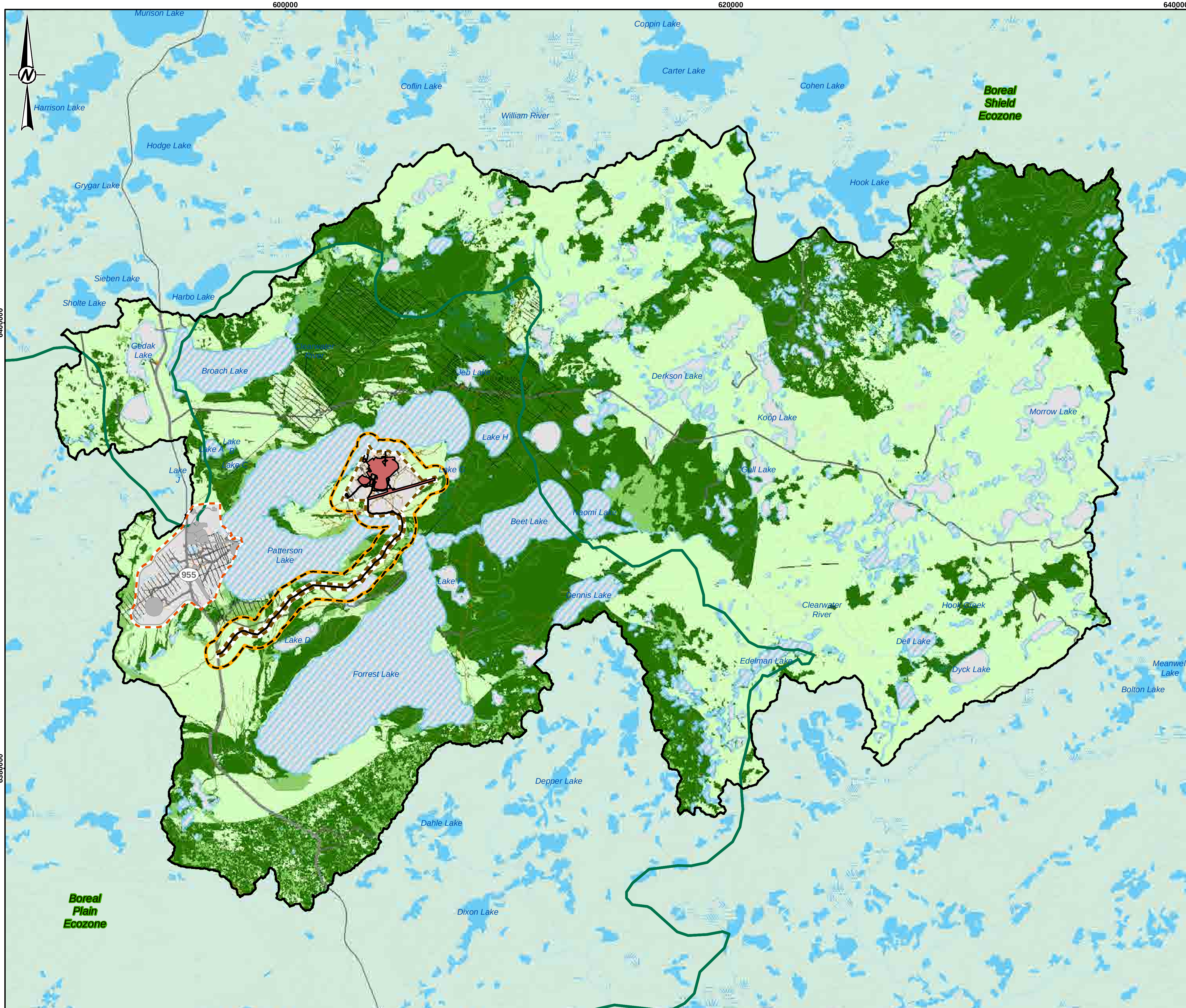
Linear feature density in the RSA is not expected to change due to the Project and the Fission Patterson Lake South Property (based on the hypothetical maximum disturbance area used in the assessment; Section 14.2.5); physical effects of linear disturbances would remain similar to the Base Case. Wolves would commonly use linear disturbance features to travel through the landscape because these features can increase travel speeds (Dickie et al. 2016). As discussed in Section 14.5.3.1.2, Habitat Distribution, upgrades to the existing access road would not change the linear density in the RSA, and service and haul roads located within the maximum disturbance area are expected to be avoided by wolves due to sensory disturbance. Similar conditions are expected at the Fission Patterson Lake South Property.

In the Base Case, Highway 955 is already expected to have a negative influence on grey wolf movement and habitat connectivity, particularly during periods of high traffic volume (Section 14.3.3.2). Addition of the Fission Patterson Lake South Property is expected to increase the number of vehicles on Highway 955 relative to the Application Case. The increase in traffic is assumed to be similar in magnitude to that of the Project. Incremental traffic increases could further affect the movement of grey wolves that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). The creation of local or regional semi-permeable movement barriers is considered possible (i.e., effect may occur but is not likely) due to future developments and would be experienced continuously until traffic from the two projects decreases and the two sites are reclaimed. Overall, small changes in movement and habitat connectivity are predicted in the RFD Case, particularly around Patterson Lake, but the high mobility of grey wolves would enable them to continue accessing available habitats within the RSA.

Climate Change

As with habitat availability, climate change and wildfire may contribute to changes in the distribution of wolf habitat. The CRDN and BNDN have observed increasing frequency of forest fires in recent years that are reported to be a contributing factor to declining wildlife populations, which has reduced harvesting opportunities in the long term (TSD II: BNDN; TSD V.2: CRDN).

Anticipated changes to habitat composition due to climate change related effects are not expected to alter habitat connectivity conditions for grey wolves because they are a highly mobile species and are able to exploit a variety of habitat types throughout the year. It was conservatively assumed that climate change would have a negative cumulative effect on habitat distribution.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
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- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
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HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

GREY WOLF HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE DURING THE SNOW-FREE PERIOD

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-12**	
REVIEW	JV	2023-02-09		

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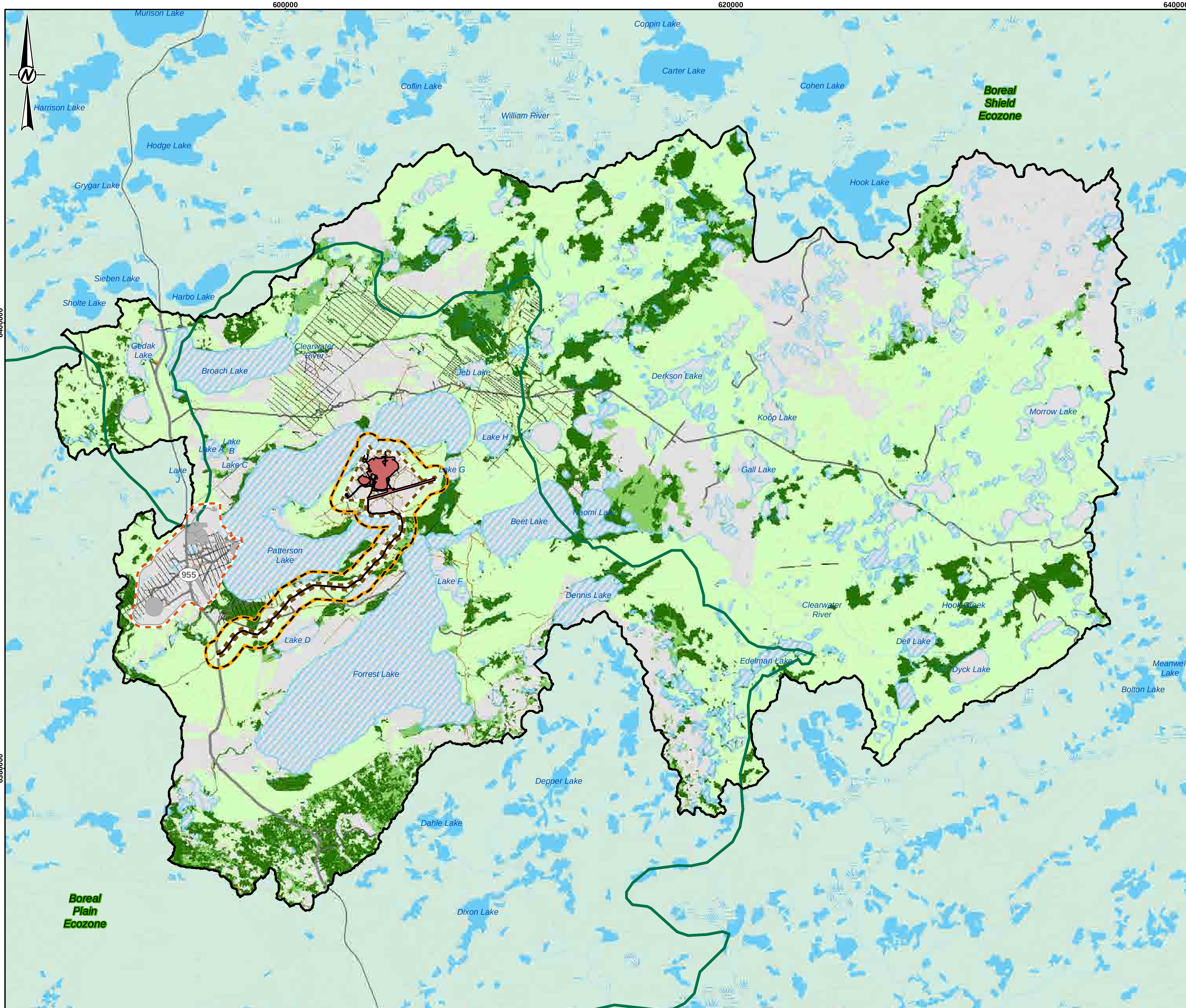
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B 25mm



LEGEND

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- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
GREY WOLF HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE DURING WINTER

CONSULTANT
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-13	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

14.5.3.2.3 Survival and Reproduction

Home Range and Vital Rates

Following the approach in Section 14.5.3.1.3, Survival and Reproduction, and conservatively assuming that the entire maximum disturbance areas for the Project (980.8 ha) and Fission Patterson Lake South Property (1,545.1 ha) becomes unsuitable for grey wolves, the loss of habitat would remove approximately 3.8% (2,525.1 ha / 66,000 ha) of one core home range. The loss of available habitat in the RFD Case is unlikely to have a measurable effect on the wolf population overlapping the RSA (i.e., effect is not expected but not impossible).

Grey wolves are expected to exhibit some avoidance of new developments in the RFD Case, though attraction to the sites may also occur. The Project and the Fission Patterson Lake South Property may displace wolves out of parts of their current territory. Reproduction and survival could decrease if wolves are forced to occupy marginal or poor suitability habitat or increase travel and energetic costs to find more suitable habitats. However, approximately 86,000 ha and 67,000 ha of suitable habitat would remain well connected and distributed across the RSA during the snow-free period and winter, respectively, and changes to survival and reproduction and abundance of grey wolf are unlikely.

Changes in prey availability due to cumulative habitat loss or alteration could affect grey wolf survival and reproduction if the changes to prey populations were sufficiently large. However, incremental additional changes to moose or beaver (i.e., two important prey species) abundance and distribution are not predicted (Section 14.5.2.3 and Section 14.5.5.3, Residual Effects Classification and Determination of Significance) and are not expected to affect wolf survival and reproduction.

Climate Change

Increased drought and wildfire may result in decreased beaver lodge occupancy and the number of active beaver colonies (Hood et al. 2007), which could negatively affect food availability for grey wolf in the RSA. Climate change is also expected to facilitate the spread of white-tailed deer into the boreal forest (Thompson et al. 1998; Murray et al. 2006; Dawe et al. 2014). An increase in moose mortality may occur as a result of climate change due to the displacement of individuals into lower quality habitat, increased energy expenditure from intraspecific competition or movement to acquire important habitats for thermal relief (Renecker and Hudson 1986; Street et al. 2015b; Laforge et al. 2016), and competition with white-tailed deer (Section 14.5.2.2.3, Survival and Reproduction). The change in prey base in the RSA may cause a shift in prey selection, resulting in an increase or decrease in grey wolf abundance. The magnitude and direction of changes to grey wolf abundance is uncertain and would depend on the interactions among climate change, habitat, and prey populations. However, any adverse changes in habitat would likely have small measurable effects on grey wolf survival and reproduction because wolves are considered habitat generalists and are resilient to natural disturbances on the landscape. Overall, due to uncertainties, it was assumed that climate change would add additional negative pressure on the survival and reproduction of grey wolf in the RSA.

14.5.3.3 Residual Effects Classification and Determination of Significance

14.5.3.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of mitigation (Table 14.5-11). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on grey wolves. Following the summary of residual effects, significance of residual effects for the Application Case and the RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-11: Classification of Residual Effects on Grey Wolf Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 146.8 ha removal of high suitability habitat during the snow-free period, representing a 0.4% reduction in the RSA, and 82.0 ha removal of high suitability winter habitat, representing a 0.7% reduction in the RSA (i.e., low magnitude) ▪ 68.1 ha removal of moderate suitability habitat during the snow-free period, representing a 1.4% reduction in the RSA, and 32.3 ha removal of moderate suitability winter habitat, representing a 0.9% reduction in the RSA (i.e., low magnitude) ▪ 731.9 ha loss of low suitability habitat during both the snow-free period and winter, representing a 1.5% and 1.3% reduction in the RSA during the snow-free period and winter, respectively (i.e., low magnitude) ▪ Small avoidance of habitat from sensory disturbance during high human activity periods	▪ 389.1 ha removal of high suitability habitat during the snow-free period, representing a 1.1% reduction in the RSA (i.e., low magnitude), and 231.4 ha removal of high suitability habitat during the winter, representing a 2.0% reduction in the RSA (i.e., low magnitude) ▪ 217.5 ha removal of moderate suitability habitat during the snow-free period, representing a 4.6% reduction in the RSA, and 61.0 ha removal of moderate suitability habitat during the winter, representing a 1.8% reduction in the RSA (i.e., low magnitude) ▪ 1,847.4 ha loss of low suitability habitat during both the snow-free period and winter, representing a 3.9% and 3.4% reduction in the RSA during the snow-free period and winter, respectively (i.e., low magnitude) ▪ Small avoidance of habitat from sensory disturbance during high human activity periods (occurs during period of overlap between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (within the LSA)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetlands ▪ Long-term (direct habitat loss): 38 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish wolf habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: for effects associated with climate change ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous

Table 14.5-11: Classification of Residual Effects on Grey Wolf Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Probability of occurrence	▪ Certain (direct habitat loss) ▪ Possible (sensory disturbance)	▪ Probable (direct habitat loss from Project and Fission Patterson Lake South Property) ▪ Possible (sensory disturbance) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small changes to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility of species)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local to regional (within and adjacent to the LSA) ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features and wetlands ▪ Long-term (direct habitat loss): 38 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish wolf habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain (direct habitat loss) ▪ Possible (sensory disturbance)	▪ Probable (direct habitat loss from Project and Fission Patterson Lake South Property) ▪ Possible (sensory disturbance) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 1.5% loss of one core home range (i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 3.8% loss of one core home range (i.e., negligible magnitude) ▪ Negligible change in grey wolf abundance and distribution due to effects related to development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features and wetlands ▪ Long-term (direct habitat loss): 38 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish wolf habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)

Table 14.5-11: Classification of Residual Effects on Grey Wolf Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Survival and reproduction	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Unlikely (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RSA = regional study area; LSA = local study area; WRSAs = waste rock storage areas; RFD = reasonably foreseeable development.

14.5.3.3.2 Significance Determination

Habitat Availability and Distribution

Grey wolf is not a federally listed or provincially tracked species, nor is it a species under consideration by COSEWIC. Under existing conditions, suitable habitat for grey wolf is common and well connected in the RSA during the snow-free period and winter. No major barriers to wolf movement are present in the RSA. Existing disturbance is low (0.4%) and aggregated in the northwest portion of the RSA, and includes Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. A seasonal trail (i.e., rough road) also passes through the RSA east from Highway 955 and likely provides a travel corridor for wolves and potentially ungulates. Highway 955, and perhaps the existing access road, likely influences wolf movement and habitat connectivity during periods of high traffic volume, but narrower linear features are predicted to have little effect on grey wolf distribution as this species commonly uses linear features for travel.

In the Application Case, the Project is expected to result in a loss of 946.8 ha of suitable habitat during the snow-free period and 846.2 ha of suitable habitat during winter, representing 1.1% and 1.2% of available suitable habitat in the RSA, respectively. Most habitat loss would occur in low suitability habitat during both the snow-free period and winter (731.9 ha and 731.9 ha, respectively). Approximately 99% of suitable (i.e., high, moderate, and low suitability habitat) spring and fall habitat would remain well connected and distributed across the RSA. Functional habitat for grey wolf is predicted to become available five years after the end of the Active Closure Stage.

Local movement patterns are expected to change because of avoidance associated with high human activity; however, wolves can move and disperse through a variety of habitat types and have also demonstrated adaptive capacity (flexibility) to human developments. An increase in the number of vehicles on Highway 955 relative to existing conditions could affect the movement of wolves that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Overall, the amount of habitat loss due to the Project is unlikely to have a measurable effect on wolf population abundance as the loss accounts for 1.5% of one core home range.

In the RFD Case, the Project combined with the Fission Patterson Lake South Property is expected result in a 2.8% reduction of suitable habitat during the snow-free period and a 3.1% reduction of suitable habitat from Base Case during the winter relative to the Base Case. The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and the distribution of high, moderate, and low suitability habitat in the RSA would remain largely unchanged. The increase in traffic from the Fission Patterson Lake South Property was assumed to be similar in magnitude to that of the Project. The presence of an additional development and traffic could further affect the movement of wolves that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). However, wolves have high mobility and habitat would remain well connected in the RFD Case. Overall, small changes in movement and habitat connectivity are predicted in the RFD Case, particularly around Patterson Lake.

Reductions in the size and occurrence of wetlands due to climate change may decrease wolf habitat because wolves select for open muskeg during the snow-free period and winter and because primary prey (i.e., moose) occupy both bogs and wetland margins during various times of the year. Increased forest fires may reduce habitat suitability for wolf during the snow-free period as mature jack pine stands are replaced with early successional jack pine forests. However, as fire frequency increases, it is anticipated that the availability of deciduous habitat would increase as black spruce dominant stands become less common, which may result in an increase of suitable wolf habitat. Further, this change may increase the amount of deciduous shrub available to moose, a primary prey item of wolves and increase habitat suitability for wolves.

Survival and Reproduction

Grey wolf density in the RSA is predicted to be lower than other populations in the Boreal Plain due in part to lower than average ungulate densities. Under existing conditions, grey wolf populations in the boreal forest are predicted to fluctuate with available food resources. Beaver and moose are common prey items for wolves in the region and both species are considered self-sustaining and ecologically effective in the Base Case, Application Case, and RFD Case; therefore, they are expected to continue to be available prey for wolves. Information on habitat availability and distribution, the small amount and highly localized existing disturbance, and survival and reproduction indicate that the wolf population overlapping the RSA is self-sustaining and ecologically effective under existing conditions.

In the Application Case, changes in habitat availability and distribution are unlikely to have a measurable effect on grey wolf survival and reproduction and abundance. Similarly, the cumulative loss of suitable habitat in the RFD Case is expected to be only a fraction of the core home range (i.e., 3.8%) of a wolf pack and should have no to little influence on the demography of the grey wolf population overlapping the RSA. Cumulative sensory disturbance may increase travel and associated energetic costs, though is not expected to measurably change vital rates; suitable habitat would remain abundant and well distributed in the RFD Case.

Other Project-wildlife interactions, such as increased access for people and predators, and higher risk of injury/mortality from wildlife-vehicle collisions and attracting animals to site were determined to have negligible effects on the grey wolf population (Section 14.4.2). The Project would not increase access for humans and predators as an access road to the site already exists and upgrades to the access road for the Project are expected to result in no measurable change to existing access for hunting/trapping. Several trails also exist in the Fission Patterson Lake South Property, and increased access to harvest wolves is not anticipated. Implementation of mitigation measures at the Project including staff, contractor, and visitor orientations; giving wildlife the right of way; identification of wildlife crossings; gaps in road berms and snowbanks; and speed limit adjustments are expected to result in a minor increase in injury or mortality to individual animals from vehicle-wildlife collisions. Environmental design features and management plans (e.g., Conventional Waste Management Plan) could limit attractants to the Project and result in a minor increase in wildlife mortality risk from adverse human-wildlife interactions. It is expected that similar mitigation policies and practices would be implemented at the Fission Patterson Lake South Property to avoid and limit potential adverse cumulative effects on grey wolf. As such, the combined effects of these pathways are predicted to not significantly influence the abundance and distribution of the grey wolf population overlapping the RSA.

Changes to prey availability due to climate change may result in both positive and negative effects on grey wolf. The spread of white-tailed deer into the region could have positive consequences for grey wolf survival if the density of prey increases. Changes to wetlands in the RSA may also result in decreased beaver lodge occupancy or number of active beaver colonies. The change in prey base in the RSA may cause a shift in prey selection, resulting in changes in grey wolf abundance; however, the changes should be within the resilience limits as wolves are adaptable and able to exploit many different food sources. Given the level of uncertainty associated with climate change predictions, a precautionary approach was applied, and the assessment assumed that climate change effects would have predominantly negative effects on grey wolf.

Summary of Significance Determination

Based on several lines of evidence the incremental and cumulative effects from the Project, other previous and existing developments and activities, and the Fission Patterson Lake South Property on grey wolf are predicted to be not significant. In the Application Case and RFD Case changes in habitat availability, habitat distribution, and survival and reproduction from planned developments are unlikely to affect the ability of grey wolf to remain self-sustaining and ecologically effective. The effects related to climate change are uncertain and could have either positive or adverse influences on grey wolf in the RSA. However, climate change is not expected to significantly influence the abundance and distribution of grey wolf and does not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.4 Black Bear

This subsection presents the results of the residual effects analysis for black bear and black bear habitat from the primary pathways identified in Section 14.4.3. Mitigation measures have been incorporated into the Project (Table 14.4-1), where feasible, to limit potential effects on black bear from Project components and activities. The residual effects analysis for black bear focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of grey wolf habitat and affect wolf abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect black bear habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter black bear movement and behaviour and adversely affect bear habitat availability and bear abundance and distribution.

14.5.4.1 Application Case

14.5.4.1.1 Habitat Availability

Direct Habitat Loss and Alteration

The direct loss of black bear habitat is primarily associated with clearing of vegetation for the Project. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure. Black bears are considered habitat generalists and occupy a variety of habitat types throughout the year in response to the shifting availability of forage and prey items (Laufenberg et al. 2018; Tomchuk 2019; Section 14.3.4.1, Habitat Availability). Research indicates bears use suitable habitat adjacent to mine footprints, including early successional habitats and reclaimed areas (Symbaluk 2008).

In spring, much of the LSA and RSA in the Base Case is low suitability habitat due to historical burns. Addition of the Project would remove 63.2 ha and 42.1 ha of moderate and high suitability habitat in the RSA, respectively (Table 14.5-12). A total of 11,615 ha of moderate and high suitability habitat would remain available in the RSA. No additional loss of moderate and high suitability habitat is predicted in the RSA, and habitat losses in the RSA during spring represent 4.3% and 0.4% of high and moderate suitability habitat, respectively (Table 14.5-12). Most of the habitat loss would occur in low suitability habitat. Loss of low suitability habitat is estimated at 841.5 ha, representing 1.1% of its availability in the RSA (Table 14.5-12). Overall, the Project would disturb 946.8 ha (1.1%) of suitable spring habitat in the RSA relative to the Base Case.

Table 14.5-12: Changes to Black Bear Habitat Availability in the Regional Study Area at Application Case during Spring

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	1,464.8	1,401.6	-63.2	-4.3
Moderate	10,252.0	10,209.9	-42.1	-0.4
Low	76,679.6	75,838.1	-841.5	-1.1
Poor	19,094.3	20,041.1	946.8	5.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

In fall, 759.3 ha and 23.3 ha of high and moderate suitability habitat, respectively, in the RSA would be removed due to the addition of the Project (Table 14.5-13). A total of 54,174.4 ha of moderate and high suitability habitat would remain within the RSA. Habitat losses in the RSA during fall represent 1.4% and 14.4% of high and moderate suitability habitat in the RSA, respectively (Table 14.5-13). Approximately 54,000 ha of high suitability habitat would remain in the RSA. There would be a loss of 128.4 ha (0.4%) of low suitability habitat. Overall, the Project would disturb 911.0 ha (1.0%) of suitable fall habitat in the RSA relative to the Base Case. The predicted habitat losses during spring and fall are associated with a corresponding increase in the amount of poor suitability habitat (Table 14.5-12 and Table 14.5-13).

Table 14.5-13: Changes to Black Bear Habitat Availability in the Regional Study Area at Application Case during Fall

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	54,795.6	54,036.2	-759.3	-1.4
Moderate	161.5	138.2	-23.3	-14.4
Low	32,212.7	32,084.4	-128.4	-0.4
Poor	20,321.0	21,232.0	911.0	4.5

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the terrestrial ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1, Ecosystem Availability). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1.1). Functional habitat is predicted to become available five years after the Active Closure Stage when reclaimed upland habitat is expected to provide plant (e.g., berries) and animal food sources (e.g., small mammals; i.e., a duration of 38 years).

Sensory Disturbance

Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment use and general mine activity would be highest. It was assumed that black bears would continue to use suitable habitat near the mine through most of the year based on the literature as discussed in Section 14.3.4.1 (i.e., frequency of effect is periodic). Nonetheless, sensory disturbance from the Project and wildlife attractants would be minimized to the extent practical. Proposed mitigation measures (Table 14.4-1), including the Environmental Protection Program and Conventional Waste Management Plan, are expected to reduce the risk of habituation of bears to the Project (Section 14.4.2); however, bears may not show a strong avoidance of the Project during the active season of spring through fall (i.e., effect is possible [may occur but not likely]).

Based on the literature review regarding disturbance effects on denning in Section 14.3.4.1, denning may be disturbed, and dens potentially abandoned by mining activities in the winter during hibernation if any dens were within 1 km of activities (Linnell et al. 2000). However, given that the LSA is expected to provide no to little preferred denning habitat (Section 14.3.4.1), the potential disturbance to denning black bears would be expected to be negligible to low in the Application Case. The implementation of pre-clearance den surveys, if and when clearing is required during denning periods, is anticipated to avoid and reduce Project-related changes to black bear denning in the LSA (Section 14.4).

Any habitat loss that may occur due to sensory disturbance is expected to end following the Active Closure Stage. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., a duration of 48 years).

14.5.4.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

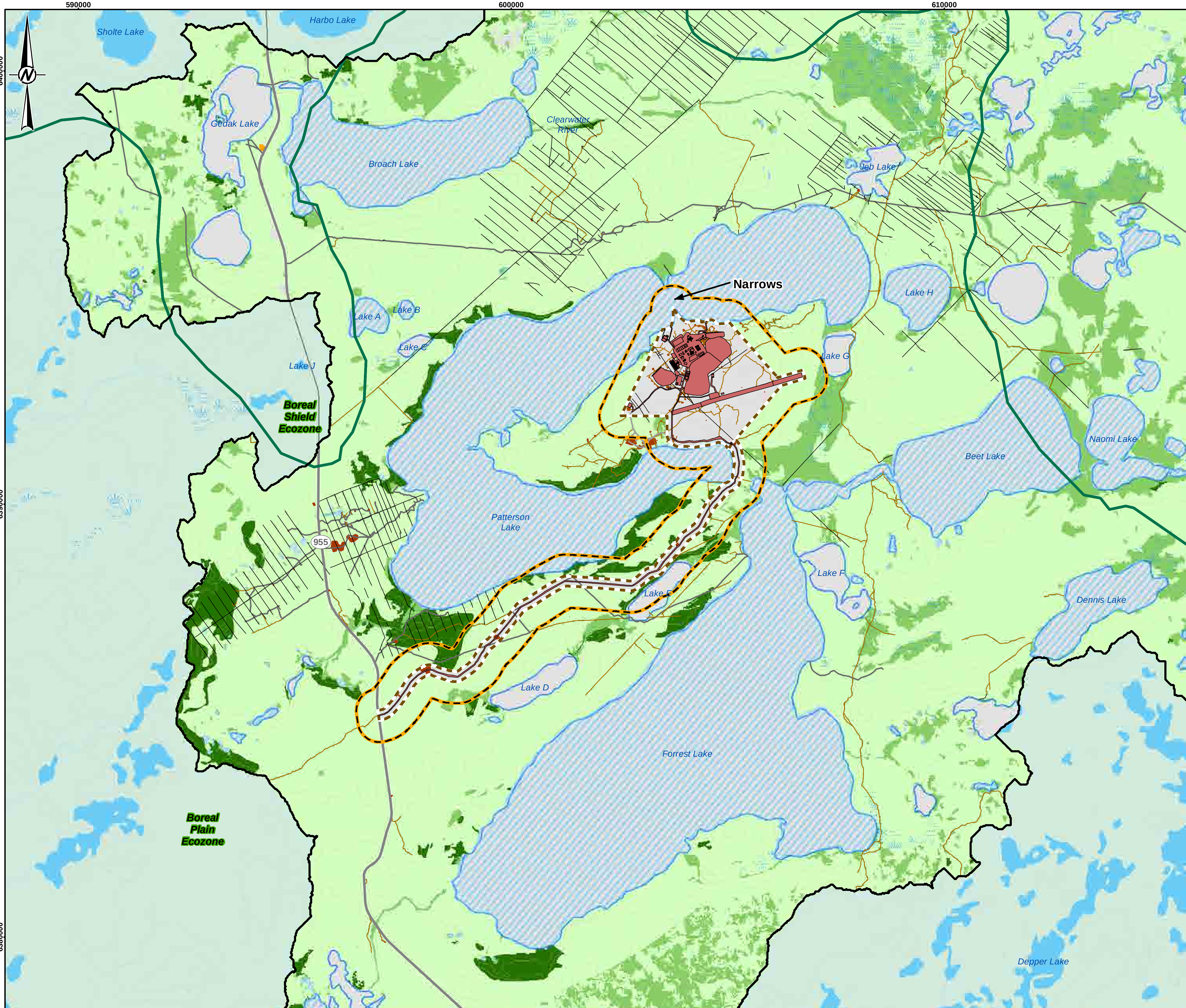
The maximum disturbance area would remove suitable black bear habitat in the LSA (i.e., local geographic extent; Figure 14.5-14 and Figure 14.5-15). However, in the Application Case, suitable spring and fall habitat would remain common and well connected in the RSA (Figure 14.5-16 and Figure 14.5-17); 99% of suitable habitat is expected to be undisturbed by the Project. Black bears have high mobility and are expected to be able to move freely through much of the RSA during the Application Case. Black bears have been shown to adjust their foraging behaviour and/or expand their home ranges in response to changes in availability of food (Laufenberg et al. 2018). Sensory disturbance could drive prey items, such as moose and woodland caribou, out of the LSA, leading to loss of habitat quality for black bear in the affected areas. While the Project could lead to a decline in prey items for black bear in the LSA, the species is adaptable in its diet (i.e., exploit other food items as described in Section 14.3.4.1) and is highly mobile, allowing individuals to shift activity centres during the active season and move to portions of the RSA where food is more abundant and accessible.

During JWG meetings, the BNDN identified a movement route for bear at the narrows of the North Arm of Patterson Lake (BNDN-JWG 2019b). Avoidance of Project infrastructure could lead to a loss of connectivity between suitable habitats in this area of Patterson Lake (Figure 14.5-14 and Figure 14.5-15). Because bears would likely avoid passing through the maximum disturbance area, especially during periods of highest human activity, the Project is predicted to change habitat connectivity in the area within and immediately surrounding the LSA (i.e., local to regional geographic extent). Overall, the Project is predicted to result in a small change to the distribution and movement of black bears around Patterson Lake but is unlikely to have a measurable effect on black bear connectivity and movement in the RSA. Effects from changes to bear habitat distribution would be continuous and occur from Construction to approximately five years after the end of the Active Closure Stage when functional bear habitat is regenerated on reclaimed areas.

Linear Features

The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Most of the existing trails in the Project footprint would be upgraded for site roads and haul roads within the maximum disturbance area. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-17). Evidence suggests that black bears may select for linear features or come to roads expecting food (Section 14.3.4.1). The Project would not change the density of linear features in the LSA and RSA. As such, upgrades to the existing access road and site roads are not expected to change the movement or connectivity of black bears relative to the Base Case.

An increase in vehicle traffic on Highway 955 created by the Project may reduce black bear landscape connectivity compared to existing conditions (Lewis et al. 2011). Indigenous Groups have commented that increased traffic volumes from mineral exploration activities on Highway 955 and the Cluff Lake Road are affecting wildlife movement patterns and distribution and are concerned that traffic related noise from the Project would exacerbate these effects (TSD II: BNDN; TSD V.2: CRDN). The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to relative to existing conditions (Section 14.4.2). This increase in traffic could affect the movement of black bears that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Black bears have been shown to alter their activity periods and complete road crossings during the night when conditions are perceived to be safer for the individual (i.e., when vehicle traffic is lowest; Ditmer et al. 2018). In general, roads do not act as absolute movement barriers for black bears (Ditmer et al. 2018), and individuals in the RSA are expected to continue to move throughout most of the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE DURING SPRING

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.5-14	
REVIEW	JV	2023-02-09		

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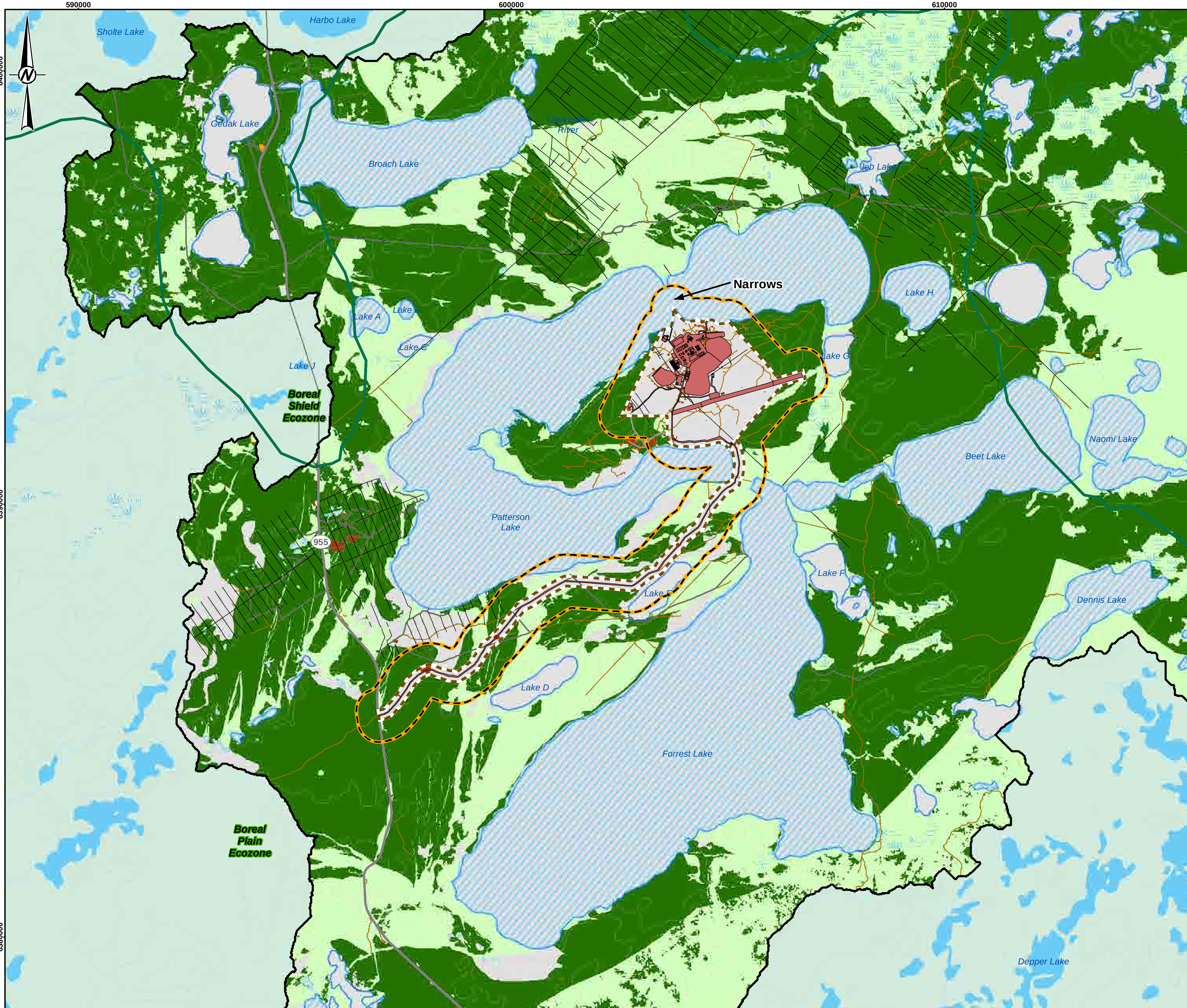

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE DURING FALL

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-15**	
REVIEW	JV	2023-02-09		

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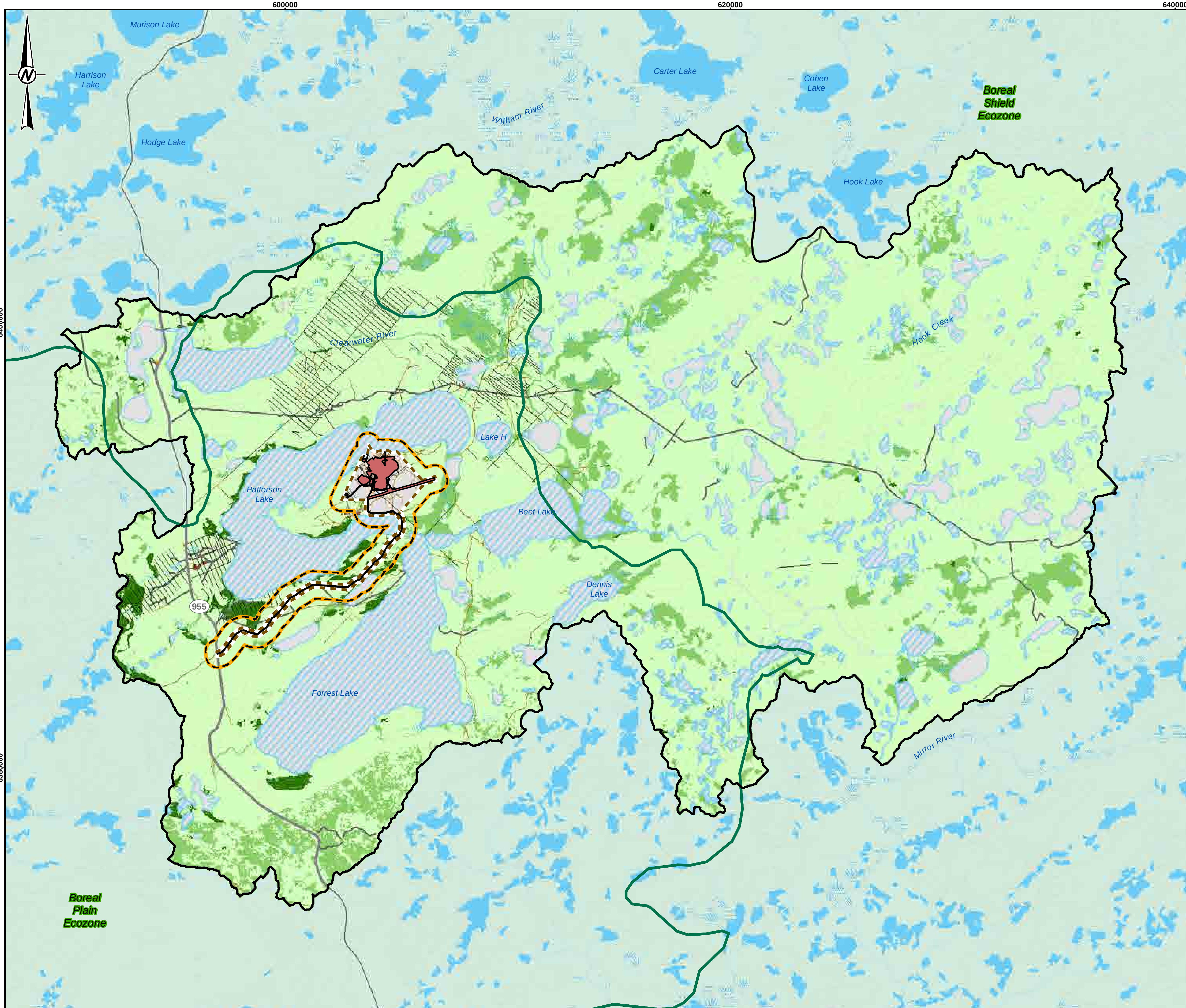

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY
- REGIONAL STUDY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE DURING SPRING

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.5-16	
REVIEW	JV	2023-02-09		

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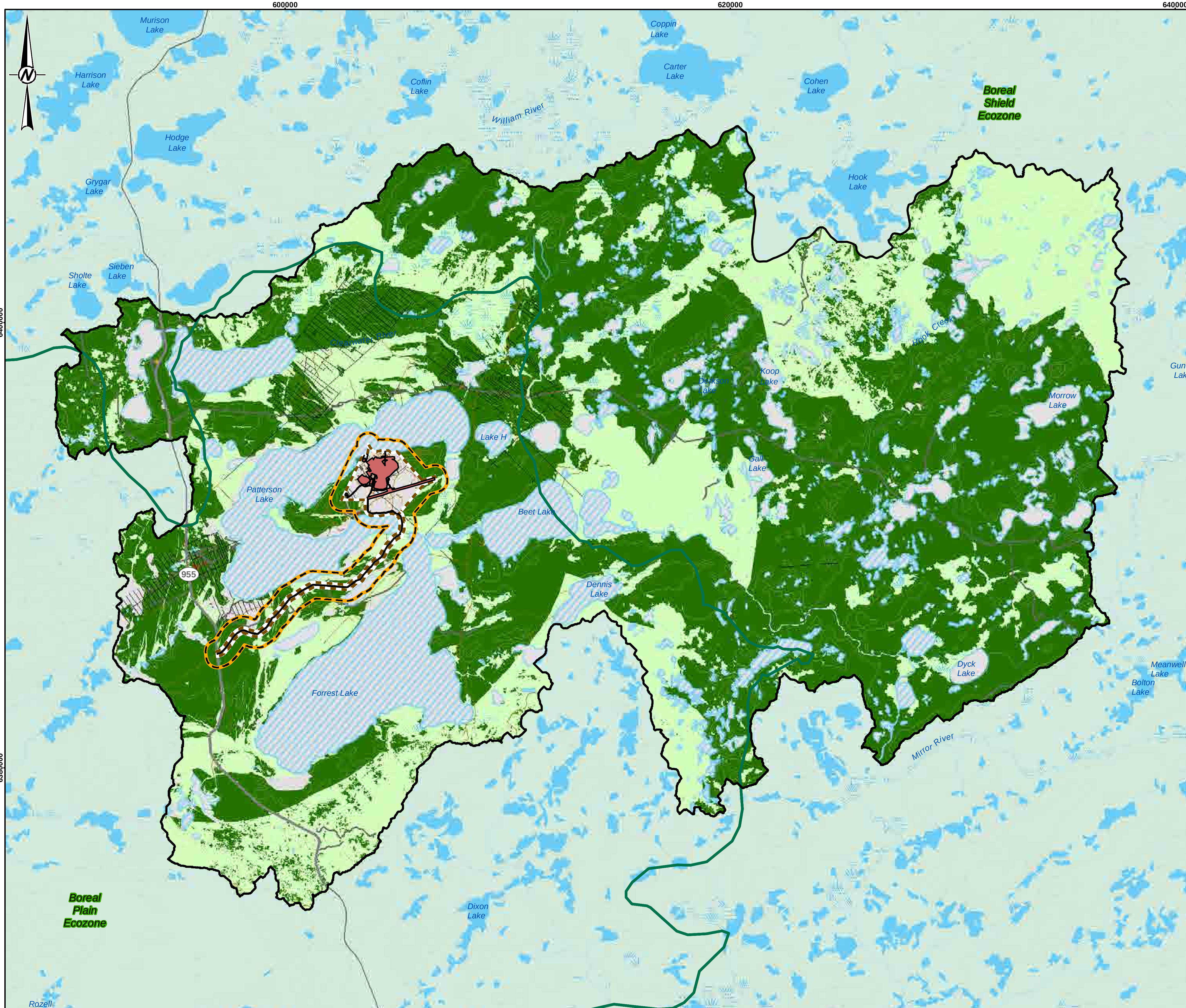
25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE DURING FALL

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-17	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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14.5.4.1.3 Survival and Reproduction

Home Range and Vital Rates

Based on estimated home range sizes in the Boreal Shield, home range size of female and male black bears in the Project was assumed to be 79.8 to 316.5 km^2, respectively (Section 14.3.4.2). Using the smaller female home range size of 79.8 km^2 (7,980 ha), the estimated loss of 946.8 ha of suitable spring habitat in the RSA (estimated loss of 911.0 ha in fall) is unlikely to affect more than one home range (i.e., 12% of one home range is altered).

The Project could affect black bear survival through habitat loss, sensory disturbance potentially leading to further losses of suitable habitat or abandonment of denning sites, and reduced prey availability in the LSA. The loss of suitable habitat may affect reproductive success if individuals are displaced into lower quality habitat. Sensory disturbance may affect reproductive success and survival of some individuals in close proximity to the Project as a result of denning site abandonment, early emergence from hibernation, or avoidance of areas near the Project. The implementation of pre-clearance den surveys, if and when clearing is required, during denning periods is anticipated to avoid and reduce Project-related changes to black bear denning in the LSA (Section 14.4).

The calculated losses of available black bear habitat in the RSA in the Application Case are expected to be well within the resilience and adaptive capacity limits of black bears; 99% of suitable habitat would remain in the Application Case. Black bears are also considered more resilient to anthropogenic effects on mortality and habitat availability than other carnivores (e.g., wolverine) due to their relatively high reproductive rates and early age at first reproduction (Hebblewhite et al. 2003).

Sound levels above about 90 dBA are likely to be aversive to mammals, resulting in potential retreat from the sound source, freeze response, or a strong startle response (Manci et al. 1988). Lower levels of noise may result in unobserved internal reactions such as increased heart rate that are energetically costly (Herrero et al. 2005). According to noise modelling results for the Project, cumulative noise contributions resulting from background and Project Construction or Operations are not expected to exceed 45 dBA within 10 km of the maximum disturbance area (Section 7.3.5.1). Therefore, noise from the Project is not expected to result in strong avoidance and not affect energetics of black bears in the LSA or RSA.

The anticipated loss of suitable habitat within the LSA is unlikely to influence survival and reproduction and abundance of the black bear population overlapping the RSA (probability of effect is not expected but is not impossible). Suitable habitat would remain abundant and well connected and distributed across the RSA relative to Base Case. Because habitat availability is not limiting, black bears would be expected to shift or alter their home ranges to exclude areas of high disturbance or use these areas less frequently when human activity levels are higher. Some changes in local prey abundance may occur; however, significant changes to moose or beaver (i.e., two important prey species) abundance and distribution are not predicted (Section 14.5.2.3 and Section 14.5.5.3).

14.5.4.2 Reasonably Foreseeable Development Case

14.5.4.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of high and moderate suitability habitat in the spring by 195.2 ha (13.3% of available in the Base Case) and 77.7 ha (0.8% of available), respectively (Table 14.5-14). Low suitability habitat would be reduced by 2,181.1 ha (2.8% of available). Together, these represent a total loss of 2,454.0 ha (2.7%) of suitable spring habitat in the RSA (i.e., regional geographic extent). Approximately 86,000 ha of suitable habitat would remain in the RSA.

Table 14.5-14: Changes to Black Bear Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case during Spring

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	1,464.8	1,269.6	-195.2	-13.3
Moderate	10,252.0	10,174.3	-77.7	-0.8
Low	76,679.6	74,498.5	-2,181.1	-2.8
Poor	19,094.3	21,548.3	2,454.0	12.9

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

In the fall, the Project and Fission Patterson Lake South Property would remove 1,886.1 ha (3.4%) of high suitability habitat, 41.6 ha (25.7%) of moderate suitability habitat, and 369.8 ha (1.1%) of low suitability habitat is predicted in the RSA (Table 14.5-15). The combined loss of low, moderate, and high suitability habitat (2,297.5 ha) represents 2.6% of the total suitable fall habitat available in the RSA (i.e., regional geographic extent). Approximately 85,000 ha of suitable habitat would remain in the RSA. The predicted habitat losses are reflected by a corresponding increase in the amount of unsuitable habitat (Table 14.5-14 and Table 14.5-15).

Table 14.5-15: Changes to Black Bear Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case during Fall

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	54,795.6	52,909.5	-1,886.1	-3.4
Moderate	161.5	119.9	-41.6	-25.7
Low	32,212.7	31,842.9	-369.8	-1.1
Poor	20,321.0	22,618.5	2,297.5	11.3

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

As described for the Application Case, indirect loss of black bear habitat is likely greatest during the spring and winter denning when bears would be more vulnerable to noise disturbance created by the Project and the Fission Patterson Lake South Property. The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Loss of black bear habitat would be irreversible for permanent features and wetlands.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus five years when reclaimed upland habitat is expected to provide forage for black bear (i.e., early-stage upland ecosites; Section 14.5.4.1.1, Habitat Availability). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 20 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As described for the Application Case (Section 14.5.4.1), indirect loss of black bear habitat from sensory disturbance is likely greatest during the winter when animals are denning and during the spring when home ranges are typically smaller and when females have young cubs present (i.e., effect is periodic through time). Potential for denning habitat in the Fission Patterson Lake South Property maximum disturbance area is also predicted to be low due to the extent of existing disturbance. Overall, the RFD Case is expected to result in a negligible effect on habitat availability for black bear in the RSA.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

Climate change may alter the processes that influence the availability and condition of black bear habitat, with effects occurring beyond the RSA (i.e., beyond regional geographic extent). Anticipated climate change effects on weather and vegetation are presented in Section 14.2.5. Wetland habitats such as open muskeg provide moderate suitability habitat for black bear during spring. However, studies have shown stronger selection for upland habitats than bogs and fens (Bastille-Rousseau et al. 2011; Latham et al. 2011a,b; McLoughlin et al. 2019). Conversion of bogs and fens to upland habitats driven by climate change may lead to an increase in suitable habitat for black bear in the RFD Case.

Black bear habitat may be negatively or positively affected by climate-mediated changes in fire activity. Black bear may benefit from climate change and wildfire if berry production and moose densities increase in recently burned areas (Schwartz and Franzmann 1989, 1990; Fisher and Wilkinson 2005). Regenerating stands in the boreal forest tend to have high densities and biomasses of berry-producing plants, making them desirable foraging areas for black bears, particularly in the summer and fall (Ouellet et al. 2008). Alternatively, black bear habitat availability may be negatively affected because well-drained black spruce stands (e.g., BP14) are selected for by bears (McLoughlin et al. 2019) and tend to be less resilient to fire disturbance and less likely to return to the same state post-fire (Hart et al. 2019).

Increased fire frequency may increase the availability of deciduous ELC units (e.g., BP06, BP07) as black spruce dominant stands become less common (Hart et al. 2019). An increase in these ELC units would mean an increase in high suitability habitat for bear during spring but may result in a decrease in suitable habitat for bear during the fall, though the increase or decrease in habitat is dependant on the future fire regime. There is a high degree of uncertainty regarding the potential effects of climate change because predictions are based on simulations that can be highly variable. The CRDN and BNDN have observed increasing frequency of forest fires in recent years, which are reported to be a contributing factor to declining wildlife populations and have reduced harvesting opportunities in the long term (TSD II: BNDN; TSD V.2: CRDN).

The direction and magnitude of effects of climate change on habitat availability for black bear in the RFD Case are uncertain. Climate change may alter the processes that influence the availability of different quality bear habitats, and effects would likely occur beyond the RSA. It was conservatively assumed that climate change would have a negative cumulative effect on habitat availability.

14.5.4.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

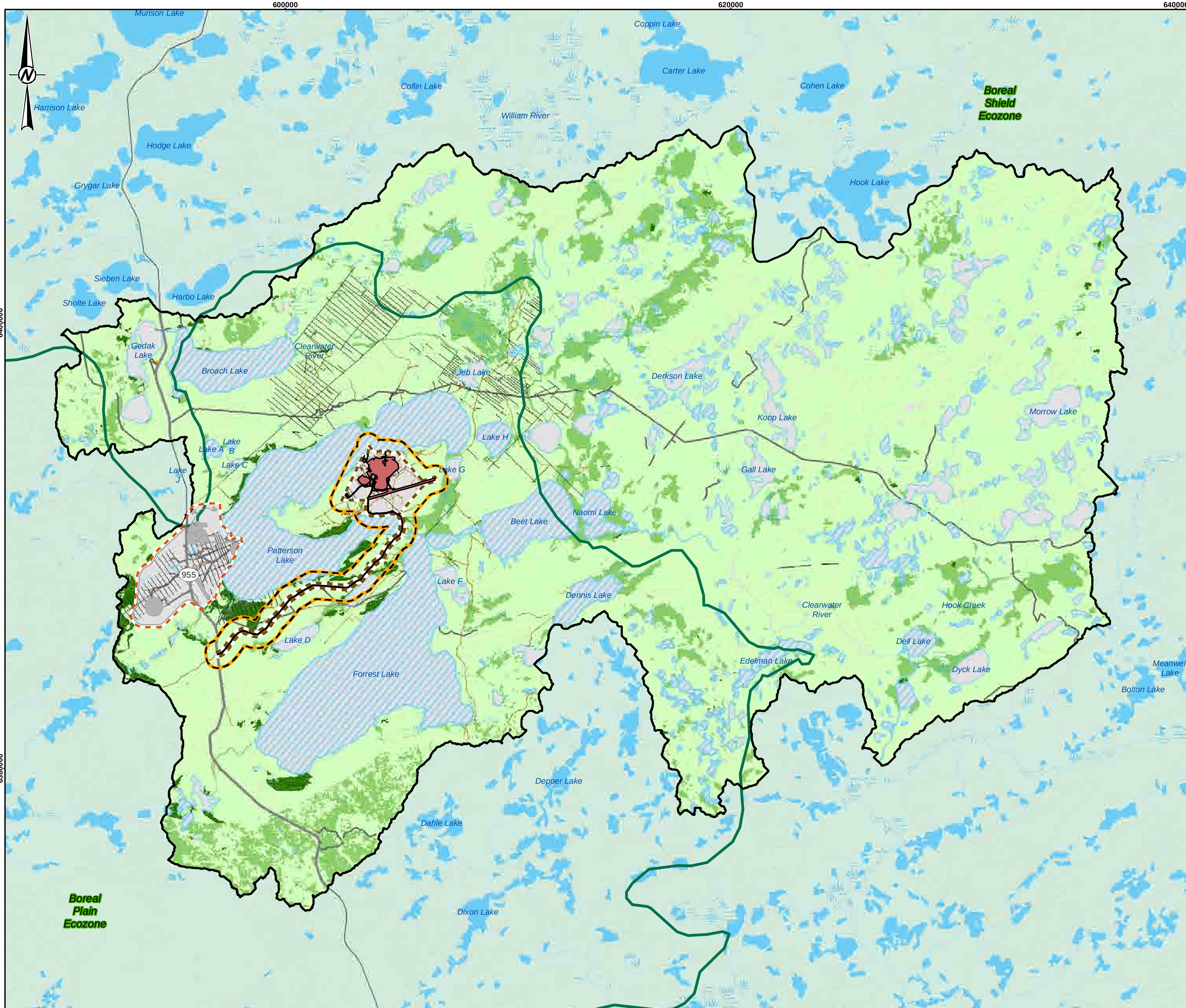
Black bear habitat distribution and connectivity conditions in the RSA would be similar to those described under the Application Case (Section 14.5.4.1.1; Figure 14.5-18 and Figure 14.5-19). The Fission Patterson Lake South Property would remove small patches of high suitability spring habitat west of Patterson Lake in the RSA and would potentially alter movement patterns for bears attempting to access the high suitability spring habitat patches that occur in the extreme western portions of the RSA (Figure 14.5-18). Larger, intact areas of high suitability fall habitat would be removed in the western portions of the RSA as part of the Fission Patterson Lake South Property (Figure 14.5-19). However, 97% of suitable spring and fall habitat would remain well connected and distributed in the RSA.

Linear Features

Linear feature density in the RSA is not expected to change due to the Project and the Fission Patterson Lake South Property (based on the hypothetical maximum disturbance area used in the assessment; Section 14.2.5); physical effects of linear disturbances would remain similar to the Base Case. In the Base Case, Highway 955 is already expected to have a negative influence on black bear movement and habitat connectivity, particularly during periods of high traffic volume (Section 14.3.4.2). Addition of the Fission Patterson Lake South Property is expected to increase the number of vehicles on Highway 955 relative to the Application Case. The increase in traffic was assumed to be similar in magnitude to that of the Project. Incremental traffic increases could further affect the movement of black bear that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). The creation of localized semi-permeable movement barriers is considered possible due to future developments and would be experienced continuously until traffic from the two projects decreases and the two sites are reclaimed. However, black bears have high mobility and habitat would remain well connected in the RFD Case. Overall, small changes in movement and habitat connectivity are predicted in the RFD Case, particularly around Patterson Lake.

Climate Change

As with habitat availability, climate change and associated wildfire may contribute to changes in the distribution of black bear habitat. Although habitat connectivity conditions in the western portion of the RSA may be reduced under the RFD Case, suitable habitat would remain widespread and connected in the RSA. As discussed in Section 14.5.4.2.1, Habitat Availability, climate change may lead to an increase in the availability of suitable habitat for black bears in the RSA, resulting in improved habitat distribution conditions under the RFD Case compared to the Base Case. Localized changes in the movement patterns of black bear are expected around the Project and the Fission Patterson Lake South Property. Given that black bears are highly mobile and flexible in their habitat preferences, habitat distribution conditions in the RSA in the RFD Case are expected to remain within the species' limits for resilience and adaptability. It was conservatively assumed that climate change would have a negative cumulative effect on habitat distribution.



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- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
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- LOCAL STUDY AREA
- ECOZONE BOUNDARY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT DURING SPRING

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.5-18	
REVIEW	JV	2023-02-09		

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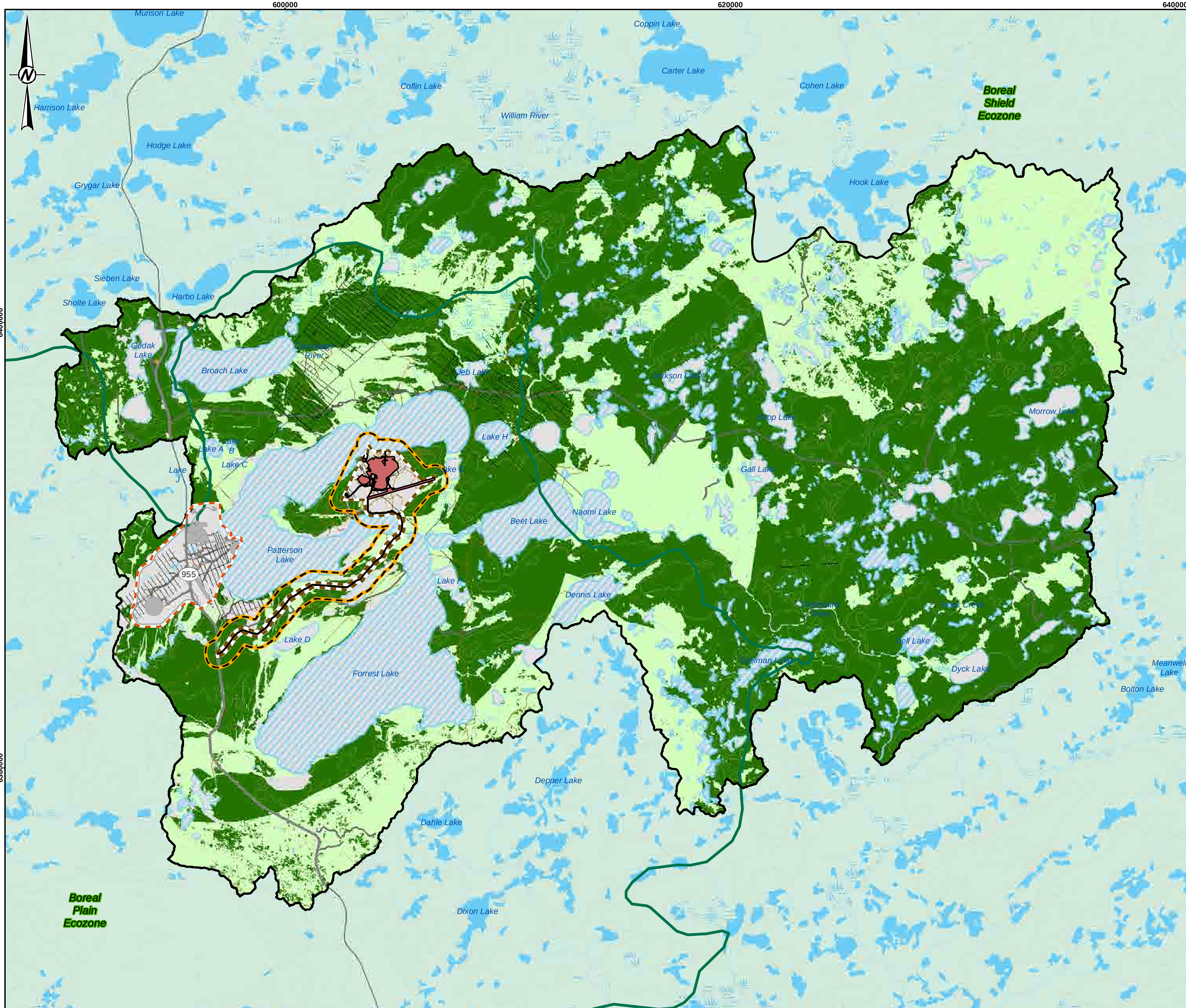

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BLACK BEAR HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE DURING FALL

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-19	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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14.5.4.2.3 Survival and Reproduction

Home Range and Vital Rates

Following the approach in Section 14.5.4.1.3, Survival and Reproduction, the projected loss of 2,454 ha of suitable spring habitat in the RFD Case represents approximately 31% of one female home range, suggesting that loss of available habitat in the RFD Case is unlikely to have a measurable effect on the black bear population overlapping the RSA (i.e., effect is not expected but not impossible).

Cumulative sensory disturbance created by the Project and Fission Patterson Lake South Property could result in additional loss of suitable habitat leading to reduced survival and reproduction. As discussed in Section 14.5.4.1.3, cumulative noise levels from existing and Project-related noise during Construction and Operations are not predicted to exceed a maximum of 45 dBA within 10 km of the maximum disturbance area. Similar noise levels (low magnitude and local spatial extent) are predicted for combined changes from the Project and the Fission Patterson Lake South Property (Section 7.3.5.2). The cumulative loss of suitable habitat in the RFD Case may possibly influence the survival and reproduction and result in a small measurable change to the abundance and distribution of the black bear around Patterson Lake (probability of effect may occur but is not likely).

Continued encroachment of anthropogenic disturbance into black bear habitat could lead to increased frequency of human-bear interactions and potential conflicts that could in turn lead to reduced bear survival and reproduction (Johnson et al. 2017). Human-bear interactions are expected to be mitigated through the Environmental Protection Program and Conventional Waste Management Plan (Section 14.4.2). It is also anticipated that the Fission Patterson Lake South Property would implement mitigation and management practices to minimize direct mortality effects on black bear. Human-bear interactions are therefore not expected to increase in the RFD Case.

Climate Change

The loss of moderate and high suitability habitat in the RFD Case could be offset by potentially positive effects of climate change on habitat availability for black bear. An increase in fire activity in the RSA because of climate change (Section 14.5.4.2.1) could lead to an increase in the availability of high suitability habitat for black bear and a greater biomass of forage items, such as berries. Studies of black bear denning chronology indicate that warmer annual temperatures created by climate change could lead to changes in hibernation emergence and an extension in the active season for individuals (Johnson et al. 2017). The magnitude of potential change is uncertain. It was assumed that climate change would add additional negative pressure on the overall survival and reproduction of black bear in the RSA.

14.5.4.3 Residual Effects Classification and Determination of Significance

14.5.4.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of effective mitigation (Table 14.5-16). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1), and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on black bear. Following the summary of residual effects, significance of residual effects for the Application Case and the RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-16: Classification of Residual Effects on Black Bear Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 63.2 ha removal of high suitability spring habitat, representing a 4.3% reduction in the RSA and 759.3 ha removal of high suitability fall habitat, representing a 1.4% reduction in the RSA (i.e., low magnitude) ▪ 42.1 ha removal of moderate suitability spring habitat, representing a 0.4% reduction in the RSA and 23.3 ha removal of moderate suitability fall habitat, representing a 14.4% reduction in the RSA (i.e., moderate magnitude) ▪ 841.5 ha removal of low suitability spring habitat, representing a 1.1% reduction in the RSA and 128.4 ha removal of low suitability fall habitat, representing a 0.4% reduction in the RSA (i.e., low magnitude) ▪ Small avoidance of habitat from sensory disturbance during high activity periods	▪ 195.2 ha removal of high suitability spring habitat, representing a 13.3% reduction in the RSA and 1,886.1 ha removal of high suitability fall habitat, representing a 3.4% reduction in the RSA (i.e., moderate magnitude) ▪ 77.7 ha removal of moderate suitability spring habitat, representing a 0.8% reduction in the RSA and 41.6 ha removal of moderate suitability fall habitat, representing a 25.7% reduction in the RSA (i.e., low magnitude) ▪ 2,181.10 ha removal of low suitability spring habitat, representing a 2.8% reduction in the RSA and 369.8 ha removal of low suitability fall habitat, representing a 1.1% reduction in the RSA (i.e., low magnitude) ▪ Small avoidance of habitat from sensory disturbance during high activity periods (i.e., occurs during period of overlap between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local to regional: sensory disturbance (within the LSA for foraging habitat but up to 1 km beyond the maximum disturbance area for den sites)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish bear habitat ▪ Long-term (i.e., sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (wetlands, any habitat covered by permanent features)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous (direct habitat loss) ▪ Periodic (sensory disturbance)	▪ Continuous (direct habitat loss) ▪ Periodic (sensory disturbance)
	Probability of occurrence	▪ Certain (direct habitat loss) ▪ Possible (sensory disturbance)	▪ Probable (direct habitat loss from Project and Fission Patterson Lake South Property) ▪ Possible (sensory disturbance) ▪ Possible (climate change)

Table 14.5-16: Classification of Residual Effects on Black Bear Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small changes to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility of species)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local to regional (LSA and movement route at the narrows of Patterson Lake) ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (i.e., direct habitat loss): 38 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish bear habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features, wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous (direct habitat loss) ▪ Periodic (sensory disturbance)	▪ Continuous (direct habitat loss) ▪ Periodic (sensory disturbance)
	Probability of occurrence	▪ Certain (direct habitat loss) ▪ Possible (sensory disturbance)	▪ Probable (direct habitat loss from Project and Fission Patterson Lake South Property) ▪ Possible (sensory disturbance) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 946.8 ha loss of suitable habitat represents less than one female home range (12%) (i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 2,454.0 ha loss of suitable habitat represents less than one female home range (31%) (i.e., low magnitude) ▪ Small measurable change in black bear abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years = 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish bear habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous

Table 14.5-16: Classification of Residual Effects on Black Bear Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Survival and reproduction	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; LSA = local study area; RSA = regional study area; WRSAs = waste rock storage areas.

14.5.4.3.2 Significance Determination

Habitat Availability and Distribution

In the Application Case, the Project is expected to result in a combined loss of 105.3 ha of high and moderate suitability spring habitat, representing 0.9% of available high and moderate suitability habitat in the RSA. In comparison, the Project is expected to result in a combined loss of 782.6 ha of high and moderate suitability fall habitat, representing 1.4% of available habitat in the RSA. During spring, most of the habitat loss would occur in low suitability habitat (841.5 ha, 1.1% of its availability in the RSA). However, during the fall, the majority of habitat loss would occur in high suitability habitat (759.3 ha, 1.4% of its availability in the RSA). Approximately 99% of suitable (i.e., high, moderate, and low suitability habitat) spring and fall habitat would remain well connected and distributed across the RSA. Black bear may avoid the Project footprint during the winter denning period and during the spring when females have young cubs present, but bears may also habituate or be attracted to the Project (Section 14.5.4.1.1). The LSA is also predicted to have low potential for denning habitat based on existing recent burns and cleared areas, and proximity to Highway 955. Overall, the amount of habitat loss due to the Project is unlikely to have a measurable effect on black bear population abundance as the loss accounts for less than one individual home range. Functional habitat for bear is predicted to become available approximately five years after the end of the Active Closure Stage.

In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable habitat in the RSA by 2.7% in the spring and 2.6% in the fall. Over 85,000 ha of suitable habitat would remain intact and well connected across the RSA during both seasons. The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and the distribution of high, moderate, and low suitability habitat in the RSA would remain largely unchanged.

The Project is not expected to change the density of linear features in the RSA as it would be in an area with an existing aggregation of roads, trails, and seismic lines / cutlines. Changes to black bear movement and habitat connectivity are expected to be small and localized to specific areas of the LSA and RSA. Because bears may avoid passing through the maximum disturbance area, an existing movement route identified by Indigenous Knowledge may be affected by the Project and alter habitat connectivity in the area within and surrounding the LSA. The Project is expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could affect the movement of bears that use habitats within and outside the western portion of the RSA. However, individuals in the RSA are expected to continue to move throughout most of the RSA because roads do not typically act as absolute movement barriers for black bear (Section 14.5.4.1.2, Habitat Distribution). Black bears display life history traits (e.g., adaptable diet, highly mobile) that provide flexibility to adapt to different types of natural and anthropogenic disturbances.

In the RFD Case, the increase in traffic from the Fission Patterson Lake South Property was assumed to be similar in magnitude to that of the Project. The presence of an additional development and traffic could further affect the movement of black bear that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). The creation of localized semi-permeable movement barriers is considered possible due to future developments and would be experienced continuously until traffic from the two projects decreases and the two sites are reclaimed. However, black bears have high mobility and habitat would remain well connected in the RFD Case. Overall, small changes in movement and habitat connectivity are predicted in the RFD Case, particularly around Patterson Lake.

Survival and Reproduction

The Project is not expected to have a measurable effect on black bear survival and reproduction. Incremental changes to bear habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the black bear population overlapping the RSA. The weight of evidence from the analysis of the primary pathways and associated mitigation indicates black bear would remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints).

In the RFD Case, the combined loss of suitable habitat from the Project and the Fission Patterson Lake South Property would represent less than one adult female home range. The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and suitable habitat would remain common and well distributed in the RSA. The cumulative loss of suitable habitat in the RFD Case may possibly influence the survival and reproduction and result in a small measurable change to the abundance and distribution of the black bear around Patterson Lake, but the population is predicted to remain self-sustaining and ecologically effective.

Other Project-wildlife interactions, such as increased access for people and predators, and higher risk of injury/mortality from wildlife-vehicle collisions and attraction of animals to site were determined to have negligible effects on the black bear population (Section 14.4.2). The Project would not increase access for humans and predators as an access road to the site already exists and upgrades to the access road for the Project are expected to result in no measurable change to existing access for hunting/trapping. Several trails also exist in the Fission Patterson Lake South Property, and increased access to harvest black bears is not anticipated. Implementation of mitigation measures at the Project including staff, contractor, and visitor orientations, giving wildlife the right of way, identification of wildlife crossings, gaps in road berms and snowbanks, and speed limit adjustments are expected to result in a minor increase in injury or mortality to individual animals from vehicle-wildlife collisions. Environmental design features and management plans could limit attractants to the Project and result in a minor increase in wildlife mortality risk from adverse human-wildlife interactions. It is expected that similar mitigation policies and practices would be implemented at the Fission Patterson Lake South Property to avoid and limit potential adverse cumulative effects on black bear. As such, the combined effects of these pathways are predicted to not significantly influence the abundance and distribution of the black bear population overlapping the RSA.

Changes to the availability and condition of suitable habitat from climate change are uncertain and could have positive and negative effects on black bear populations overlapping the RSA. Changes in precipitation and fire frequency may increase or decrease habitat availability and alter food abundance. Given the level of uncertainty associated with climate change predictions, a precautionary approach was applied, and the assessment assumed that climate change effects would have predominantly negative effects on black bear.

Summary of Significance Determination

Based on several lines of evidence the incremental and cumulative effects from the Project, other previous and existing developments and activities, and the Fission Patterson Lake South Property on black bear are predicted to be not significant. In the Application Case and RFD Case, changes in habitat availability, habitat distribution, and survival and reproduction from planned developments are unlikely to affect the ability of black bear to remain self-sustaining and ecologically effective. The effects related to climate change are uncertain and could have either positive or adverse influences on black bear in the RSA. However, climate change is not expected to significantly influence the abundance and distribution of black bear and does not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.5 Beaver

14.5.5.1 Application Case

The residual effects analysis for beaver focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of beaver habitat and affect beaver abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect beaver habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter beaver movement and behaviour and adversely affect beaver habitat availability and beaver abundance and distribution.

14.5.5.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Construction of Project infrastructure would reduce the availability of suitable beaver habitat. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure. A loss of 7.4 ha of high suitability habitat is predicted, representing a change of 0.5% at the scale of the RSA (Table 14.5-17). No loss of moderate suitability habitat is predicted and a loss of 28.8 ha (0.1%) of low suitability would occur as a result of the Project. The predicted habitat losses are reflected in the corresponding increase in the amount of poor suitability habitat (Table 14.5-17). As described under existing conditions, beavers do not appear to avoid areas near anthropogenic disturbance (e.g., Boyles and Savitzky 2008; Mumma et al. 2018; Scrafford et al. 2020). Consequently, no further loss of habitat is expected because of beaver avoidance behaviour in proximity to the maximum disturbance area, which includes the anticipated Project footprint. Overall, 33,362.7 ha of suitable beaver habitat would remain in the RSA in the Application Case.

Table 14.5-17: Changes to Beaver Lodge Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	1,529.3	1,521.9	-7.4	-0.5
Moderate	1,583.8	1,583.8	0.0	0.0
Low	30,285.8	30,257.0	-28.8	-0.1
Poor	74,091.9	74,128.0	36.2	<0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the upland deciduous forest ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). The WRSAs are not anticipated to disturb wetland ecosystems (Section 13.5.2.1.1, Ecosystem Availability). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project.

Beaver habitat loss is mainly associated with the alteration of open water and adjacent deciduous forest stands. Some areas of the Project footprint may return to moderately suitable beaver habitat after the Active Closure Stage because shrubby willow habitats near water features can establish relatively quickly. Moderate and high suitability habitats for beaver include early regenerating ecosites, so functional upland foraging habitat is expected to return in 6 to 20 years following the end of the Active Closure Stage (i.e., minimum duration of habitat loss is approximately 39 years following the start of Construction). At least 40 years from the end of the Active Closure Stage would be required for mature forest trees to be established for use in lodges and dams. In the RSA, the Project is conservatively predicted to contribute to a loss of 27.8 ha (0.4%) of burned and unburned wetland ELC units (Section 13.5.2, Wetland Ecosystem). The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

14.5.5.1.2 Habitat Distribution

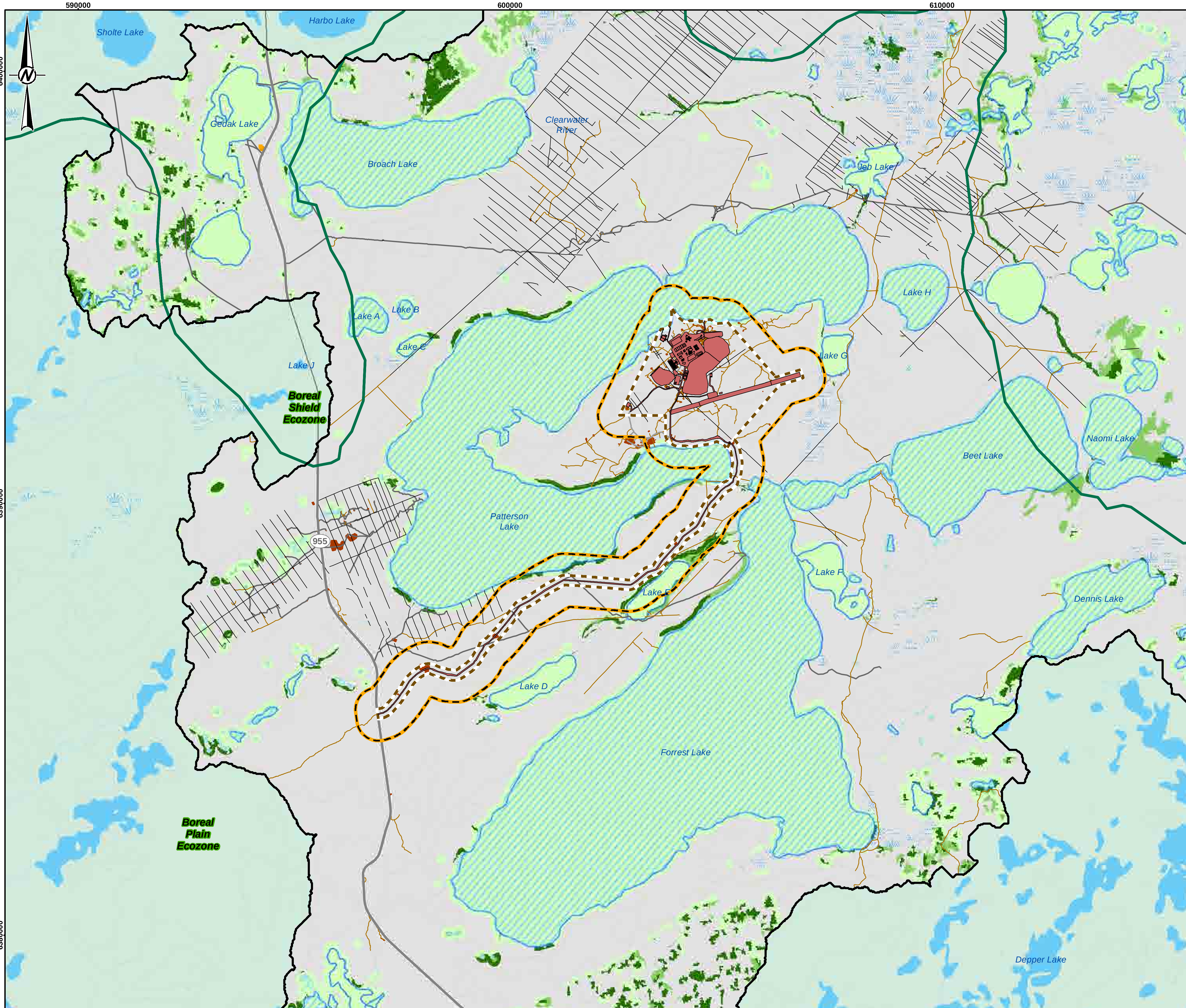
Habitat Arrangement and Connectivity

The maximum disturbance area would potentially affect suitable beaver habitat in the LSA as follows (Figure 14.5-20):

- An area of open water connecting Patterson Lake and Forrest Lake would be affected by the adjacent access road.
- A small area of open water and its adjacent burned deciduous forest may be altered by the site road near the shore of Lake Patterson.

The distribution of high and moderate suitability habitat in the RSA remains largely unchanged as a result of the Project because areas of concentrated high and moderate suitability beaver habitat are not affected by the maximum disturbance area (Figure 14.5-21). Low suitability habitat is also largely unchanged relative to Base Case conditions. Anthropogenic linear features have not been found to decrease the likelihood of occurrence or distribution of beaver (Mumma et al. 2018), and the Project would not change the density of linear features in the LSA and RSA. The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Most of the existing trails in the Project footprint would be upgraded for site roads and haul roads within the maximum disturbance area. Beaver have limited sensitivity to sensory disturbance (Section 14.5.5.1.1, Habitat Availability) and are not expected to experience additional decreases in functional habitat due to the presence of humans, Project infrastructure, and the associated noise and lights.

Beaver sign in the LSA was limited, and no sign was observed along the shores of Patterson Lake or Forrest Lake, or the along the small creek connecting Patterson and Forrest lakes (Annex VIII.1). In the RSA, most beaver sign was observed southwest of Forrest Lake and north of Naomi Lake (Annex VIII.1). Considering the information on beaver activity in the LSA and RSA, the mobility of beaver, the extensive network of available waterbodies and watercourses, and the small magnitude and site-specific nature of beaver habitat loss, it is unlikely that the Project would cause a measurable change in beaver movement patterns at the local or regional scales. The Project is not expected to introduce movement barriers that would impede dispersal within or across the LSA or RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BEAVER LODGE HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-20**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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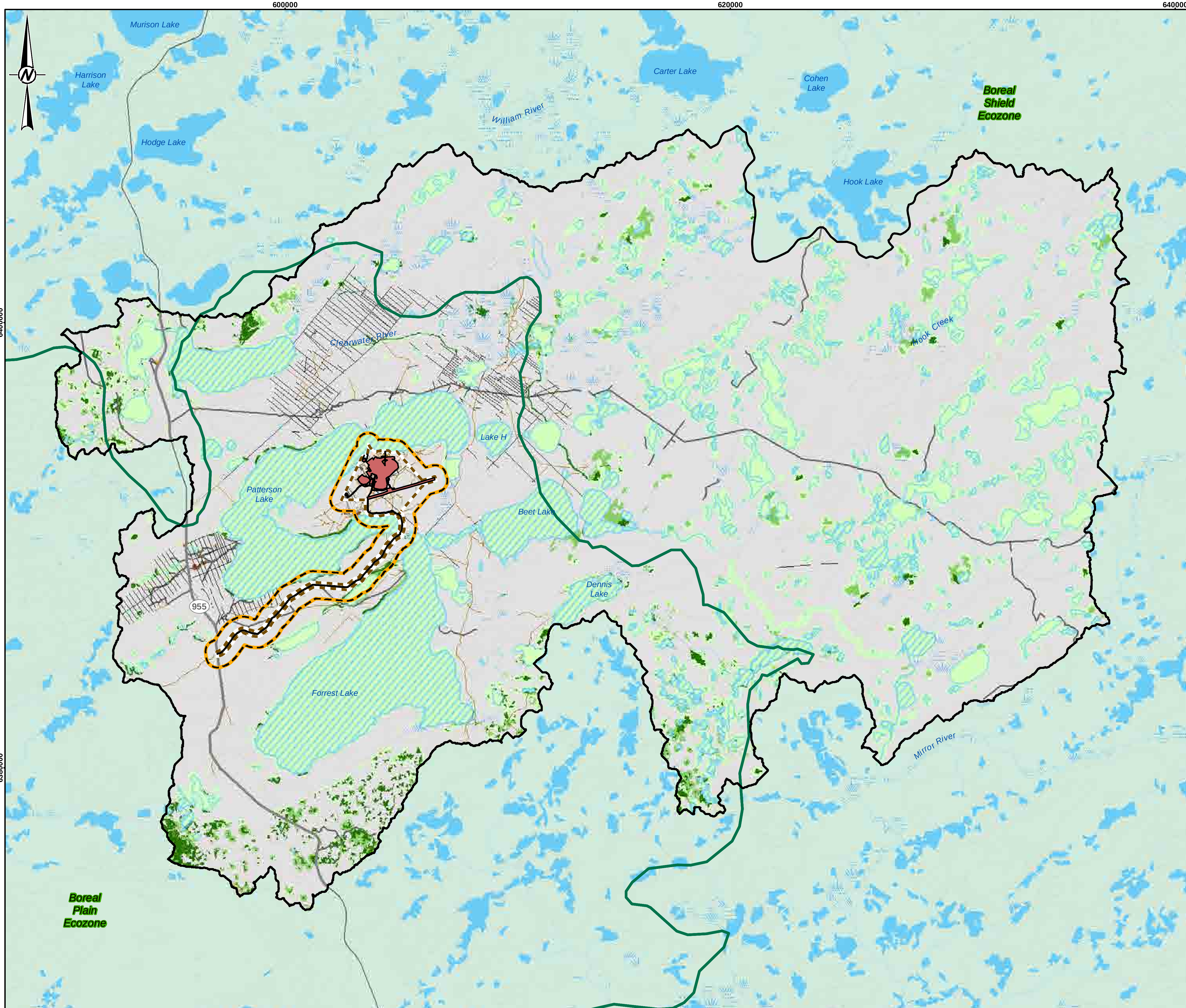

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
BEAVER LODGE HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-21	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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14.5.5.1.3 Survival and Reproduction

Changes to beaver survival, reproduction, and abundance because of alterations to the amount, quality, distribution, and connectivity of habitats are expected to be small and reversible because:

- There is limited disturbance to high suitability habitat in the LSA and RSA.
- Beavers are relatively tolerant of sensory disturbance associated with human and infrastructure presence.
- Changes to the local and regional distribution of habitats would be small and highly localized.
- Beaver habitat should remain well connected in the Application Case, and no measurable alterations to beaver movement patterns are predicted.

Loss of suitable available habitat (36.2 ha) represents about 4 home ranges for beavers in the boreal region, which have an average summer home range of 10.3 ha (Section 14.3.5.2, Habitat Distribution). Loss of high suitability (7.4 ha) habitat represents about on beaver home range. Further, habitat is not considered limiting for beavers as they can exploit different types of landscapes by modifying the environment. Specifically, beavers can build dams to increase the suitability of their habitats. Habitat loss is unlikely to have a measurable effect on the beaver population in the RSA (probability of effect is not expected but is not impossible).

14.5.5.2 Reasonably Foreseeable Development Case

14.5.5.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable beaver habitat. This reduction includes the removal of 21.6 ha (1.4%) of high suitability habitat, 2.9 ha (0.2%) of moderate suitability habitat, and 179.1 ha (0.6%) of low suitability habitat in the RSA (Table 14.5-18). Together, these represent a total loss of 203.6 ha (0.6%) of suitable beaver habitat in the RSA. The predicted habitat losses are reflected by a corresponding increase in the amount of poor suitability habitat (Table 14.5-18). As described for the Application Case, indirect loss of beaver habitat from sensory disturbance is not expected. The Project contribution to future habitat loss is 7.4 ha (Table 14.5-17), representing 30.2% of the quantified cumulative effect. Overall, approximately 33,000 ha of suitable beaver would remain in the RSA in RFD Case.

Cumulative effects of direct habitat loss in the RFD Case are expected to be continuous, confined to the maximum disturbance areas, and reversible for most upland habitats. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Nonetheless, effects from changes in the availability of wetland habitat and to upland habitat affected by permanent features would be conservatively assumed to be irreversible.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 6 to 20 years when reclaimed upland habitat is expected to provide forage for beaver (i.e., early-stage upland ecosites; Section 14.5.5.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 35 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Table 14.5-18: Changes to Beaver Lodge Habitat Availability in the Regional Study Area for the Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	1,529.3	1,507.7	-21.6	-1.4
Moderate	1,583.8	1,580.9	-2.9	-0.2
Low	30,285.8	30,106.7	-179.1	-0.6
Poor	74,091.9	74,295.5	203.6	0.3

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

Climate Change

Climate change is expected to alter the local climate and vegetation as described in Section 14.2.5 and may alter the processes that influence the availability and quality of beaver habitat, with effects likely occurring beyond the RSA (i.e., beyond regional geographic extent). The replacement of coniferous-dominated forests with more deciduous-dominated forest stands could lead to an increase in habitat suitability for beaver under projected temperature and precipitation scenarios but is also dependent on the future fire regime. An increase in the frequency and intensity of wildfires could reduce the quantity and quality of available lodge construction material (i.e., logs), at least over the short to medium term (Hood et al. 2007). Conversely, fires tend to renew beaver foraging habitat, which would increase the availability of suitable food sources (e.g., willow and aspen) five to 30 years post-wildfire (Thompson 1988; Boulanger et al. 2017).

Beavers could be negatively and positively affected by climate-induced changes depending on how wetland cover on the landscape is affected under climate change conditions; however, the magnitude of changes to wetland ecosystem availability due to climate change are uncertain (Section 14.2.5). Shifts in the size or occurrence of wetlands on the landscape and altered vegetation composition in wetlands (Cerezke 2009) could negatively affect the amount and quality of these habitats for beaver. Patterson Lake water surface elevations are expected to rise under a climate change scenario relative to the Base Case (Section 9.4.1). This projection suggests that suitable habitat associated with Patterson Lake in the Base Case is unlikely to decline. It was conservatively assumed that climate change would contribute to a negative cumulative effect on habitat availability for beaver.

14.5.5.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

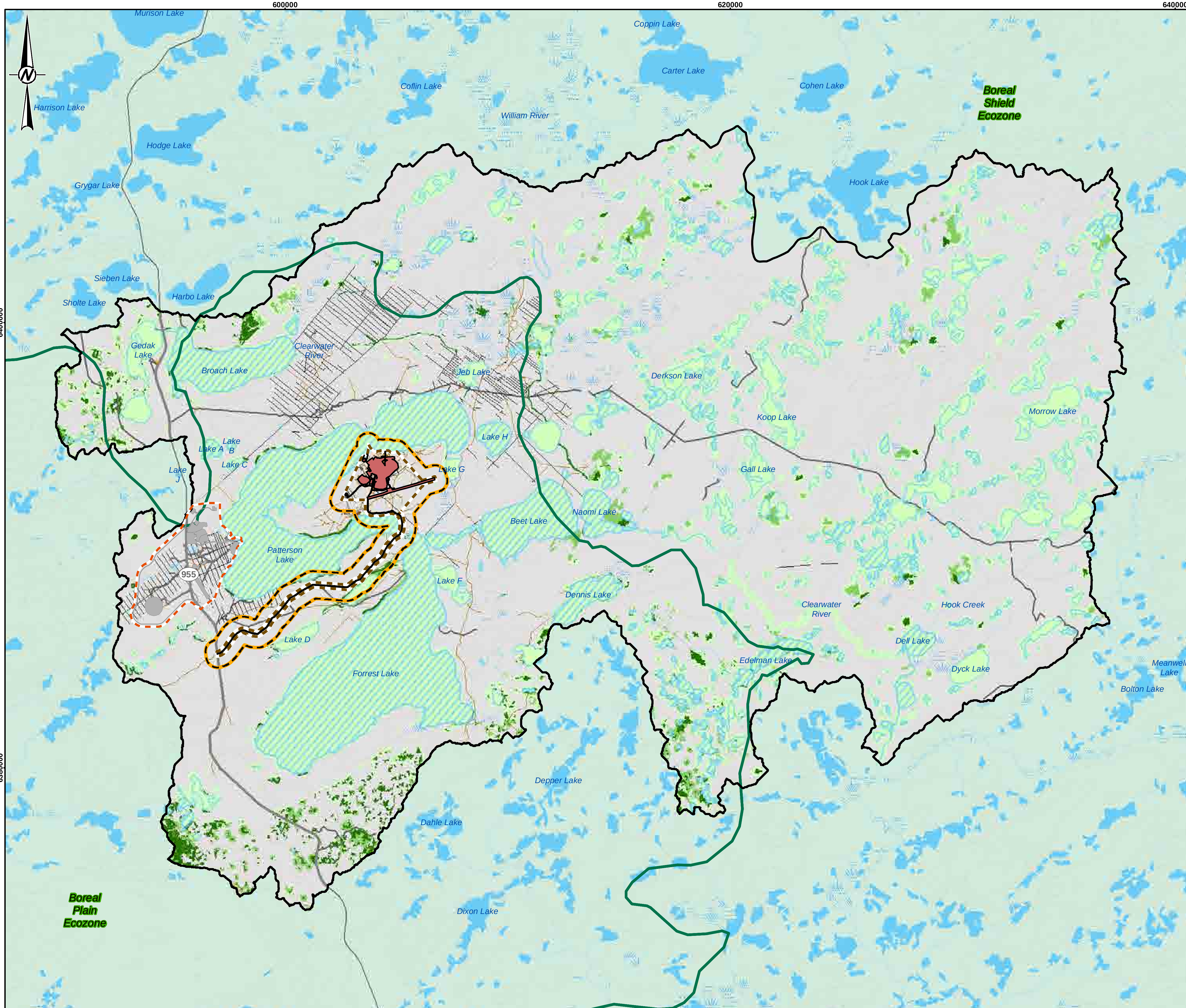
The Project and the Fission Patterson Lake South Property would alter suitable beaver habitat in the following areas of the RSA (Figure 14.5-22):

- Small areas of open water and adjacent upland along the creek connecting Patterson Lake and Forrest Lake, and along part of the shore of Patterson Lake; and
- Small patches of high and moderate suitability habitat near the western boundary of the RSA, resulting from the Fission Patterson Lake South Property.

The distribution of suitable beaver habitat in the RSA remains largely unchanged as a result of the Project and the Fission Patterson Lake South Property (Figure 14.5-22).

Climate Change

Climate change may alter the processes that influence the distribution and connectivity of beaver habitat within and beyond the RSA. Changes in the size and occurrence of wetlands could reduce habitat connectivity in the RSA by isolating smaller wetlands and lakes and shrinking the network of connected waterbodies. The magnitude of this change is uncertain because climate change predictions are highly variable. Wildfire may also contribute to changes in habitat connectivity on the landscape by temporarily changing the configuration of suitable habitat for beaver in the RSA. Applying the precautionary approach, climate change is predicted to decrease habitat connectivity in the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
BEAVER LODGE HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-22	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

14.5.5.2.3 Survival and Reproduction

Loss of available suitable habitat (203.6 ha) is approximately 20 beaver home ranges for individuals in the boreal region (i.e., 10 ha). However, most of the change in habitat is associated with low suitability habitat (179.1 ha). Loss of high and moderate suitability habitat represents two to three beaver home ranges. The magnitude of change in beaver survival and reproduction would depend on whether or not the habitat removed is occupied. Beavers are relatively adaptable in their selection of home ranges and can occur in human-modified habitats (Mumma et al. 2018; Scrafford et al. 2020). As a result, the combined loss of habitat from the Project and Fission Patterson Lake South Property may possibly influence survival and reproduction (i.e., effects may occur but are not likely) and any changes in abundance and distribution would be limited to the area around Patterson Lake. Habitat loss in the RFD Case is not expected to have a measurable demographic effect on the beaver population; approximately 33,000 ha of suitable habitat would remain well connected in the RSA. Effects on beaver abundance, survival, and reproduction due to direct habitat loss in the RFD Case would be continuous, but reversible following Closure.

Climate Change

Further habitat loss and changes in connectivity may occur as a result of climate change, as described in Section 14.5.5.2.1, Habitat Availability, and Section 14.5.5.2.2, Habitat Distribution. Increased frequency and intensity of forest fires is likely to have a negative effect on beaver abundance and distribution. For example, research in Alberta has demonstrated that repeated burning decreased beaver lodge occupancy and reduced the number of active colonies (Hood et al. 2007). Climate change could also change beaver survival rates if predator-prey relationships change in the region (e.g., decrease in abundance of moose and increase in predation on beaver by wolves). It is uncertain how much and in which direction wolf diet and prey base would shift due to low confidence in the magnitude and type of changes. Any changes to beaver abundance related to climate change are considered irreversible.

Mean annual stream flow and discharge is expected to increase for watercourses in the RSA under a climate change scenario (Section 9.4, Climate Change Scenario). While increases in mean annual daily flow are expected to be minor, with modelled increases ranging from 2.8% to 8.7% at various measurement nodes along the Clearwater River, elevated discharge and stream flow could discourage beavers from occupying these riparian areas as the species typically avoids watercourses or streams of higher flows that are more likely to repeatedly breach the dams that the animals construct (Dittbrenner et al. 2018). Given the modest increase in stream flow anticipated under a climate change scenario in the RSA, it is unlikely that these changes in hydrology conditions would lead to measurable avoidance by beaver (i.e., reduced abundance) along the watercourses present. Overall, the effects from climate change were assumed to have a small but measurable effect on the abundance and distribution of beaver in the RSA.

14.5.5.3 Residual Effects Classification and Determination of Significance

14.5.5.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of effective mitigation (Table 14.5-19). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on beaver. Following the summary of residual effects, significance of residual effects for the Application Case and the RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-19: Classification of Residual Effects on Beaver Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 7.4 ha removal of high suitability habitat, representing a 0.5% reduction in the RSA (i.e., low magnitude) ▪ 0.0 ha removal of moderate suitability habitat ▪ 28.1 ha removal of low suitability habitat, representing a 0.1% reduction in the RSA (i.e., low magnitude ▪ Small avoidance of habitat from sensory disturbance during high activity periods	▪ 21.6 ha removal of high suitability habitat representing a 1.4% reduction in the RSA (i.e., low magnitude) ▪ 2.9 ha removal of moderate suitability habitat representing a 0.2% reduction in the RSA (i.e., low magnitude) ▪ 179.1 ha removal of moderate suitability habitat representing a 0.6% reduction in the RSA (i.e., low magnitude) ▪ Small avoidance of habitat from sensory disturbance during high activity periods (i.e., occurs during period of overlap between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (i.e., well within the LSA)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 39 to 73 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-20 years to establish suitable foraging habitat and at least 40 years to establish mature forest (trees for lodges and dams) ▪ Short-term (sensory disturbance): restricted to Construction and the Active Closure Stage	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 35 years for functional forage habitat, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Short-term (sensory disturbance): restricted to overlap of high activity between projects
	Reversibility	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous (direct habitat loss) ▪ Occasional (sensory disturbance)	▪ Continuous (direct habitat loss) ▪ Occasional (sensory disturbance)
	Probability of occurrence	▪ Certain (direct habitat loss) ▪ Unlikely (sensory disturbance)	▪ Probable (direct habitat loss from Project and Fission Patterson Lake South Property) ▪ Unlikely (sensory disturbance) ▪ Possible (climate change)

Table 14.5-19: Classification of Residual Effects on Beaver Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Negligible change in habitat connectivity caused by habitat loss and sensory disturbance (i.e., negligible magnitude)	▪ Landscape disturbance created by human developments would cause small measurable loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent for wetland habitats and for habitat covered by permanent features (e.g., WRSAs) ▪ Long-term (direct habitat loss): 39 to 73 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-20 years to establish suitable foraging habitat and at least 40 years to establish mature forest (trees for lodges and dams) ▪ Short-term (sensory disturbance): restricted to Construction and the Active Closure Stage)	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change ▪ Long-term (direct habitat loss): maximum of 35 years for functional forage habitat, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Short-term (sensory disturbance): restricted to overlap of high activity between projects
	Reversibility	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous (direct habitat loss) ▪ Occasional (sensory disturbance)	▪ Continuous (direct habitat loss) ▪ Occasional (sensory disturbance)
	Probability of occurrence	▪ Probable (direct habitat loss) ▪ Unlikely (sensory disturbance)	▪ Probable (direct habitat loss from Project and Fission Patterson Lake South Property) ▪ Unlikely (sensory disturbance) ▪ Possible (climate change)

Table 14.5-19: Classification of Residual Effects on Beaver Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 7.4 ha of high suitability habitat represents one beaver home range (i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ Loss of 21.6 ha of high and moderate suitability habitat represents 2 to 3 beaver home ranges (i.e., low magnitude) ▪ Small measurable change in beaver abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent for loss of wetlands and habitat covered by permanent features ▪ Long-term (direct habitat loss): 39 to 73 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-20 years to establish suitable foraging habitat and at least 40 years to establish mature forest (trees for lodges and dams) ▪ Short-term (sensory disturbance): restricted to Construction and the Active Closure Stage	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 35 years for functional forage habitat, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Short-term (sensory disturbance): restricted to overlap of high activity between projects
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; RSA = regional study area; LSA = local study area; WRSAs = waste rock storage areas.

14.5.5.3.2 Significance Determination

Habitat Availability and Distribution

In the Application Case, the Project would induce limited, localized changes to the quantity, quality, arrangement, and distribution of beaver habitat. The Project is expected to result in a loss of 7.4 ha of high suitability habitat and 28.8 ha of low suitability habitat, which represents 0.5% and 0.1% of the available high suitability and low suitability habitats in the RSA in the Base Case. Reclamation is predicted to regenerate functional habitat for beaver 6 to 20 years after the end of the Active Closure Stage. Relative to other areas of the RSA, the LSA does not contain a large quantity of high and moderate suitability habitat. In addition, baseline surveys recorded little to no recent beaver activity in the LSA suggesting that available local habitats may not currently be occupied. Given the mobility of beaver, the spatial extent and location of Project-related loss of suitable habitat are unlikely to measurably affect beaver movement within the animals' territories or during juvenile dispersal events. As a result, no measurable change to the abundance or distribution of beavers are expected in the RSA.

In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable habitat in the RSA by 203.6 ha. Habitat loss in the RFD Case is not expected to have a measurable demographic effect on the beaver population; approximately 33,000 ha of suitable habitat would remain well connected in the RSA.

The most important climate effects would be those associated with reductions in the size and occurrence of wetlands, which are important habitats for beavers because they support multiple functions for the species (i.e., suitable for lodges, foraging, and cover). Such changes to wetlands could reduce beaver habitat connectivity by shrinking the network of interconnected waterbodies and watercourses in the RSA. As a result, small changes to local and regional beaver movement patterns may occur. Lastly, the increased frequency and intensity of forest fires combined with potential effects of drought could negatively affect the abundance and distribution of beavers in the RSA as active lodges in burned areas are abandoned and the number of active colonies decrease.

The assessment also identified some potential positive effects of climate change for beavers. For example, fires regenerate beaver forage, such as willow and aspen, and are expected to play a role in altering the composition habitats in boreal. The transition from coniferous dominant stands (i.e., habitats not preferred by beavers) to mixed wood or deciduous dominant stands (i.e., preferred habitats) could be positive for beavers provided wetlands remain on the landscape. Given the level of uncertainty associated with climate change predictions, a precautionary approach was applied, and the assessment assumed that climate change effects would have predominantly negative effects on beaver in the RSA.

Survival and Reproduction

Beaver is not a federally listed or provincially tracked species, nor is it a species under consideration by COSEWIC. Under existing conditions, beaver population estimates are thought to be lower than long-term historical estimates. However, the current abundance and distribution of beaver represents a strong recovery from near extirpation in the early 1900s due to over-harvesting of the species. Beavers have recolonized most areas of their historical range, demonstrating their resiliency. They are also adaptable, making use of human modified landscapes and structures such as culverts and borrow pits. Further, they can engineer their environments by building dams to increase the suitability of habitat in their territory. The available information suggests that beavers in the RSA are self-sustaining and ecologically effective in the Base Case.

Other Project-wildlife interactions, such as increased access for people and predators, and higher risk of injury/mortality from wildlife-vehicle collisions and attracting animals to site, were determined to have negligible effects on the beaver population (Section 14.4.2). The Project would not increase access for humans and predators as an access road to the site already exists and upgrades to the access road for the Project are expected to result in no measurable change to existing access for hunting/trapping. Several trails also exist on the Fission Patterson Lake South Property, and increased access to harvest beavers is not anticipated. Implementation of mitigation measures at the Project including staff, contractor, and visitor orientations; giving wildlife the right of way; identification of wildlife crossings; gaps in road berms and snowbanks; and speed limit adjustments are expected to result in a minor increase in injury or mortality to individual animals from vehicle-wildlife collisions. It is expected that similar mitigation policies and practices would be implemented at the Fission Patterson Lake South Property to avoid and limit potential adverse cumulative effects on beaver. As such, the combined effects of these pathways are predicted to not significantly influence the abundance and distribution of the beaver population overlapping the RSA.

Summary of Significance Determination

Based on several lines of evidence the incremental and cumulative effects from the Project, other previous and existing developments and activities, and the Fission Patterson Lake South Property on beaver are predicted to be not significant. In the Application Case and RFD Case, changes in habitat availability, habitat distribution, and survival and reproduction from planned developments are unlikely to affect the ability of beaver to remain self-sustaining and ecologically effective. The effects related to climate change are uncertain and could have either positive or adverse influences on beaver in the RSA. However, climate change is not expected to significantly influence the abundance and distribution of beaver and does not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.6 Little Brown Myotis

14.5.6.1 Application Case

The residual effects analysis for little brown myotis focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of little brown myotis habitat and affect myotis abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect little brown myotis habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise, and vibrations) can alter little brown myotis movement and behaviour and adversely affect little brown myotis habitat availability and little brown myotis abundance and distribution.

14.5.6.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Vegetation removal and site clearing during Construction could result in a loss of potential summer roosting habitat for little brown myotis. Damage to or removal of trees on the landscape, particularly in mature forest stands where roosting is most likely to occur, could remove habitat for little brown myotis or other bat species. In the LSA and RSA, deciduous trees such as trembling aspen and birch are the primary species that provide sufficiently large cavities required by females with pre-volant young (Appendix 14B). Once habitat is removed, the effect of this loss would be experienced continuously until functional habitat is reclaimed. In affected habitats of the LSA, the functionality of potential foraging and roosting habitat would be lost or degraded as a result of the Project. Bats occupying these habitats in the LSA would be displaced from the area and shift their home ranges in the RSA.

Project buildings have the potential to provide roosting habitat for little brown myotis. Potential for bat roosting was not assessed for the current level of building design.

Given the low potential for hibernacula in the LSA as described in Section 14.3.6.1, Habitat Availability, the Project would not likely remove hibernacula.

The Project is expected to result in a loss of less than 0.1 ha of moderate suitability little brown myotis roosting habitat, representing less than 0.1% of this habitat in the RSA (Table 14.5-20). Most of the habitat loss would occur in low suitability roosting habitat, which is common in RSA. Loss of low suitability habitat is estimated at 114.7 ha, representing 0.5% of its availability in the RSA (Table 14.5-20). Approximately, 22,000 ha of suitable roosting habitat would remain in the RSA. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure. Although the Project footprint and sensory disturbance would mainly affect low suitability habitat, baseline surveys confirm that bats occupy the LSA; therefore, these habitats are assumed to support bat use during the non-hibernating period.

Table 14.5-20: Changes to Little Brown Myotis Roosting Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	127.8	127.8	0.0	0.0
Moderate	989.5	989.5	< -0.1	< -0.1
Low	21,080.7	20,966.0	-114.7	-0.5
Poor	85,292.7	85,407.5	114.7	0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the terrestrial ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1.1). The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Mature forest that includes potential roosting trees would take time to regenerate. Functional little brown myotis roosting habitat is expected to become available 60 to 80 years beyond the Active Closure Stage, based on the age of mature ELC units characterized under existing conditions (Section 13.3.1.3); this may take longer for development of late seral forest (i.e., more than 120 years) depending on soil productivity and climate change.

Sensory Disturbance

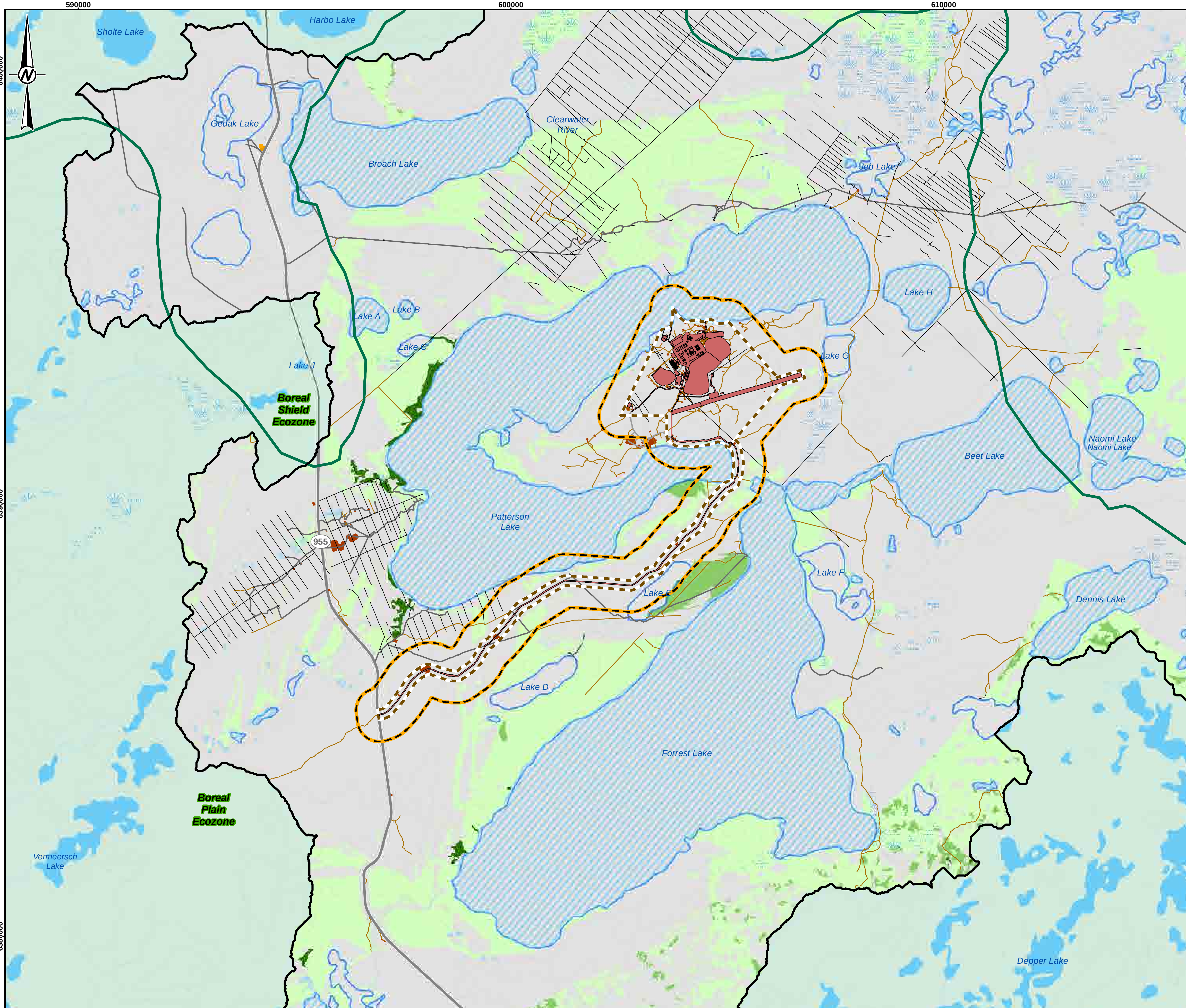
Sensory disturbance associated with site preparation or operations could lead to site abandonment and indirect losses of bat roosting or foraging habitat (Appendix 14B). Bats may avoid some areas of higher disturbance by up to 100 m (Luo et al. 2014). Subsequently, bats are expected to reduce their use or avoid using habitats within 100 m of the Project. Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment use, blasting, and general mine activity would be highest. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a precautionary approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., a duration of 48 years).

14.5.6.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

The loss of less than 114.7 ha of suitable roosting habitat from the Project is predicted to in a small change in the habitat distribution and connectivity within the LSA (Figure 14.5-23). The narrow strip of low suitability habitat west of Lake G would be lost along with the small patches of low suitability along the shore of Patterson Lake at the north end of the maximum disturbance area. These patches of low suitability habitat were quite isolated under existing conditions (Section 14.3.6.2, Habitat Distribution). The Project is predicted to have no to little influence on habitat distribution and connectivity in and the RSA (Figure 14.5-24). Small patches of high suitability habitat and large patches of low suitability roosting habitat would remain intact and connected within the RSA (i.e., poor suitability burned habitat is expected to provide connectivity to suitable roosting habitat; Section 14.3.6.2). Suitable habitats that are within 100 m of human developments with high levels of activity were assigned a suitability rank of poor based on scientific literature and as a precautionary approach (Appendix 14B).

To avoid areas of sensory disturbance, little brown myotis may alter movement patterns in the LSA by flying around the maximum disturbance area as opposed to flying through it. For example, bats may travel around the area of concentrated Project infrastructure (i.e., mill terrace, mine terrace, airstrip, WRSAs). Project activities are expected to result in small changes to foraging movements within the LSA, particularly during periods of high levels of activity (i.e., Construction and the Active Closure Stage), but should not constrain seasonal migratory movements from hibernation habitat to summer roosting habitat in the RSA or beyond the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

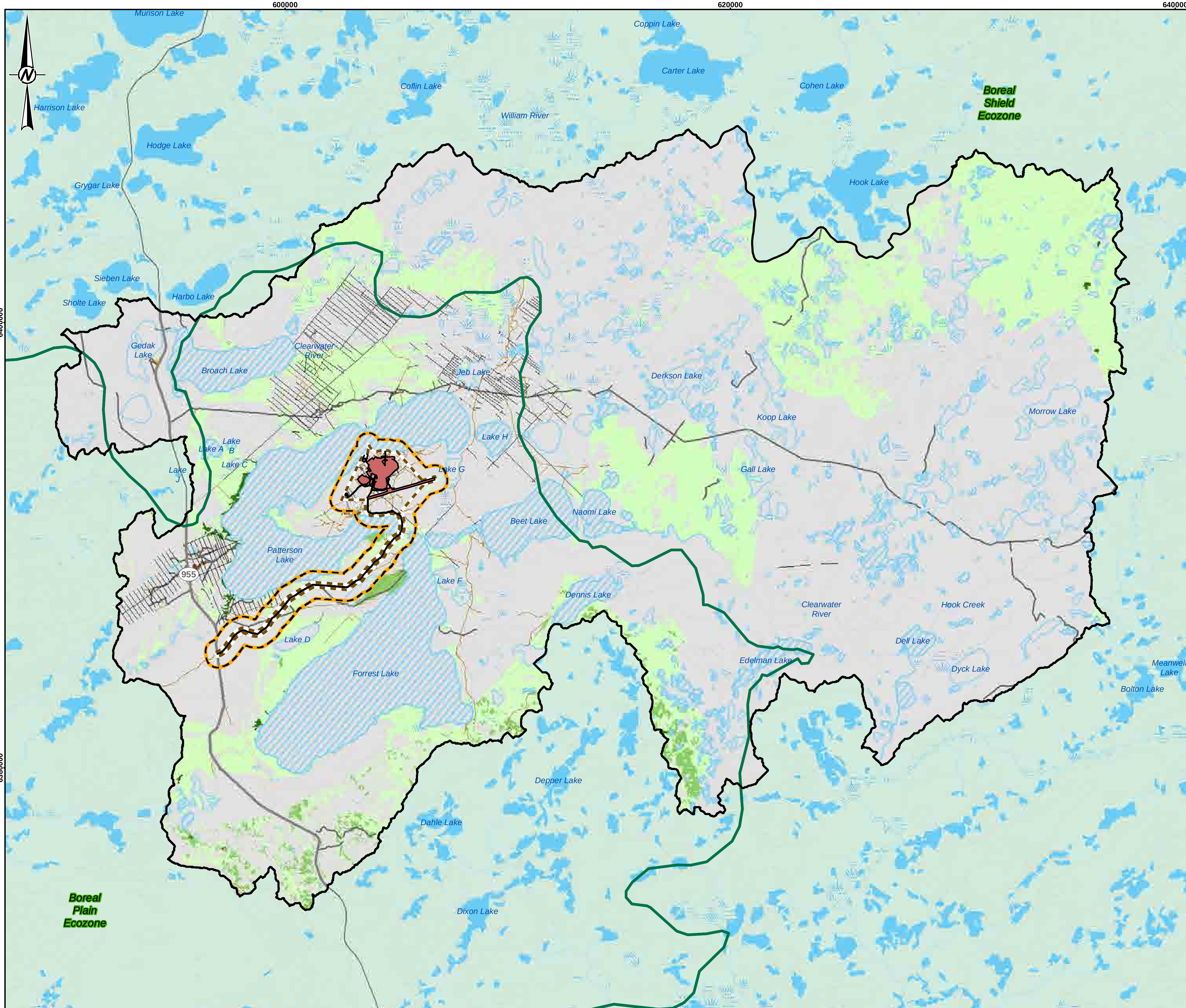
TITLE

LITTLE BROWN MYOTIS ROOSTING HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT	20144150		PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-23**	
REVIEW	JV	2023-02-09		



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)	**DISTURBANCE CLASS**
WATERCOURSE	ACCESS ROAD
OPEN WATER (WITHIN THE RSA)	CUTLINE/SEISMIC
WATERBODY (WITHIN THE RSA)	SECONDARY HIGHWAY
WATERBODY (OUTSIDE OF RSA)	ROUGH ROAD
WETLAND	TRAIL
WOODED AREA	NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
ECOZONE BOUNDARY	OIL AND GAS DEVELOPMENT
LOCAL STUDY AREA	**HABITAT SUITABILITY INDEX**
REGIONAL STUDY AREA	HIGH
PROPOSED PROJECT FOOTPRINT	MODERATE
MAXIMUM DISTURBANCE AREA	LOW
	POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

LITTLE BROWN MYOTIS ROOSTING HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT	20144150		PHASE 3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN REV. 0
GIS	VMB	2023-02-09	
CHECK	SM	2023-02-09	**FIGURE 14.5-24**
REVIEW	JV	2023-02-09	

Linear Features

The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. Most of the existing trails in the Project footprint would be upgraded for site roads and haul roads within the maximum disturbance area. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-24). The Project would not change the density of linear features in the LSA and RSA. Bats that forage in open air space, such as little brown myotis, appear to be less sensitive to barrier effects; therefore, linear features may act for commuting and forage for little brown myotis (Section 14.3.6.2).

In the Base Case, Highway 955 is predicted to have a potential negative influence on little brown myotis movement, particularly during periods of high traffic volume (Section 14.3.6.2). The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to relative to existing conditions (Section 14.4.2). This increase in vehicle traffic could have minor incremental effects on the movement of little brown myotis that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect).

Relative to the Base Case, the Project is predicted to have a small and localized effect on little brown myotis movements and distribution. Effects from changes to little brown myotis habitat distribution would be continuous and occur from Construction to beyond the Active Closure Stage until functional habitat is regenerated on reclaimed areas and sensory disturbance is no longer expected to influence little brown myotis behaviour (Section 14.5.6.1.1, Habitat Availability).

14.5.6.1.3 Survival and Reproduction

Home Range

Change in habitat availability is expected to be the primary Project-related effect that would influence the survival and reproduction of little brown myotis in the LSA and RSA. The calculated losses of little brown myotis habitat in the RSA represent less than 0.5% of available suitable roosting habitat in the Base Case. The loss of less than 0.1 ha of moderate suitability habitat represents less than 1% of the estimated home range of little brown myotis (17 ha to 65 ha; Section 14.3.6.3, Survival and Reproduction). The loss of 114.7 ha of low suitability habitat represents 2 to 7 home ranges. A single home range can include several individuals. Applying a precautionary approach to address uncertainty, the Project has the potential to displace several individuals from the LSA, which could lead to a small decline in the local abundance of little brown myotis. Habitat loss is not expected to have a measurable demographic effect on the little brown myotis population; approximately 22,000 ha of suitable habitat would remain connected in the RSA.

Vital Rates

As discussed in Section 14.3.6.3, sensory disturbance could result in reduced survival from stress, increased energy use, and reduced foraging success in the LSA. However, as described in Section 14.5.6.1.2, Habitat Distribution, the Project is expected to cause minimal disruption to local bat movement patterns, which would be unlikely to influence on survival and reproduction (i.e., effect is not expected but not impossible).

Lights may also cause bats to desert a roost if the roost entry point is illuminated (BCT 2008). This type of disruption could negatively influence little brown myotis abundance and is more likely to occur around Project facilities than along the access road. However, mitigation outlined in Section 14.4 and Table 14.4-1 would minimize the risk of roost abandonment in proximity to infrastructure. Further, no high suitability habitat and limited moderate suitability habitat is found within the LSA, suggesting that Project lighting would be unlikely to affect survival and reproduction.

Disease

The Project would not be expected to increase the risk of introducing or spreading WNS in the RSA.

14.5.6.2 Reasonably Foreseeable Development Case

14.5.6.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable roosting habitat for little brown myotis. This loss includes the removal of 27.1 ha (21.2%) of high suitability habitat, less than 0.1 ha (less than 0.1%) of moderate suitability habitat, and 313.2 ha (1.5%) of low suitability habitat in the RSA (Table 14.5-21). Together, these represent a total loss of 340.4 ha (1.5%) of suitable little brown myotis roosting habitat in the RSA relative to the Base Case (i.e., regional geographic extent). The loss of high suitability habitat would all be attributable to the Fission Patterson Lake South Property as no high suitability habitat loss would be due to the Project. Overall, 21,858 ha of suitable roosting habitat would remain in the RSA. The cumulative effects from the decrease in habitat availability would be continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Loss of habitat covered by permanent features and wetlands would be irreversible.

Table 14.5-21: Changes to Little Brown Myotis Roosting Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	127.8	100.7	-27.1	-21.2
Moderate	989.5	989.5	< -0.1	< -0.1
Low	21,080.7	20,767.5	-313.2	-1.5
Poor	85,292.7	85,633.1	340.4	0.4

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = Reasonably Foreseeable Development; < = less than.

Project buildings have the potential to provide roosting habitat for little brown myotis; however, the extent of potential habitat in buildings is unknown and was not considered in the assessment of availability of habitat for the RFD Case.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 60 to 80 years for little brown myotis habitat to be regenerated (i.e., mature upland ecosites; Section 14.5.6.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property completely overlaps habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 95 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

Similar to the Application Case, indirect loss of little brown myotis habitat from sensory disturbance may occur in foraging and roosting habitats when human activities that generate noise and lights are present. The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

The projected climate change effects are summarized in Section 14.2.5. Future climate changes could reduce wetland (forage) habitat availability in the RSA and increase the amount of suitable roosting habitat if climate-induced weather and fire disturbance patterns change as expected. Reductions in the size and occurrence of wetlands may decrease forage habitat for little brown myotis. As climate-induced fire frequency increases, the replacement of coniferous-dominated forest with mixed-wood or deciduous forest stands may benefit little brown myotis because the species prefers mature forest stands dominated by deciduous species (Psyllakis and Brigham 2006; Willis et al. 2006; Park and Broders 2012; Environment Canada 2018). However, forests within the RSA may be resilient to fire, particularly with respect to jack pine stands, as self-replacement is the most common post-fire trajectory (Hart et al. 2019).

The direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. There is also a high degree of uncertainty regarding the potential effects of climate change because predictions are based on simulations that can be highly variable. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale. It was conservatively assumed that climate change would contribute to a negative cumulative effect on habitat availability for little brown myotis.

14.5.6.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

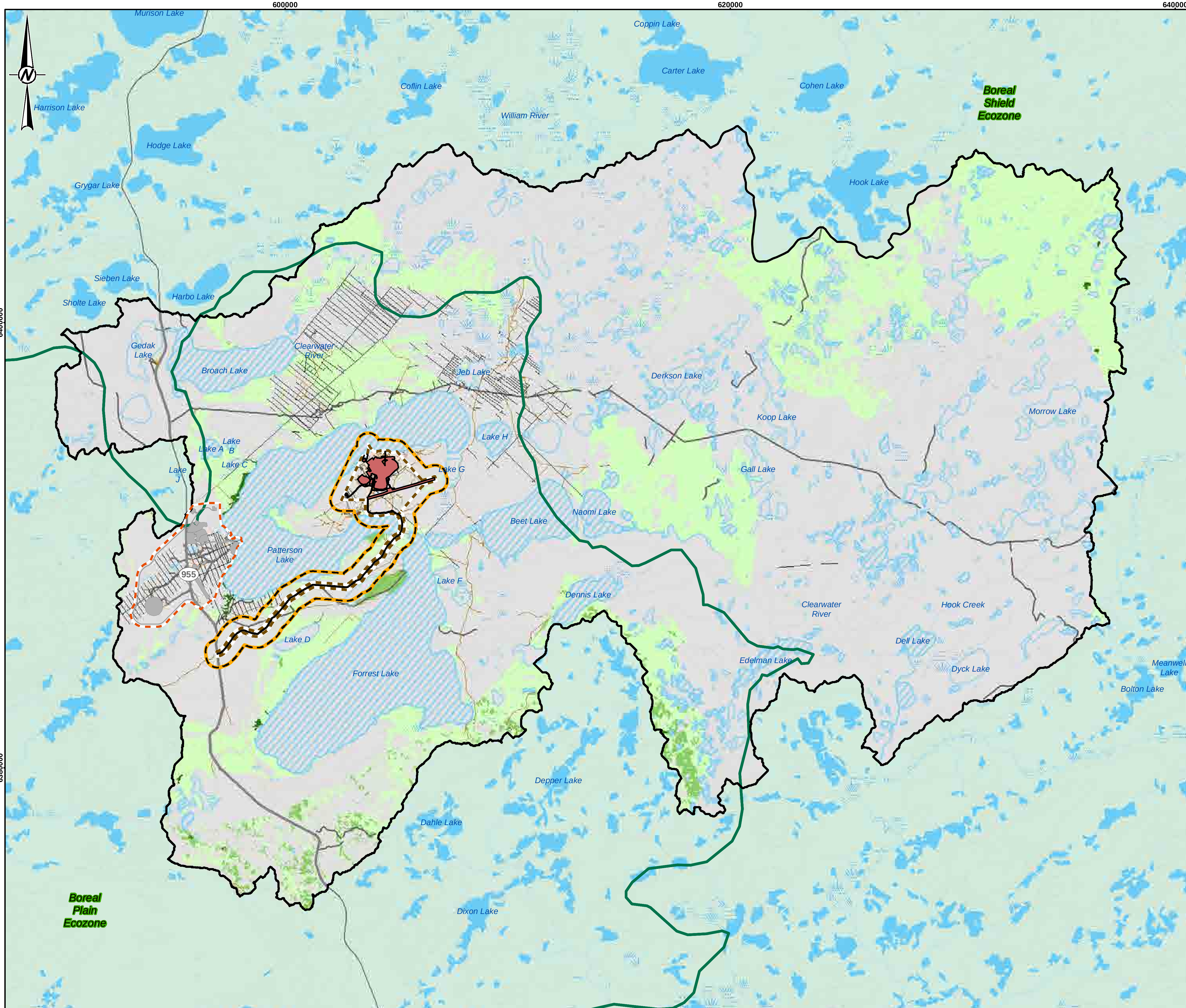
Addition of the Fission Patterson Lake South Property would result primarily in a reduction of high and low suitability little brown myotis habitat (Figure 14.5-25). The distribution of low and moderate suitability habitat would remain largely unchanged as a result of the Project and the Fission Patterson Lake South Property.

Linear Features

The Fission Patterson Lake South Property is expected to incrementally increase the number of vehicles on Highway 955 relative to the Application Case, which could further reduce the movement of little brown myotis that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Limitations to movement would be limited to the western portion of the RSA and reversible after project infrastructures are removed and traffic levels reduced after the closure of both projects.

Climate Change

As with habitat availability, further alterations in the arrangement and connectivity of roosting habitat in the RSA could result from climate-induced effects, but the magnitude and location of these potential effects are difficult to predict. An increase in the intensity and frequency of wildfires could alter the distribution of mature forest habitat patches, which could change where suitable habitat occurs throughout the RSA. Little brown myotis may have to adjust movement between habitat patches if climate change alters the configuration of suitable roosting habitats and foraging habitats within existing home ranges.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

LITTLE BROWN MYOTIS ROOSTING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-25**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

14.5.6.2.3 Survival and Reproduction

Home Range

The cumulative loss of potential suitable habitat in the RFD Case may affect survival and reproductive success if individuals are displaced into poor quality habitat or if large amounts of suitable habitat is removed. Using the approach in Section 14.5.6.1.3, Survival and Reproduction, the loss of less than 27.1 ha of high and moderate suitability habitat represents approximately less than one to two home ranges of little brown myotis. The loss of 313.2 ha of low suitability habitat represents five to 18 home ranges. A single home range can include several individuals. The magnitude of change in little brown myotis survival and reproduction would depend on whether or not the low suitability habitat removed is occupied. The combined loss of habitat from the Project and Fission Patterson Lake South Property may possibly influence survival and reproduction (i.e., effects may occur but are not likely) and any changes in abundance and distribution would be limited to the area around Patterson Lake. Habitat loss in the RFD Case is not expected to have a measurable demographic effect on the little brown myotis population as almost 22,000 ha of suitable habitat would remain connected in the RSA.

Vital Rates

Cumulative developments occurring in the RSA could increase flight times and stress from noise and lights in close proximity to the developments, which could incrementally reduce survival or reproduction in addition to direct habitat loss in the RSA. However, these changes would still not be expected to have a measurable demographic effect on the population (i.e., effect may occur but is unlikely [possible]). Cumulative habitat loss due to sensory disturbance in the RFD Case should be reversible five years after closure of one of the projects or when there is no temporal overlap between projects.

Disease

The Project and the Fission Patterson Lake South Property would not be expected to increase the risk of introducing or spreading WNS in the RSA.

Climate Change

Further habitat loss and changes in connectivity may occur as a result of climate change, as described in Section 14.5.6.2.1, Habitat Availability, and Section 14.5.6.2.2, Habitat Distribution. Increased frequency and intensity of forest fires is likely to have a negative effect on bat occupancy in recently burned habitats. Forest fires could also result in the mortality of juvenile bats if maternity roosts are affected before the young become mobile.

Climate change is expected to alter the levels and timing of precipitation, which could have adverse effects on the insect populations that little brown myotis rely on as prey. The timing of peak abundances for some insects has shifted to occur earlier in the year as a result of climate change and this timing is expected to continue to shift in the future (Both et al. 2009). Reduced insect abundance is one possible outcome of climate change, which could limit survival of reproductive females and pups if they are unable to accumulate sufficient winter fat stores for overwinter survival (Kunz et al. 1998; Both et al. 2009). Little brown myotis are highly sensitive to changes in adult mortality, particularly because they are long lived, produce few offspring (i.e., typically one per year), and females likely have lower reproductive rates at higher latitudes (COSEWIC 2013). Reduced survival among females could have negative consequences for the viability of the regional population.

It is unclear how climate change may affect the spread of WNS in the boreal portions of Canada and whether winter temperatures would remain low enough to limit its sustained presence in bat populations (Layng et al. 2019). As discussed in previous subsections, there is a high degree of uncertainty in the magnitude and extent to which the climate would influence conditions in the RSA during the lifespan of the Project.

14.5.6.3 Residual Effects Classification and Determination of Significance

14.5.6.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of effective mitigation (Table 14.5-22). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1), and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on little brown myotis. Following the summary of residual effects, significance of residual effects for the Application Case and the RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-22: Classification of Residual Effects on Little Brown Myotis Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 0 ha removal of high suitability roosting habitat ▪ Less than 0.1 ha removal of moderate suitability roosting habitat, representing <0.1% reduction in the RSA (i.e., low magnitude) ▪ 114.7 ha removal of low suitability roosting habitat, representing a 0.5% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 27.1 ha removal of high suitability roosting habitat, representing a 21.2% reduction in the RSA (i.e., moderate magnitude) ▪ Less than 0.1 ha removal of moderate suitability roosting habitat, representing <0.1% reduction in the RSA (i.e., low magnitude) ▪ 313.2 ha removal of low suitability roosting habitat, representing a 1.5% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (i.e., up to 100 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [includes 100 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 60-80 years to establish mature ecosites ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous

Table 14.5-22: Classification of Residual Effects on Little Brown Myotis Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small changes to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 60-80 years to establish mature ecosites ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features, wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Less than 0.1 ha of moderate suitability habitat represents less than one little brown myotis home range (i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 27.1 ha of high and moderate suitability habitat represents 1 to 2 home ranges (i.e., low magnitude) ▪ Small measurable change in little brown myotis abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 60-80 years to establish mature ecosites ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous

Table 14.5-22: Classification of Residual Effects on Little Brown Myotis Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Survival and reproduction	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; LSA = local study area; RSA = regional study area; WRSAs = waste rock storage areas; < = less than.

14.5.6.3.2 Significance Determination

Habitat Availability and Distribution

Existing disturbances in the RSA are predicted to have little influence on little brown myotis movement and habitat connectivity, except Highway 955 and the access road for the proposed Project during periods of high traffic volume. Although roosting habitat is limited in the RSA due to fire disturbance, foraging habitat is abundant and well connected, and WNS is presently not detected. Bats are relatively resilient and adaptable, making use of anthropogenic features such as abandoned mines, buildings, and bridges as hibernacula and roosting sites. Further, bats often forage near edge habitats (i.e., more open areas adjacent to forest), including in areas next to anthropogenic disturbance provided that sensory disturbances are not too intense. The little brown myotis population that overlaps the RSA is considered self-sustaining and ecologically effective in the Base Case.

In the Application Case, the Project is expected to result in a loss of less than 0.1 ha of moderate suitability little brown myotis roosting habitat, representing less than 0.1% of this habitat in the RSA. Most of the habitat loss would occur in low suitability roosting habitat (i.e., 114.7 ha, 0.5% of this habitat's availability in the RSA). Functional roosting habitat for little brown myotis is predicted to become available 60 to 80 years after the end of the Active Closure Stage. The change in habitat availability would likely induce a small residual effect for little brown myotis, as little brown myotis are not habitat specialists and have been documented in a wide variety of coniferous and deciduous forest types (COSEWIC 2013). Moreover, little brown myotis are well adapted to anthropogenic disturbance and use buildings, bat houses, and bridges for maternity roosts, which indicates that they have resilience to changes in natural (i.e., treed) summer habitat. Project-related declines in habitat availability are expected to be within the limits for resilience and adaptability of the species.

The Project is not expected to change the density of linear features in the RSA as it would be in an area with an existing aggregation of roads, trails, and seismic lines / cutlines. The Project is expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could affect the movement of little brown myotis within and outside the western portion of the RSA. However, bats should still be able to move through the landscape to access habitat patches in other portions of the RSA and beyond. To avoid areas of inhospitable land cover (i.e., open habitat) and sensory disturbance, little brown myotis may alter movement patterns in the LSA by flying around the maximum disturbance area as opposed to flying through it. Little brown myotis are expected to be somewhat resilient to changes in habitat distribution because of their high mobility.

In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of moderate and high suitability habitat in the RSA by 2.4%, which represents less than two home ranges. The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and the distribution of high and moderate suitability habitat in the RSA would remain largely unchanged with the exception of a loss of 21.2% (27.1 ha) of high suitability habitat due to the Fission Patterson Lake South Property. Cumulative effects from the two projects are likely but uncertain given that the Fission Patterson Lake South Property has recently entered the formal regulatory process.

The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could further reduce the movement of little brown myotis that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Changes to the abundance and distribution of little brown myotis around Patterson Lake from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted in the RFD Case. However, little brown myotis have high mobility and can accommodate moderate to high levels of anthropogenic disturbance. Therefore, cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species resilience and adaptability limits.

Climate change is projected to decrease wetlands and increase forest fires in the boreal region, which could lead to a decrease in wetland forage habitat and increase suitable roosting habitat for little brown myotis through the replacement of coniferous-dominated forest with mixed-wood and deciduous forest stands. The effects of habitat loss caused by development or climate change are expected to act over long time periods considering the time required for mature forest cover to develop from restored upland habitat types. Climate change effects would be beyond regional, but the direction and magnitude of changes is uncertain given the variability in climate model projections. Currently, with no WNS in the RSA, little brown myotis is predicted to adapt to climate and development-related influences on habitat availability and distribution and remain self-sustaining and ecologically effective in the RFD Case.

Survival and Reproduction

Little brown myotis is a provincially tracked, secure species (SKCDC 2021) and is listed as Endangered under Schedule 1 of the federal SARA (Government of Canada 2023). The species' listing under SARA is due to dramatic population declines caused by WNS, which presently does not affect the population of little brown myotis in the RSA but is the main limiting factor for the species.

Neither the Project nor the Project combined with the Fission Patterson Lake South Property are expected to have measurable effects on little brown myotis survival and reproduction. Incremental and cumulative changes to habitat availability, habitat distribution, and survival and reproduction from the Project and the Fission Patterson Lake South Property are expected to remain within the resilience and adaptability limits of the little brown myotis populations overlapping the RSA.

The peak abundance of some insects may shift as a result of climate change, which could limit survival of reproductive females and pups. It is unclear how climate change may affect the spread of WNS in the boreal portions of Canada and if winter temperatures would remain low enough to limit its sustained presence in bat populations (Layng et al. 2019). As discussed in previous subsections, there is a high degree of uncertainty in the direction and magnitude of effects from the climate change in the RSA.

The potential future spread of WNS to the RSA could have significant adverse effects on the survival of the regional little brown myotis population. Should WNS spread to northwestern Saskatchewan and the RSA, little brown myotis is expected to rapidly exceed its limits of resilience and adaptability, independent of predicted effects from the Project or the Fission Patterson Lake South Property. In other words, a potential future spread of WNS would likely result in significant adverse effects on little brown myotis. However, under conditions where WNS does not affect the population, little brown myotis is expected to remain self-sustaining and ecologically effective in both the Application Case and RFD Case.

Summary of Significance Determination

The weight of evidence from the analysis of direct habitat loss, habitat distribution, and associated survival and reproduction indicates little brown myotis would remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints). Therefore, the residual effects from the Project are predicted to be not significant.

Cumulative effects from the previous and existing developments, and the Project and the Fission Patterson Lake South Property in the RFD Case, are expected to remain within the species' resilience and adaptability limits. Little brown myotis would remain self-sustaining and ecologically effective in the RFD Case assuming WNS did not spread to the RSA. Overall, the residual effects from the Project and the Fission Patterson Lake South Property are predicted to be not significant. Effects from climate change are uncertain and potentially adverse but are not expected to significantly influence the abundance and distribution of little brown myotis and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

Despite the conclusion that cumulative effects from the Project and Fission Patterson Lake South Property are predicted to be not significant, should WNS spread to the RSA, little brown myotis are not predicted to remain self-sustaining or ecologically effective. Effects on survival and population viability caused by WNS are expected to exceed the resilience and adaptability limits of the regional population. The arrival of WNS in the RSA would represent a significant adverse effect for little brown myotis, independent of effects from either the Project or the Fission Patterson Lake South Property.

14.5.7 Olive-Sided Flycatcher

14.5.7.1 Application Case

The residual effects analysis for olive-sided flycatcher focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of olive-sided flycatcher habitat and affect flycatcher abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect olive-sided flycatcher habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise, and vibrations) can alter olive-sided flycatcher movement and behaviour and adversely affect olive-sided flycatcher habitat availability and olive-sided flycatcher abundance and distribution.

14.5.7.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Construction of Project infrastructure would reduce the availability of olive-sided flycatcher habitat. The Project is expected to result in a loss of 4.1 ha of high suitability olive-sided flycatcher nesting habitat and 90.3 ha of moderate suitability habitat within the LSA, which represents a change of 0.1% and 0.4% of high and moderate suitability habitat, respectively, at the scale of the RSA (Table 14.5-23). No additional loss of high or moderate suitability habitat in the RSA is predicted, and a total of 3,746.5 ha of high and 20,805.8 ha of moderate suitability habitat would remain in the RSA (Table 14.5-23). Most of the habitat loss would occur in low suitability nesting habitat. Loss of low suitability habitat is estimated at 535.3 ha, representing 1.2% of its availability in the RSA (Table 14.5-23). Overall, the Project would disturb 629.7 ha (0.9%) of suitable nesting habitat in the RSA relative to the Base Case. The predicted habitat losses are associated with a corresponding increase in the amount of poor suitability habitat (Table 14.5-23).

The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure. Although the maximum disturbance area and sensory disturbances would mainly affect low suitability habitat, baseline surveys confirmed that olive-sided flycatcher occupy the LSA and adjacent area; therefore, these habitats are assumed to support olive-sided flycatcher use during the nesting season.

Table 14.5-23: Changes to Olive-Sided Flycatcher Nesting Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	3,750.6	3,746.5	-4.1	-0.1
Moderate	20,896.1	20,805.8	-90.3	-0.4
Low	45,038.5	44,503.2	-535.3	-1.2
Poor	37,805.5	38,435.2	629.7	1.7

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the terrestrial ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1.1).

Reclaimed areas adjacent to undisturbed mid- to late-seral forest may function as nesting habitat upon completion of the Active Closure Stage. However, it would take 60 to 80 years beyond the Active Closure Stage for ELC units to establish mature forest types that are present under existing conditions (Section 13.3.1.3) and may take longer for development of late seral forest (i.e., more than 120 years) depending on soil productivity and climate change. Habitat conditions would continue to improve with structural progression on reclaimed sites, eventually resulting in gap dynamics and the accumulation of snags and structural complexity important for this species. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Sensory Disturbance

Based on provincial setback distances, olive-sided flycatcher nesting habitat was reduced to poor suitability within 300 m of the maximum disturbance area (i.e., the Project would represent a high level of activity; Appendix 14B; ENV 2017). Average existing ambient nighttime and daytime noise levels in the noise RSA (i.e., 10 km buffer around maximum disturbance area) ranged from 21 dBA during the night to 42 dBA during the day (Section 14.3.7.3, Survival and Reproduction). In the Application Case, the minimum cumulative noise level (i.e., existing conditions plus the Project) during Construction and Operations in the noise RSA is predicted to be 26 dBA during the nighttime and the maximum cumulative noise level is predicted to be 45 dBA during the daytime (Section 7.3.5.1).

Within the noise LSA (i.e., 1.5 km buffer around the maximum disturbance area), noise levels are predicted to increase by a maximum of 6 dBA (from 30 dBA to 36 dBA) during the daytime and 14 dBA (from 21 dBA to 35 dBA) during the nighttime (e.g., receptors R-09 and R-31; Section 7.3.5.1). The results predict that cumulative noise levels during Construction and Operations would exceed baseline values at about 1.5 km from the Project by a maximum of 14 dBA during the nighttime and 6 dBA during the daytime, which is beyond the 300 m setback distance or ZOI used in habitat modelling. However, based on noise thresholds described in Section 14.3.7.3, sensory disturbance from the Project is expected to mostly affect habitat suitability for olive-sided flycatcher within the LSA (i.e., within 500 m of the maximum disturbance area). Beyond the LSA, sensory disturbance is predicted have minor influences on habitat quality for olive-sided flycatcher and is not expected to result in complete avoidance or nest site abandonment.

Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment use, and general mine activity would be highest. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3) but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., a duration of 48 years).

14.5.7.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

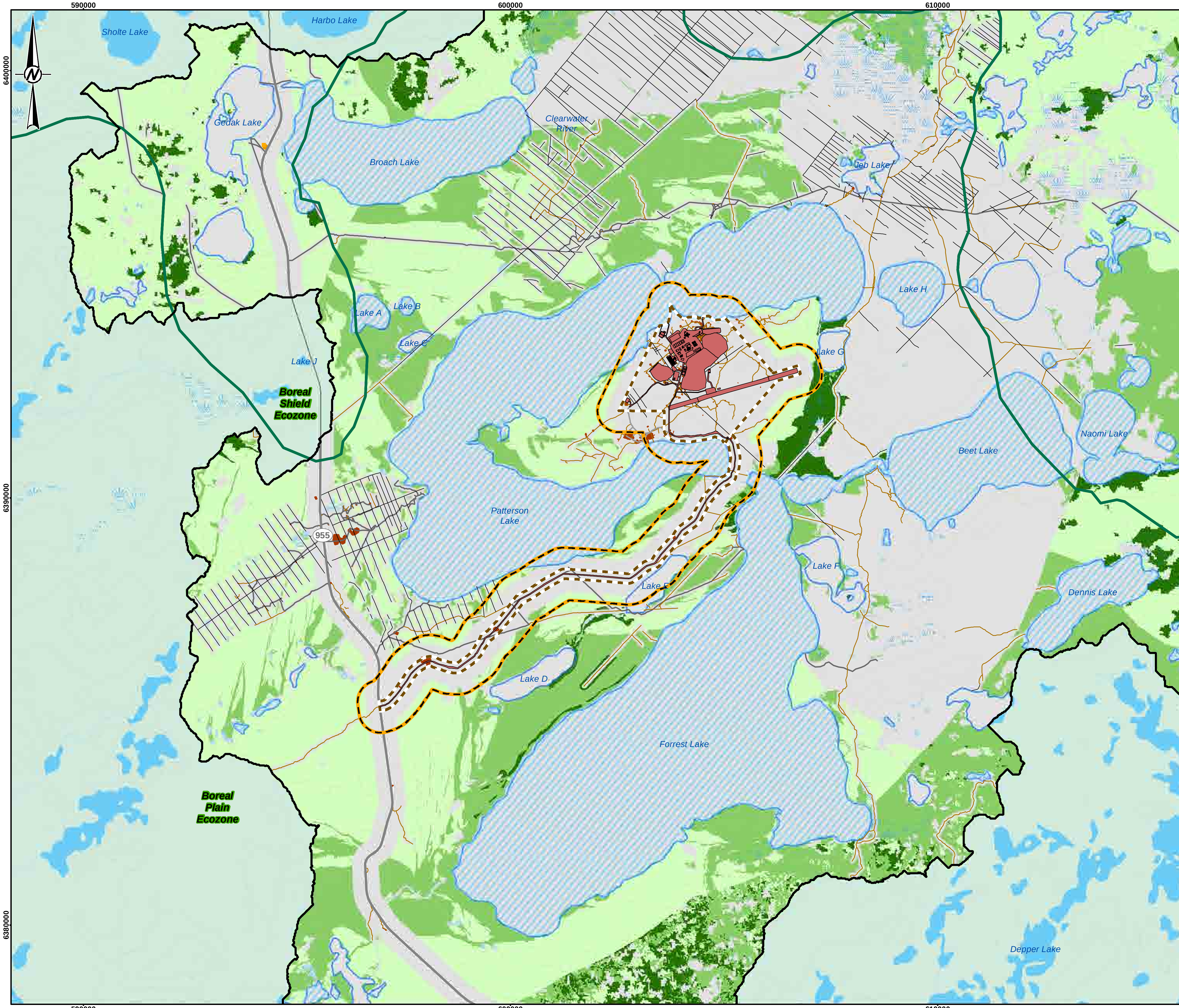
The maximum disturbance area may be perceived by olive-sided flycatcher as a barrier to movement; however, the land around the maximum disturbance area would remain in natural cover. The maximum disturbance area would remove suitable olive-sided flycatcher habitat in the LSA (i.e., local geographic extent; Figure 14.5-26) and Project activities would likely cause some animals to avoid the LSA. As discussed in Section 14.3.7.1, it was assumed that habitat within 50 to 300 m of infrastructure would represent poor suitability for nesting olive-sided flycatcher, dependent on the level of activity, though the precise threshold of avoidance by olive-sided flycatcher due to sensory disturbance is uncertain. Suitable habitat would remain within and adjacent to the LSA between Patterson Lake and Forrest Lake and is expected to provide nesting habitat for olive-sided flycatcher (Figure 14.5-27).

Olive-sided flycatcher is a mobile species and capable of moving around or over Project infrastructure in the maximum disturbance area. Suitable habitat would remain common and well connected in the RSA (Figure 14.5-27). Overall, the Project is unlikely to have a measurable effect on olive-sided flycatcher connectivity and movement in the RSA. Perceived barriers to movement created by the Project are not expected to prevent individuals from locating suitable habitat patches outside of the LSA.

Linear Features

The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to relative to existing conditions (Section 14.4.2). This increase in vehicle traffic could have an incremental increase in negative influence on the movement of olive-sided flycatcher that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect).

The loss of less than 1% of suitable nesting habitat in the RSA is predicted to have a negligible ecological effect on olive-sided flycatcher territory spacing or population connectivity. In addition, the Project is not expected to change the density of linear features in the LSA or RSA, which should result in little change to the movements of olive-sided flycatcher in the Application Case relative to the Base Case. However, sensory disturbance from traffic along the access road is expected to reduce habitat connectivity for olive-sided flycatcher within and perhaps beyond the LSA. Overall, the Project is predicted to result in small changes to movement and habitat connectivity relative to Base Case in the LSA and RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

OLIVE-SIDED FLYCATCHER NESTING HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

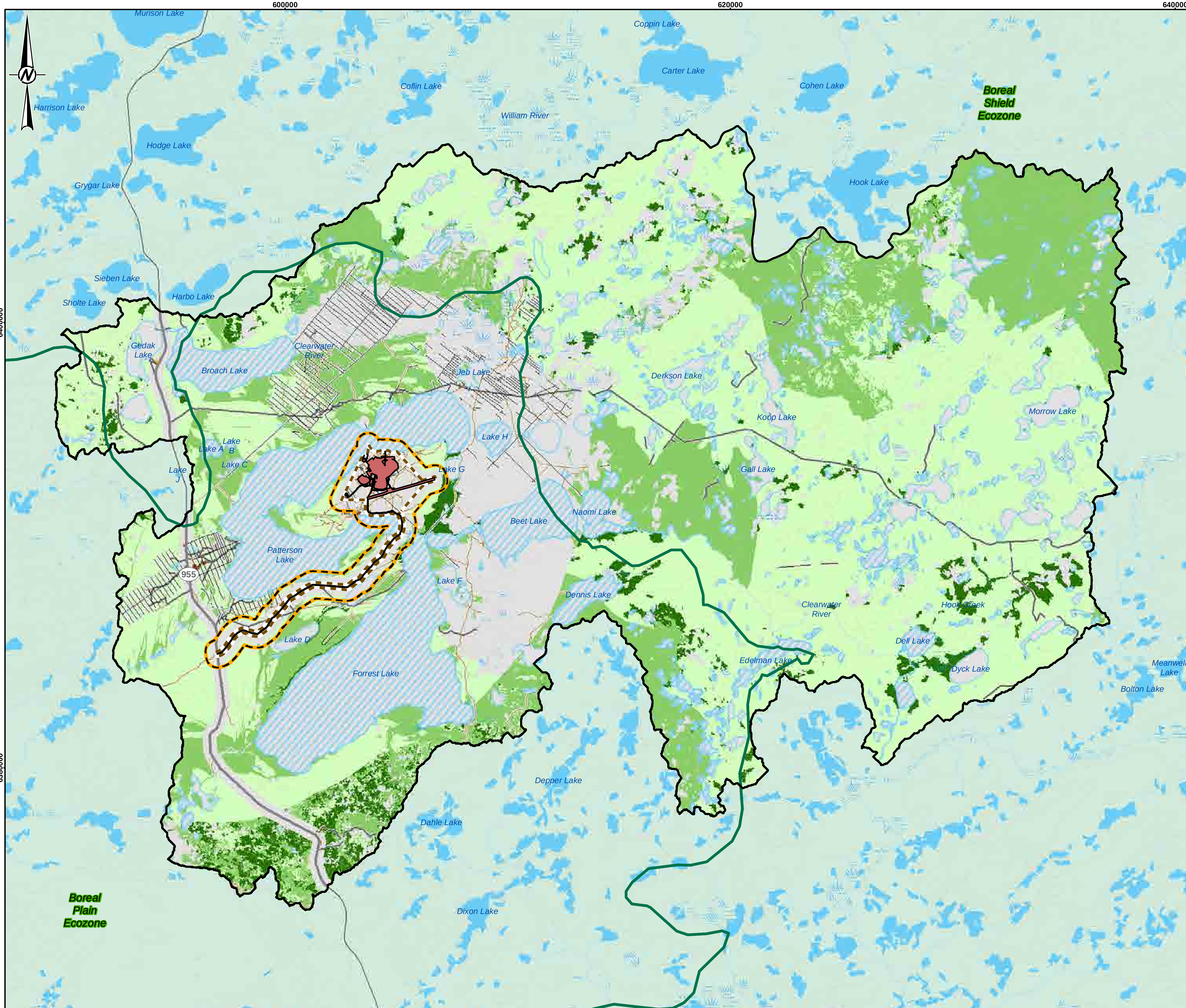
CONSULTANT

wsp

PROJECT	20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN / REV. 0
GIS	VMB	2023-02-09	
CHECK	SM	2023-02-09	
REVIEW	JV	2023-02-09	

FIGURE 14.5-26

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

OLIVE-SIDED FLYCATCHER NESTING HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-27**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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14.5.7.1.3 Survival and Reproduction

Breeding Territory and Population Status

The Project could affect olive-sided flycatcher survival through habitat loss and sensory disturbance. The calculated losses of olive-sided flycatcher nesting habitat in the RSA represent 0.9% of suitable nesting habitat (about 630 ha) in the Application Case. Using the upper value of reported breeding territory size of 45 ha, the projected loss of 630 ha of low, moderate, and high suitability habitat in the Application Case represents approximately 14 olive-sided flycatcher breeding territories. This estimate conservatively assumes that all available suitable habitat would be fully saturated with breeding pairs, which is not expected but not impossible. These changes are expected to be well within the resilience and adaptability limits of the species, which is highly mobile and predicted to move to unaffected habitat in the LSA and RSA. The loss of nesting habitat may affect reproductive success if individuals are displaced or return to breeding grounds to find habitat removed and subsequently are unable to establish a new territory or establish a territory in lower quality habitat. However, it is currently unknown if the availability of breeding habitat is a limiting factor for olive-sided flycatcher (Environment Canada 2016), and 99% of suitable nesting habitat would remain well connected in the RSA. Habitat loss may possibly result in a measurable effect on the olive-sided flycatcher population in the RSA (probability of effect may occur but is not likely).

Vital Rates

Sensory disturbance from artificial light (e.g., additional lighting that might be needed during major earthworks or for new infrastructure) can have consequences for songbird reproduction by causing maladaptive timing of reproduction compared to food availability, or by disrupting the link between mate quality and early dawn song (Kempenaers et al. 2010). However, disturbance from Project lighting on olive-sided flycatcher would be minimized by through infrastructure lighting design where practicable.

As discussed in Section 14.5.7.1.1, Habitat Availability, cumulative noise levels from existing and Project-related noise during Construction and Operations are not predicted to exceed a maximum of 45 dBA. Project noise is expected to have a negligible influence on olive-sided flycatcher habitat and abundance given that the predicted noise level is less than the 50 dBA threshold and slightly larger than the 10 dBA increase from background conditions provided by ECCC (ECCC 2019), and less than other threshold values for birds (Section 14.3.7.3). Sensory disturbance effects were not identified as an important factor in the federal recovery strategy for this species (Environment Canada 2016).

14.5.7.2 Reasonably Foreseeable Development Case

14.5.7.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable nesting habitat for olive-sided flycatcher. Removal of 4.1 ha (0.1%) of high suitability habitat, 235.1 ha (1.1%) of moderate suitability habitat, and 1,434.8 (3.2%) of low suitability habitat is predicted in the RSA (Table 14.5-24). Together, these represent a total loss of 1,674.0 ha (2.4%) of suitable nesting habitat in the RSA (i.e., regional geographic extent). Approximately 68,000 ha of suitable nesting habitat would remain in the RSA. The predicted habitat losses are associated with a corresponding increase in the amount of poor habitat (Table 14.5-24). These estimates include indirect losses of olive-sided flycatcher nesting habitat as a result of avoidance behaviour in proximity to development footprints (Appendix 14B). The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Effects from changes in the availability of wetland habitat and upland habitat affected by permanent features would be irreversible. The Project contribution to future habitat loss would be 629.7 ha (Table 14.5-23), representing 37.6% of the quantified cumulative effect.

Table 14.5-24: Changes to Olive-Sided Flycatcher Nesting Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	3,750.6	3,746.5	-4.1	-0.1
Moderate	20,896.1	20,661.0	-235.1	-1.1
Low	45,038.5	43,603.7	-1,434.8	-3.2
Poor	37,805.5	39,479.5	1,674.0	4.4

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 60 to 80 years for functional olive-sided flycatcher habitat to be regenerated (i.e., mature and late-stage seral forest; Section 14.5.7.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 95 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As described for the Application Case, sensory disturbance may indirectly reduce olive-sided flycatcher habitat quality in the RSA. In the RFD Case, cumulative noise levels from existing conditions, Project Construction, and Fission Patterson Lake South Property noise levels during construction and full-scale operations (i.e., maximum value for each receptor) are predicted to range from a minimum of 26 dBA during the nighttime period, which represents an increase of 0 dBA relative to existing conditions, to a maximum of 45 dBA, which represents an increase of 3 dBA relative to existing conditions (Section 7.3.5.2). The spatial extent of the small increase in noise is predicted to be within 10 km of the maximum disturbance area. This increase is expected to result in a negligible effect on habitat availability for olive-sided flycatcher in the RSA.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

In addition to development, natural factors such as climate change and climate change induced wildfire may contribute cumulatively to influence habitat availability for olive-sided flycatcher. Wetland ecosystem availability and condition may be adversely affected as described in Section 14.2.5. However, the direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. The shrinking of wetlands may result in a loss of natural edge habitats associated with wetlands and used by olive-sided flycatcher (Schneider 2013; COSEWIC 2018).

Increased climate change induced fires may reduce nesting habitat over the short term; however, burned edges can be attractive to the species as discussed in Section 14.3.7.1. Generally, the net effects of natural disturbance can result in more suitable habitat than was historically available for olive-sided flycatcher because recent burn openings in the RSA are expected to provide suitable contrast habitat adjacent to mature forest for olive-sided flycatcher. However, burned areas greater than 284 ha in size are generally considered lower suitability than smaller burn openings. An increase in the frequency and intensity of forest fires as a result of climate change may cause a reduction in suitable habitat for olive-sided flycatcher depending on the overall size of burned areas and the extent of remaining late seral forest resulting in high-contrast edge habitat opportunity. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale; however, the magnitude of habitat change induced by climate change is uncertain, and thus the effects on olive-sided flycatcher would also be uncertain (COSEWIC 2018).

14.5.7.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

The Fission Patterson Lake South Property would not remove any additional patches of high suitability habitat in the RSA but would remove some small, unconnected patches of moderate suitability nesting habitat in the RSA (Figure 14.5-28). Most of the habitat loss is associated with low suitability habitat; however nesting habitat remains abundant and well connected in the RFD Case. Sensory disturbance from the two projects is expected to have a negligible influence on movement patterns of olive-sided flycatcher around the area of Patterson Lake.

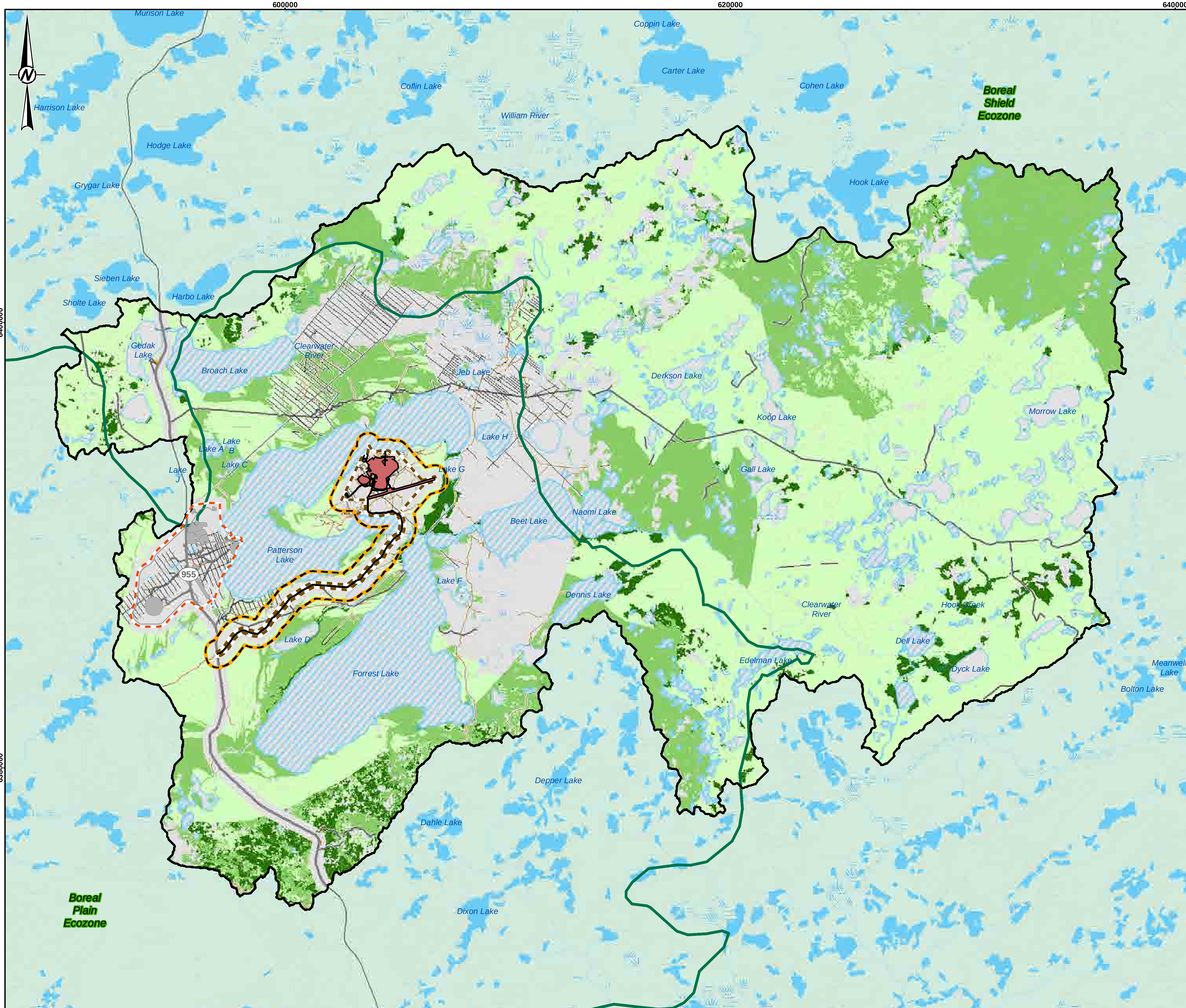
Linear Features

In the Base Case, Highway 955 is predicted to have a negative influence on movement and habitat connectivity of olive-sided flycatcher, particularly during periods of high traffic volume (Section 14.3.7.2, Habitat Distribution). The Fission Patterson Lake South Property is expected to have a similar increase in traffic to the increase in traffic from the Project, which could have minor effects on movement of olive-sided flycatchers that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect).

The distribution of olive-sided flycatcher nesting habitat in the RSA would remain largely unchanged. The creation of local or regional movement barriers is considered unlikely as a result of the Project and the Fission Patterson Lake South Property. Olive-sided flycatcher is expected to continue accessing available habitats within the RSA, and seasonal migratory movements should remain unaffected. Reconfiguration of habitat edges around anthropogenic disturbance would be unlikely to negatively affect this species, which prefers high-contrast habitat edges (Section 14.3.7.2). Edge effects such as increased predation risk are not expected to change from existing conditions due to aggregated disturbance near the western boundary where the two projects would be developed. Overall, the RFD Case is predicted to result in small changes to movement and habitat connectivity relative to the Base Case in the area around Patterson Lake.

Climate Change

As with habitat availability, climate change and climate change induced wildfire may contribute to changes in the distribution of olive-sided flycatcher nesting habitat. An increase in the frequency and intensity of wildfires would alter the distribution and composition of forest, and changes to temperature and precipitation levels may reduce the size and condition of wetlands on the landscape, resulting in changes to size and location of suitable habitat in the RSA. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale; however, the magnitude of habitat change induced by climate change is uncertain, and thus the effects on olive-sided flycatcher would be uncertain.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

OLIVE-SIDED FLYCATCHER NESTING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-28**	
REVIEW	JV	2023-02-09		

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25mm 0

14.5.7.2.3 Survival and Reproduction

Breeding Territory and Population Status

The Project and the Fission Patterson Lake South Property could affect olive-sided flycatcher survival through habitat loss and sensory disturbance. Loss of breeding habitat would lower the reproductive output of the species in the RSA as breeding pairs would be displaced to areas outside of anthropogenic disturbance. The projected loss of 1,674 ha of suitable habitat in the RFD Case represents approximately 37 olive-sided flycatcher breeding territories, of which 14 would be attributable to the Project. As discussed in Section 14.5.7.1.3, Survival and Reproduction, the loss of habitat would only affect all potential breeding territories if habitat were saturated with breeders, which is not expected. Over 68,000 ha of suitable nesting habitat would remain well connected and distributed in the RSA (of which 24,407 ha is high and moderate suitability habitat; Table 14.5-24) and adult birds are predicted to find other breeding sites. Although the estimated loss of habitat could influence the local abundance of olive-sided flycatcher around Patterson Lake, suitable habitat would remain largely intact and available in the RSA for breeding pairs, which is expected to result in negligible effects on the population.

Vital Rates

Similar to the Project, effects of lighting from the Fission Patterson Lake South Property is expected to be minimized through infrastructure lighting design. As such, disturbances would likely be limited to areas near the infrastructure of the projects and would have a minor influence on the olive-sided flycatcher population in the RSA.

As discussed in Section 14.5.7.2.1, Habitat Availability, cumulative noise levels from existing conditions and the two projects are not predicted to exceed a maximum of 45 dBA within 10 km of the maximum disturbance area. Noise levels would not exceed the 50 dBA threshold presented by ECCC (ECCC 2019). The increase in sensory disturbance from the Project and Fission Patterson Lake South Property may possibly have a localized measurable effect on survival and reproduction but is not likely (i.e., probability of effect is possible). Sensory disturbance effects were not identified as an important factor in the federal recovery strategy for this species (Environment Canada 2016). Cumulative changes in habitat from the Project and Fission Patterson Lake South Property may result in a small measurable change to the population abundance and distribution of olive-sided flycatcher around Patterson Lake. Cumulative effects due to sensory disturbance in the RFD Case should be reversible five years after closure of one of the projects or when there is no temporal overlap between projects.

Climate Change

Climate change is expected to alter the onset of spring and summer, which may cause a positive effect on olive-sided flycatcher reproduction. Section 22 outlines the future climate extreme projections for the Project, which are also summarized in Section 14.2.5.

A longer, warmer growing season may increase forest productivity in the future and alter ecological succession (Sauchyn et al. 2009). Olive-sided flycatchers are not expected to raise more than one clutch per year due to their late migration and long reproductive period (Altman and Sallabanks 2020). With climate change, an earlier growing season may have a positive effect on olive-sided flycatcher because this may enable individuals to repeat nest attempts following failure with sufficient time left in the nesting season for nestlings to successfully fledge. Further, a longer, warmer growing season altering the onset of spring and summer may result in a change in the timing of food availability such as insect hatches.

More frequent forest fires resulting from climate change may also change the timing of insect emergence on breeding grounds of olive-sided flycatcher (COSEWIC 2018; Nituch and Bowman 2013). Long-distance migrant bird species often exhibit a strong synchronization between breeding and peak food abundance, and climate change may affect this timing by creating a temporal mismatch between reproduction and optimal foraging conditions for prey (Both et al. 2009; COSEWIC 2018).

Climate change is also predicted to increase the frequency and intensity of extreme weather events, including droughts, forest fires, and heavy precipitation (IPCC 2007; de Groot et al. 2013). Extreme weather events during the breeding season could result in reduced fecundity and nest success and increase mortality. The frequency and intensity of hurricanes are predicted to increase as a result of climate change, which may negatively affect olive-sided flycatcher during fall migration and on wintering grounds and affect the population in the RSA. Stralberg et al. (2015a) projected a change over time in richness and total density of boreal breeding birds due to climate change related effects. Overall, the olive-sided flycatcher population is predicted to decrease 3.1% through 2040 based on climate change and continue its decline to 10.1% between 2041 and 2070 (Stralberg et al. 2015b). However, uncertainty is high regarding the potential effects of climate change because predictions are based on simulations that can be highly variable. Climate change may result in more pronounced effects on olive-sided flycatcher than the combined effects of the Project and the Fission Patterson Lake South Property.

14.5.7.3 Residual Effects Classification and Determination of Significance

14.5.7.3.1 Classification Summary

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation (Table 14.5-25). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation are expected to reduce the magnitude and duration of residual effects on olive-sided flycatcher. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-25: Classification of Residual Effects on Olive-Sided Flycatcher Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 4.1 ha removal of high suitability nesting habitat, representing a 0.1% reduction in the RSA (i.e., low magnitude) ▪ 90.3 ha removal of moderate suitability nesting habitat, representing a 0.4% reduction in the RSA (i.e., low magnitude) ▪ 535.3 ha removal of low suitability nesting habitat, representing a 1.2% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 4.1 ha removal of high suitability nesting habitat, representing a 0.1% reduction in the RSA (i.e., low magnitude) ▪ 235.1 ha removal of moderate suitability nesting habitat, representing a 1.1% reduction in the RSA (low magnitude) ▪ 1,434.8 ha removal of low suitability nesting habitat, representing a 3.2% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (i.e., up to 300 m beyond the maximum disturbance area; some effects on habitat quality possible beyond 300 m)	▪ Regional (Project and Fission Patterson Lake South Property [includes 300 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 113 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus at least 80 years to establish late seral stage forests ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change in habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 113 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus at least 80 years to establish late seral stage forests ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)

Table 14.5-25: Classification of Residual Effects on Olive-Sided Flycatcher Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat distribution	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 629.7 ha loss of suitable habitat represents approximately 14 breeding territories for the species (i.e., low magnitude). ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 1,674 ha loss suitable habitat represents approximately 37 breeding territories for the species (i.e., moderate magnitude) ▪ Small measurable change in olive-sided flycatcher abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 113 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus at least 80 years to establish late seral stage forests ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Possible	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; RSA = regional study area; WRSAs = waste rock storage areas.

14.5.7.3.2 Significance Determination

Habitat Availability and Distribution

Suitable olive-sided flycatcher nesting habitat is common and well distributed in the RSA and relatively less abundant in the LSA under existing conditions. Suitable nesting habitat represents 65% of the RSA and high and moderate suitability habitat comprise 35% of available suitable habitat. Existing anthropogenic disturbance is low (0.4%) in the RSA and aggregated in the northwest portion of the study area, and most linear features consist of existing access road, trails, rough roads, and seismic lines / cutlines, which are not predicted to functionally affect the movement and habitat connectivity of olive-sided flycatcher, which have high mobility. Highway 955 likely influences olive-sided flycatcher movement and habitat connectivity during periods of high traffic volume. The available information suggests that olive-sided flycatcher in the RSA is self-sustaining and ecologically effective under existing conditions.

Anticipated loss of nesting habitat in the LSA is relatively small compared to the extent of suitable nesting habitat present elsewhere in the RSA. In the Application Case, the Project is expected to result in a loss of 4.1 ha of high suitability habitat, representing 0.1% of this habitat in the RSA. Most of the habitat loss would occur in moderate (90.3 ha) and low suitability (535.3 ha) habitat; 99% of suitable nesting habitat would remain in the

RSA. Functional nesting habitat for olive-sided flycatcher is predicted to become available as early as the end of Closure but would be as much as 80 years to 120 years following the Active Closure Stage for the development of late-stage seral habitat. Changes to habitat availability are likely to have negligible effects on the regional breeding population of olive-sided flycatcher given the small anticipated loss of habitat relative to what is available to in the rest of the RSA. The Project is unlikely to have a measurable effect on olive-sided flycatcher habitat connectivity and movement in the RSA given the small area of new disturbance and presence of well-connected suitable habitat within and adjacent to the LSA.

In the RFD Case, the Project and Fission Patterson Lake South Property would combine to reduce the amount suitable nesting in the RSA by 2.4%; approximately 68,000 ha of suitable nesting habitat would remain in the RSA. Reconfiguration of habitat edges around anthropogenic disturbance is unlikely to negatively influence this species, which prefers high-contrast habitat edges (Altman and Sallabanks 2012). The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and the distribution of suitable habitat in the RSA (including high and moderate suitability habitat) would remain largely unchanged.

Minor changes in local movement patterns around Patterson Lake may be experienced by olive-sided flycatcher as a result of sensory disturbance associated with the projects. However, the Project and Fission Patterson Lake South Property would be unlikely to affect olive-sided flycatcher habitat connectivity and movement in the RSA given the small area of new disturbance concentrated in an area of existing disturbance. In the Base Case, Highway 955 was predicted to have negative influence on olive-sided flycatcher movement and habitat connectivity, particularly during periods of high traffic volume. The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could affect the movement of olive-sided flycatcher that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). However, the creation of local or regional movement barriers is considered unlikely as a result of the Project and the Fission Patterson Lake South Property due to the abundance and distribution of suitable nesting habitat that would remain in the RFD Case.

Losses and increases in the availability and distribution of suitable habitat from climate change are possible. Increased forest fire frequency and extent on the landscape may cause a reduction or increase in suitable habitat for olive-sided flycatcher depending on the overall size of burned areas and the extent of remaining late seral forest resulting in high-contrast edge habitat opportunity. Reductions in the size and occurrence of wetlands due to climate change induced effects could lead to a reduction in available nesting habitat for olive-sided flycatcher as a result of a potential loss of natural edge habitats. An increase in the frequency and intensity of forest fires or extreme weather events could also reduce nesting habitat over the short term. Climate effects may also result in a change in the onset of spring and summer, ultimately affecting the timing of food availability as a result of changing insect emergence on the breeding grounds of olive-sided flycatcher. These changes may ultimately benefit or adversely affect the abundance and distribution of olive-sided flycatcher in the RSA. There is uncertainty associated with the direction and magnitude of the effects that climate change would have on olive-sided flycatcher habitat in the RSA.

Survival and Reproduction

The status of olive-sided flycatcher under Schedule 1 of the SARA was recently updated from Threatened to Special Concern (Government of Canada 2023) and was previously down-listed to Special Concern by COSEWIC in recognition that population declines have slowed in recent decades (COSEWIC 2018). The species is a provincially tracked S4B, S4M species, indicating that the species' breeding and migratory populations are apparently secure.

Light and noise disturbance associated with the Project could lead to reduced survival and reproduction for breeding pairs occupying breeding territories near the Project footprint. Proposed mitigation measures (e.g., infrastructure designs to minimize light pollution where practicable, use and maintenance of noise suppression equipment) is expected to minimize the effects of sensory disturbance on songbirds. Approximately 14 and 37 breeding territories would be disturbed in the Application Case and RFD Case, respectively (includes both direct and indirect effects). The increase in sensory disturbance from the Project and Fission Patterson Lake South Property may possibly have a localized measurable effect on survival and reproduction but is not likely. Over 68,000 ha of suitable nesting habitat would remain well connected and distributed in the RSA (of which 24,407 ha is high and moderate suitability habitat) and adult birds are predicted to find other breeding sites. Although the estimated loss of habitat could influence the local abundance of olive-sided flycatcher around Patterson Lake, suitable habitat would remain largely intact and available in the RSA for breeding pairs, which is expected to result in negligible effects on the population in RSA.

Edge effects such as competitive exclusion and increased predation risk potentially resulting from climate change effects are not expected to change from existing conditions. A longer growing season may also allow for a longer breeding season and for repeat nesting attempts following failure. Given the level of uncertainty associated with climate change predictions, a precautionary approach was applied, and the assessment assumed that climate change effects would have predominantly negative effects on olive-sided flycatcher.

Summary of Significance Determination

Olive-sided flycatcher is predicted to remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints). Overall, the anticipated changes to olive-sided flycatcher habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the regional population. Therefore, the residual effects from the Project on olive-sided flycatcher are predicted to be not significant.

Regional changes to the abundance and distribution of olive-sided flycatcher from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted in the RFD Case. However, the changes would mostly be observed in the area of Patterson Lake as habitat in most of the RSA would remain abundant and well connected for this highly mobile species that is adapted to fire disturbance. In the Base Case, the RSA has a low level of anthropogenic disturbance that is highly aggregated in the western portion of the study area where development of the two projects would occur. Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Overall, the residual effects from the Project and Fission Patterson Lake South Property on olive-sided flycatcher are predicted to be not significant. Effects from climate change are potentially adverse but are not expected to significantly influence the abundance and distribution of olive-sided flycatcher and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.8 Rusty Blackbird

14.5.8.1 Application Case

The residual effects analysis for rusty blackbird focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of rusty blackbird habitat and affect rusty blackbird abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect rusty blackbird habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter rusty blackbird movement and behaviour and adversely affect rusty blackbird habitat availability and rusty blackbird abundance and distribution.

14.5.8.1.1 Habitat Availability

Direct Habitat Loss and Alteration

In the Base Case, high and moderate suitability nesting habitat for rusty blackbird is limited in the LSA and RSA, while low suitability nesting habitat is much more common and expected to still provide successful breeding habitat (Section 14.3.8.1). The majority of the LSA and RSA contains poor suitability habitat. Construction of Project infrastructure would reduce the availability of rusty blackbird habitat and most of the change would affect low suitability habitat. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure.

The Project is expected to result in a loss of 0.2 ha of high suitability nesting habitat and 0.1 ha of moderate suitability habitat within the LSA, which represents a change of 0.1% and less than 0.1% of high and moderate suitability habitat, respectively, at the scale of the RSA (Table 14.5-26). No additional loss of high or moderate suitability habitat in the RSA is predicted, and a total of 403.0 ha of high and 516.5 ha of moderate suitability habitat remains in the RSA (Table 14.5-26). Loss of low suitability nesting habitat is estimated at 31.0 ha, representing 0.2% of its availability in the RSA (Table 14.5-26). The Project footprint and sensory disturbances would mainly affect poor and low suitability habitat. Overall, 14,447.7 ha of suitable rusty blackbird nesting habitat would remain in the RSA in the Application Case.

Table 14.5-26: Changes to Rusty Blackbird Nesting Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	403.2	403.0	-0.2	-0.1
Moderate	516.5	516.5	-0.1	< -0.1
Low	13,559.2	13,528.2	-31.0	-0.2
Poor	93,011.7	93,043.0	31.3	0.0

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the upland ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). The WRSAs are not anticipated to disturb wetland ecosystems (Section 13.5.2.1.1). The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1). Previously burned upland habitats (i.e., young forests) within 75 m of open water or suitable shrubby wetland habitats that have been burned (i.e., young and immature) are considered suitable nesting habitat for rusty blackbird (Appendix 14B; Avery 2020). As such, it is expected that reclaimed habitats would function as nesting habitat 6 years to 10 years after the Active Closure Stage (i.e., a duration of 43 years).

Sensory Disturbance

Based on provincial setback distances, rusty blackbird nesting habitat was reduced to poor suitability within 300 m of the maximum disturbance area (i.e., the Project would represent a high level of activity; Appendix 14B; ENV 2017). Average existing ambient nighttime and daytime noise levels in the noise RSA (i.e., 10 km buffer around maximum disturbance area) ranged from 21 dBA during the night to 42 dBA during the day (Section 14.3.7.3). In the Application Case, the minimum cumulative noise level (i.e., existing conditions plus the Project) during Construction and Operations in the noise RSA is predicted to be 26 dBA during the nighttime and the maximum cumulative noise level is predicted to be 45 dBA during the daytime (Section 7.3.5.1).

Within the noise LSA (i.e., 1.5 km buffer around the maximum disturbance area), noise levels are predicted to increase by a maximum of 6 dBA (from 30 dBA to 36 dBA) during the daytime and 14 dBA (from 21 dBA to 35 dBA) during the nighttime (e.g., receptors R-09 and R-31; Section 7.3.5.1). The results predict that cumulative noise levels during Construction and Operations would exceed baseline values at about 1.5 km from the Project by a maximum of 14 dBA during the nighttime and 6 dBA during the daytime, which is beyond the 300 m setback distance or ZOI used in habitat modelling. However, based on noise thresholds described in Section 14.3.8.3, Survival and Reproduction, sensory disturbance from the Project is expected to mostly affect habitat suitability for rusty blackbird within the LSA (i.e., within 500 m of the maximum disturbance area). Beyond the LSA, sensory disturbance is predicted have minor influences on habitat quality for rusty blackbird and is not expected to result in complete avoidance or nest site abandonment.

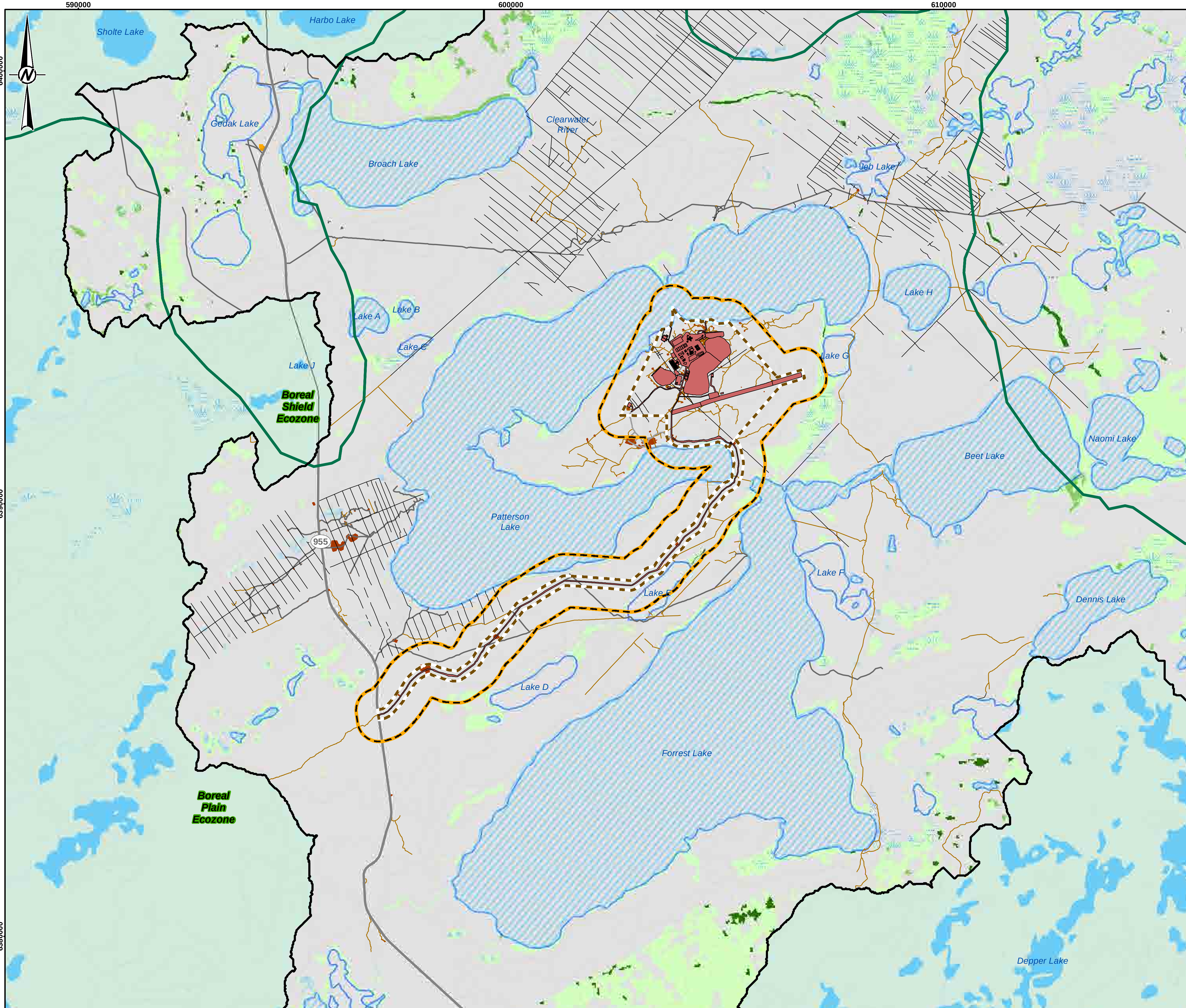
Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment use and general mine activity would be highest. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3) but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., a duration of 48 years).

14.5.8.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

The maximum disturbance area would remove suitable rusty blackbird habitat in the LSA (i.e., local geographic extent; Figure 14.5-29) and Project activities would likely cause some animals to avoid the LSA. Suitable habitats that are within 300 m of human developments with high levels of activity, and within 150 m of human developments with medium levels of activity, were assigned a suitability rank of poor as a precautionary approach (Appendix 14B), though the precise threshold of avoidance by rusty blackbird due to sensory disturbance is not known. Given the small loss of suitable nesting habitat from the Project, there would be negligible change in its distribution in the LSA (Figure 14.5-29) and the RSA (Figure 14.5-30). Suitable nesting habitat would remain connected within the RSA in the Application Case relative to the Base Case (Figure 14.5-30).

Rusty blackbird is a mobile species and capable of moving around or over Project infrastructure in the maximum disturbance area. The species is also able to move between multiple unconnected wetlands within their home range for foraging (Section 14.3.8.2, Habitat Distribution). Overall, the Project is unlikely to have a measurable effect on rusty blackbird habitat connectivity and movement in the RSA given the small area of new disturbance concentrated in an area where poor suitability habitat is dominant. Perceived barriers to movement created by the Project are not expected to prevent individuals from locating suitable habitat patches outside of the LSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

RUSTY BLACKBIRD NESTING HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.5-29	
REVIEW	JV	2023-02-09		

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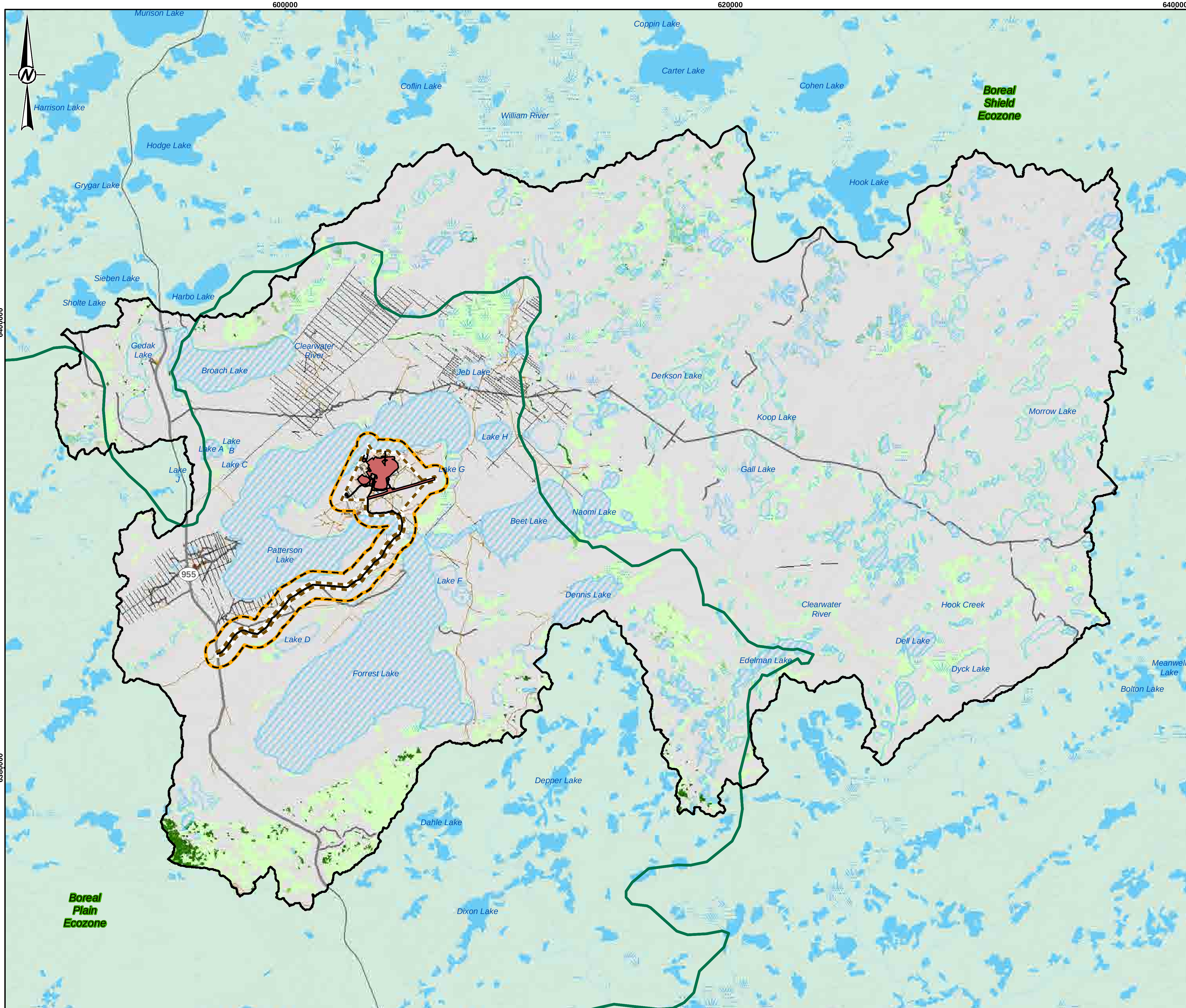
25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

RUSTY BLACKBIRD NESTING HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-30	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

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Linear Features

Based on literature on potential effects from linear features presented in Section 14.3.8.2, small changes in local movement patterns are possible and would be continuous so long as habitat remains disturbed. As discussed in Section 14.3.7.2, studies have shown that narrow linear disturbances do not necessarily represent barriers to bird movement. Upgrades to the existing access road and realignment to avoid the wetland west of the proposed airstrip within the maximum disturbance area are not expected to change the density of linear features in the LSA and RSA. However, rusty blackbird movements may be restricted in the LSA based on the relative amount of existing disturbance aggregated near Highway 955 in the western portion of the RSA (Section 14.3.8.2).

In the Base Case, Highway 955 is predicted to have a negative influence on movement and habitat connectivity of rusty blackbird, particularly during periods of high traffic volume (Section 14.3.8.2). The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (Section 14.4.2). However, generally, road alignments avoid intersecting wetlands (suitable rusty blackbird habitat). Therefore, the anticipated increase in Project-related vehicle traffic could have minor effects on the movement of rusty blackbirds that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Overall, the Project is predicted to result in small changes to movement and habitat connectivity relative to Base Case in the LSA and RSA.

14.5.8.1.3 Survival and Reproduction

Breeding Territory and Population Status

The loss of suitable breeding habitat may affect reproduction if individuals are displaced or return to breeding grounds to find habitat removed and subsequently are unable to establish a new territory or are forced to establish a territory in poor quality habitat. These individuals may experience reduced reproductive success. The calculated losses of rusty blackbird nesting habitat in the RSA represent 0.4% (about 32 ha) of suitable nesting habitat in the Application Case. Based on a breeding territory of 37.5 ha (Avery 2020), the 32 ha loss of suitable habitat represents approximately one breeding territory for rusty blackbird. Therefore, the potential loss of suitable nesting habitat would unlikely displace more than a single breeding pair. These changes are expected to be within the resilience and adaptability limits of rusty blackbird, which is a highly mobile species and predicted to move to unaffected habitat in the LSA and RSA. Habitat loss would therefore unlikely have a measurable effect on the rusty blackbird population in the RSA (probability of effect is not expected, but not impossible).

Vital Rates

The Project could affect the quality of nesting habitat and reproduction through sensory disturbance. The effects of noise on the abundance of rusty blackbirds are unknown, but general noise thresholds for birds are presented in Section 14.3.8.3. As discussed in Section 14.5.8.1.1, Habitat Availability, cumulative noise levels from existing and Project-related noise during Construction and Operations are not predicted to exceed a maximum of 45 dBA. Similar to olive-sided flycatcher (Section 14.5.7.1.3), rusty blackbird habitat and abundance is expected to be minimally affected by Project noise given that the predicted level is less than the 50 dBA threshold provided by ECCC (ECCC 2019).

Although rusty blackbird may avoid areas associated with high levels of human presence and noise, this avoidance is unlikely to influence survival or reproduction because habitat removal resulting from the Project would be minimal and remain common in the RSA (i.e., 99% of suitable habitat would not be disturbed). Changes in habitat from the Project are unlikely to have a measurable effect on survival and reproduction of the rusty blackbird population breeding in the RSA.

14.5.8.2 Reasonably Foreseeable Development Case

14.5.8.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and Fission Patterson Lake South Property would reduce the availability of suitable (i.e., high, moderate, low suitability) nesting habitat for rusty blackbird by 49.4 ha (less than 0.1%) in the RSA. This estimate includes indirect losses of rusty blackbird nesting habitat as a result of avoidance behaviour in proximity to development footprints (Appendix 14B). The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Effects from changes in the availability of wetland habitat and upland habitat affected by permanent features would be irreversible. The Project contribution to future habitat loss is 31.3 ha (Table 14.5-27), representing 63.3% of the quantified cumulative effect.

Table 14.5-27: Changes to Rusty Blackbird Nesting Habitat Availability in the Regional Study Area for the Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	403.2	403.0	-0.2	-0.1
Moderate	516.5	516.5	-0.1	< -0.1
Low	13,559.2	13,510.1	-49.1	-0.4
Poor	93,011.7	93,061.1	49.4	0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than; RFD = reasonably foreseeable development.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 6 to 10 years for functional rusty blackbird habitat to be regenerated (i.e., early seral stage ecosites near wetlands; Section 14.5.8.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 25 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As described for the Application Case, sensory disturbance may indirectly reduce rusty blackbird habitat quality in the RSA. In the RFD Case, cumulative noise levels from existing conditions, Project Construction, and Fission Patterson Lake South Property noise levels during construction and full-scale operations (i.e., maximum value for each receptor) are predicted to range from a minimum of 26 dBA during the nighttime period, which represents an increase of 0 dBA relative to existing conditions, to a maximum of 45 dBA, which represents an increase of 3 dBA relative to existing conditions (Section 7.3.5.2). The spatial extent of the small increase in noise is predicted be within 10 km of the maximum disturbance area. This increase is expected to result in a negligible effect on habitat availability for rusty blackbird in the RSA.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

In addition to development, natural factors such as climate change and climate change induced wildfire may contribute cumulatively to influence habitat availability for rusty blackbird. Wetland ecosystem availability and condition may be adversely affected as described in Section 14.2.5. However, the direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain.

A reduction in wetland habitat could affect the shrubby and treed wetlands used by rusty blackbird for their nesting habitat (Appendix 14B). Conversion of wet, treed fen habitat to drier, upland habitat could have negative implications for rusty blackbird habitat availability in the RSA because rusty blackbirds are much less common in upland habitat (Nordell and Bayne 2017; COSEWIC 2017; Avery 2020). Changes to wetland availability due to fire are anticipated to be limited as self-replacement of non-forest poorly drained sites is the most common trajectory post-fire (Hart et al. 2019). Further, changes in wetland ecosystem availability due to increased fire interval under climate change scenario were also observed to be relatively stable (Hart et al. 2019).

Increased fires may reduce breeding habitat as fires would burn through treed wetlands, affecting mature conifers that provide potential nesting habitat for the species. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale; however, the magnitude of habitat change induced by climate change is uncertain, and thus the effects on rusty blackbird are uncertain. It was assumed that climate change would put additional adverse pressure on habitat availability in the RSA.

14.5.8.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

The Fission Patterson Lake South Property would remove an additional 18.1 ha of suitable habitat (no high and moderate suitability habitat would be affected) in the RSA (Figure 14.5-31). Suitable habitat for rusty blackbird would remain connected in the RFD Case. In the RFD Case, habitat changes from sensory disturbance are expected to have a negligible influence on the movement patterns of rusty blackbird around the area of Patterson Lake.

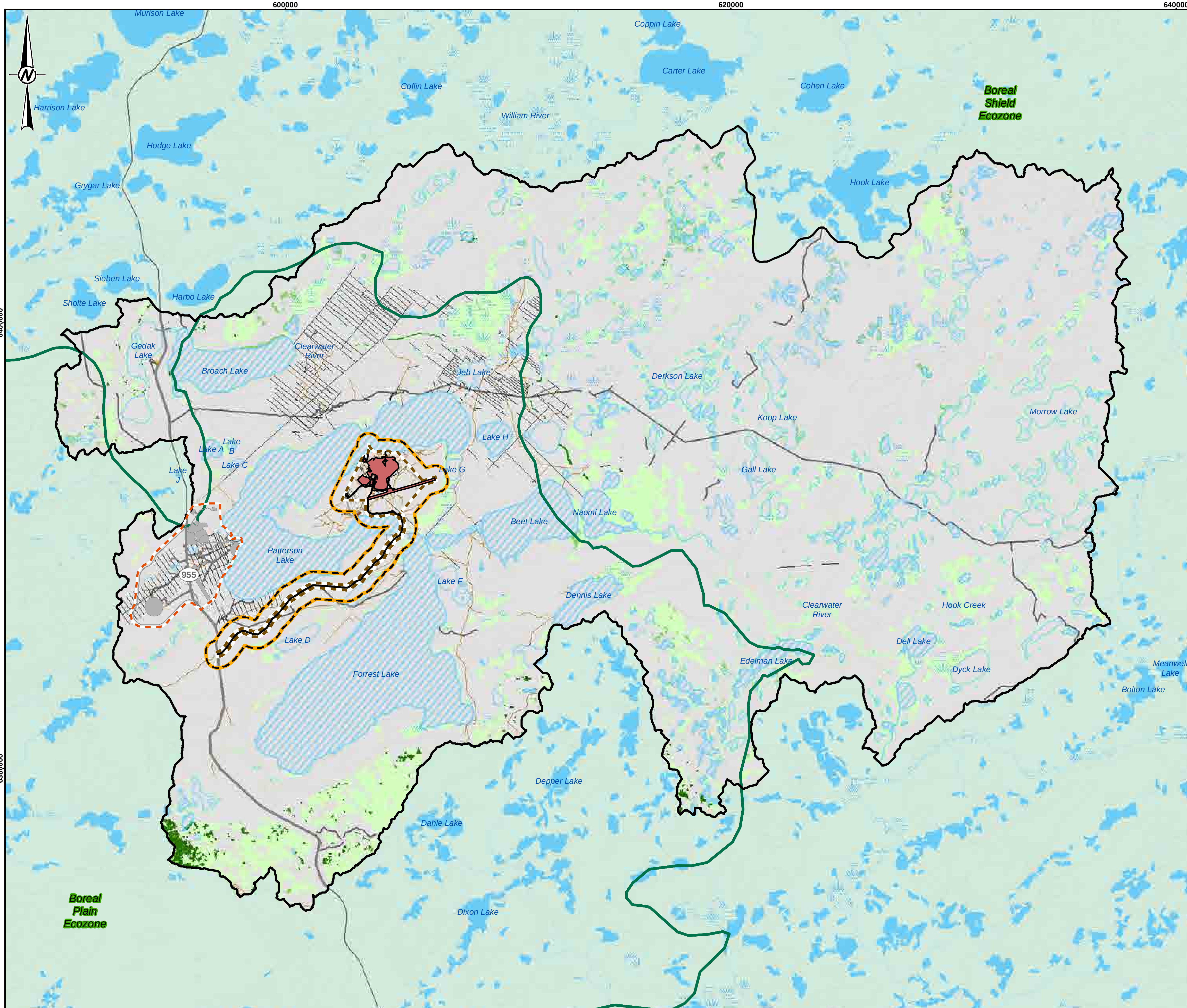
Linear Features

In the Base Case, Highway 955 is predicted to have a negative influence on movement and habitat connectivity of rusty blackbird, particularly during periods of high traffic volume (Section 14.3.8.2). The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could have minor effects on the movement of rusty blackbirds that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect).

The distribution of rusty blackbird nesting habitat in the RSA would remain largely unchanged. The creation of local or regional movement barriers is considered unlikely as a result of the Project and the Fission Patterson Lake South Property. Rusty blackbird is expected to continue accessing available habitats within the RSA, and seasonal migratory movements should remain unaffected. Overall, the RFD Case is predicted to result in small changes to movement and habitat connectivity relative to the Base Case in the area around Patterson Lake.

Climate Change

As with habitat availability, climate change and climate-induced wildfire may contribute to changes in the distribution of rusty blackbird nesting habitat. An increase in the frequency and intensity of wildfires would alter the distribution and composition of forest, and changes to temperature and precipitation levels may reduce the size and condition of wetlands on the landscape, resulting in changes to size and location of suitable habitat in the RSA. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale; however, the magnitude of habitat change induced by climate change is uncertain. It was assumed that climate change would increase adverse effects on habitat in the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

RUSTY BLACKBIRD NESTING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-31**	
REVIEW	JV	2023-02-09		

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: I:\CLIENTS\NexGen\20144150\Mapping\Products\FINAL_EIS_FIGURES_WSP_LOGO_UPDATE\14_Wildlife_and_Wildlife_Habitat\17x11\20144150_068_Fig14_5-31_RustyBlackbird_RSA_RFDCase_Rev0.mxd PRINTED ON: 2023-02-09 AT 7:20:03 AM

14.5.8.2.3 Survival and Reproduction

Breeding Territory and Population Status

The Project and Fission Patterson Lake South Property would result in the loss of 50 ha of rusty blackbird nesting habitat in the RSA (less than 0.1%) in the RFD Case. Based on a breeding territory of 37.5 ha (Avery 2020), the 50 ha loss of suitable habitat represents approximately 1.3 rusty blackbird breeding territories, which is similar to the magnitude in the Application Case, and predicted to have negligible effects on the population.

Vital Rates

As discussed in Section 14.5.8.2.1, Habitat Availability, cumulative noise levels from existing conditions and the two projects are not predicted to exceed a maximum of 45 dBA within 10 km of the maximum disturbance area. Noise levels would not exceed the 50 dBA threshold presented by ECCC (ECCC 2019). The increase in sensory disturbance from the Project and Fission Patterson Lake South Property may possibly have a localized measurable effect on survival and reproduction but is not likely (i.e., probability of effect is possible). Cumulative changes in habitat from the Project and Fission Patterson Lake South Property are similar to the Application Case and predicted to result in a negligible change to the population abundance and distribution of rusty blackbird in the RSA. Cumulative habitat loss due to sensory disturbance in the RFD Case should be reversible five years after closure of one of the projects or when there is no temporal overlap between projects.

Climate Change

Climate change is expected to affect the rusty blackbird population in the RSA for the foreseeable future, though the magnitude of these effects is uncertain because predictions are based on simulations, and many scenarios are possible. In the long term, directional climate change trends have been linked with declines in rusty blackbird populations and are thought to play a major role in the contraction of this species' range (McClure et al. 2012). Section 22 outlines the future climate extreme projections for the Project, which are summarized in Section 14.2.5. Although seasonal precipitation deficits may occur (i.e., drought), they are anticipated to occur within the natural variability and resiliency of wetland ecosystems and would not affect overall ecosystem availability (Section 13.5.2.2.1).

Temperature is projected to increase, resulting in increased warm nights and reduced ice and frost days. Due to a longer, warmer growing season, the onset of spring and summer is predicted to be altered, which may result in an adverse effect on the reproductive rate of rusty blackbirds by causing a temporal mismatch between peak breeding and peak prey availability. Insectivorous long-distance migrants, such as the rusty blackbird, are particularly susceptible to this effect (Both et al. 2009).

Climate change is also predicted to increase the frequency and intensity of extreme weather events, including droughts, forest fires, and heavy precipitation (IPCC 2007; de Groot et al. 2013). Climate change may also result in more frequent and severe storms (IPCC 2007). It is possible these storms may flood nest sites and foraging areas of rusty blackbird; in addition, late spring snowstorms may cause breeding failure for this early nesting species. Individuals may also be susceptible to extreme weather events outside of the breeding season (i.e., hurricanes in their winter range; COSEWIC 2017). Changes in climate that affect survival and reproduction would have effects beyond the RSA scale; however, the magnitude of change in survival and reproduction induced by climate change is uncertain. It was assumed that climate change would put additional adverse pressure on rusty blackbird survival and reproduction in the RSA.

14.5.8.3 Residual Effects Classification and Determination of Significance

14.5.8.3.1 Classification Summary

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation (Table 14.5-28). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1), and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on rusty blackbird. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-28: Classification of Residual Effects on Rusty Blackbird Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 0.2 ha removal of high suitability nesting habitat, representing a 0.1% reduction in the RSA (i.e., low magnitude) ▪ 0.1 ha removal of moderate suitability nesting habitat, representing a <0.1% reduction in the RSA (i.e., low magnitude) ▪ 31.0 ha removal of low suitability nesting habitat, representing a 0.2% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 0.2 ha removal of high suitability nesting habitat, representing a 0.1% reduction in the RSA (i.e., low magnitude) ▪ 0.1 ha removal of moderate suitability nesting habitat, representing a <0.1% reduction in the RSA (i.e., low magnitude) ▪ 49.1 ha removal of low suitability nesting habitat, representing a 0.4% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (i.e., up to 300 m beyond the maximum disturbance area; some effects on habitat quality possible beyond 300 m)	▪ Regional (Project and Fission Patterson Lake South Property [includes 300 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 43 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish rusty blackbird nesting habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

Table 14.5-28: Classification of Residual Effects on Rusty Blackbird Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	**RFD Case**
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 43 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish rusty blackbird nesting habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Approximately one breeding range affected by habitat loss (i.e., low magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ Approximately 1.3 breeding ranges affected by habitat loss (i.e., low magnitude) ▪ Negligible change in rusty blackbird abundance and distribution due to effects related to changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 43 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish rusty blackbird nesting habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RSA = regional study area; RFD = reasonably foreseeable development; WRSAs = waste rock storage areas; < = less than.

14.5.8.3.2 Significance Determination

Habitat Availability and Distribution

Limited availability of treed and shrubby (i.e., willow) wetlands with adequate open water and large areas of burned and non-burned upland forest not adjacent to wetlands results in a small amount of high and moderate quality nesting habitat in the LSA and RSA under existing conditions. High and moderate suitability habitat are estimated at 0.9% of the RSA. Low suitability habitat (e.g., more open and shrubby wetlands, recently burned wetlands) represent almost 13% of the RSA and is well connected across the landscape considering the species life history traits. It was assumed that rusty blackbirds inhabiting the RSA have adapted to the existing fire regime and low suitability habitat provides successful nesting habitat for the species in the Base Case. Existing anthropogenic disturbance is low (0.4%) in the RSA and aggregated in the northwest portion of the study area, and most linear features consist of existing access road, trails, rough roads, and seismic lines / cutlines, which are not predicted to functionally affect the movement and habitat connectivity of rusty blackbird. Adult rusty blackbirds have high mobility and often forage in multiple unconnected wetlands within their home range. Highway 955 may adversely influence the movement and habitat connectivity of rusty blackbird in the southwest portion of the RSA, particularly during periods of high traffic volume. Overall, existing anthropogenic disturbances in the LSA and RSA are predicted to have had a negligible influence on the population abundance and distribution of rusty blackbird in the RSA. The available information suggests that rusty blackbird in the RSA is self-sustaining and ecologically effective under existing conditions.

In the Application Case, the Project would reduce the availability of rusty blackbird habitat and most of the change would comprise low suitability habitat (39 ha). Clearing activities associated with construction would result in a measurable change to the existing distribution of rusty blackbird habitat in the LSA. Approximately, 0.2 ha and 0.1 ha of high and moderately suitable would be disturbed by the Project; the total loss of suitable nesting habitat is much less than 0.1% of the RSA. The Project would mostly affect existing poor suitability habitat. Overall, 14,448 ha of suitable rusty blackbird nesting habitat would remain connected in the RSA in the Application Case relative to the Base Case. Functional habitat for rusty blackbird is predicted to become available 6 to 10 years after the end of the Active Closure Stage. The Project is unlikely to have a measurable effect on rusty blackbird habitat connectivity and movement in the RSA given the small area of new disturbance, which is concentrated in an area where poor suitability habitat is dominant.

In the RFD Case, the Project and Fission Patterson Lake South Property would reduce the availability of suitable nesting habitat by 49.4 ha (less than 0.1%) in the RSA. The Fission Patterson Lake South Property would not disturb moderate and high suitability habitat relative to the Application Case. Minor changes in local movement patterns around Patterson Lake may be experienced by rusty blackbird as a result of sensory disturbance associated with the projects. However, the Project and Fission Patterson Lake South Property are unlikely to affect rusty blackbird habitat connectivity and movement in the RSA given the small area of new disturbance. The distribution of rusty blackbird nesting habitat in the RSA would remain largely unchanged. The Project and Fission Patterson Lake South Property are expected to increase the number of vehicles on Highway 955 relative to existing conditions, which could have minor effects on the movement of rusty blackbird that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). The creation of local or regional movement barriers is considered unlikely as a result of the Project and the Fission Patterson Lake South Property. Rusty blackbird is expected to continue accessing available habitats within the RSA, and seasonal migratory movements should remain unaffected.

Wetlands are considered one of the ecosystems most sensitive to predicted changes in temperature and to the related alterations in precipitation and timing and volume of snowmelt (Section 14.2.5). The direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. Increased fires may reduce breeding habitat as fires would burn through treed wetlands, affecting mature conifers that provide potential nesting habitat for the species. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the RSA scale; however, the magnitude of habitat change induced by climate change is uncertain, and thus the effects on rusty blackbird are uncertain. It was assumed that climate change would put additional adverse pressure on habitat availability in the RSA.

Survival and Reproduction

Rusty blackbird is listed under Schedule 1 of the SARA as Special Concern and is a provincially tracked S3M species, indicating that the species' breeding and migratory populations are vulnerable/rare to uncommon but there is uncertainty in the non-breeding population status. Evidence suggests that rusty blackbird is declining throughout its range and has displayed one of the steepest population declines of any bird in North America (Section 14.3.8.3). Approximately 1.0 and 1.3 breeding territories would be disturbed in the Application Case and RFD Case, respectively (includes both direct and indirect effects). The increase in sensory disturbance from the Project and Fission Patterson Lake South Property may possibly have a localized measurable effect on survival and reproduction but is not likely. Overall, cumulative changes in habitat from the Project and Fission Patterson Lake South Property (i.e., RFD Case) are similar to the Application Case and predicted to result in a negligible change to the population abundance and distribution of rusty blackbird in the RSA.

An increase in the frequency and intensity of forest fires or extreme weather events could result in reduced fecundity and nest success or increased mortality. Climate effects may also result in a change in the onset of spring and summer, ultimately affecting the timing of food availability by causing a temporal mismatch between peak breeding and peak prey availability. These changes may ultimately affect the abundance and distribution of rusty blackbird in the RSA but the magnitude of the effects on rusty blackbird nesting habitat and prey availability are uncertain. Climate change may adversely affect survival and reproduction of rusty blackbird irrespective of the Project.

Summary of Significance Determination

The weight of evidence from the analysis of the primary pathways and associated mitigation indicates rusty blackbird would remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints). Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of rusty blackbird populations overlapping the RSA. Therefore, the residual effects from the Project on the rusty blackbird are predicted to be not significant.

The Project and Fission Patterson Lake South Property would reduce the availability of suitable nesting habitat for rusty blackbird by 49.4 ha in the RFD Case, equating to an incremental increase of 18.1 ha and much less than a single breeding territory relative to the Application Case. Small changes in local movement patterns around Patterson Lake may be experienced as a result of sensory disturbance associated with the projects. However, the Project and Fission Patterson Lake South Property are unlikely to affect rusty blackbird habitat connectivity and movement in the RSA. Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Rusty blackbird is predicted to remain self-sustaining and ecologically effective in the RFD Case. Overall, the residual effects from the Project and Fission Patterson Lake South Property on rusty blackbird are predicted to be not significant.

Effects from climate change are potentially adverse but are not expected to significantly influence the abundance and distribution of rusty blackbird and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.9 Common Goldeneye

14.5.9.1 Application Case

The residual effects analysis for common goldeneye focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of common goldeneye and affect common goldeneye abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect common goldeneye habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter common goldeneye movement and behaviour and adversely affect common goldeneye habitat availability and common goldeneye abundance and distribution.

14.5.9.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Construction of Project infrastructure would reduce the availability of suitable common goldeneye habitat, with a loss of 3.5 ha of suitable habitat, which represents a change of less than 0.1% of suitable habitat at the scale of the RSA (Table 14.5-29). The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure. A total of 13,100.5 ha of suitable habitat would remain in the RSA (Table 14.5-29). The predicted habitat losses are associated with a corresponding increase in the amount of unsuitable habitat (Table 14.5-29).

Table 14.5-29: Changes to Common Goldeneye Nesting Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
Suitable	13,103.9	13,100.5	-3.5	< -0.1
Not suitable	94,386.8	94,390.3	3.5	<0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than.

The loss of breeding habitat is likely representative of potential losses to stopover habitat for migrating individuals that do not breed in the RSA. Given the extent of available waterbodies in the RSA that could be used for stopover habitat during migration, the minimal loss of suitable riparian and wetland habitat due to the Project is not expected to have a measurable effect on migrating individuals. The size and abundance of alternative waterbodies in the RSA could provide sufficient options for stopover locations should individuals avoid habitat in proximity to the maximum disturbance area. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the upland ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). The WRSAs are not anticipated to disturb wetland ecosystems (Section 13.5.2.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1). Mature forest that includes potential nesting trees would take time to regenerate. It would take 60 to 80 years beyond the Active Closure Stage for ELC units to establish mature forest types that are present under existing conditions (Section 13.3.1.3) and may take longer for development of late seral forest (i.e., more than 120 years) depending on soil productivity and climate change. Functional common goldeneye nesting habitat is expected to become available 80 years after the Active Closure Stage (i.e., a duration of 113 years).

Sensory Disturbance

Sensory disturbance associated with site preparation or Operations could lead to site abandonment and indirect losses of common goldeneye nesting habitat (Section 14.3.9.1, Habitat Availability). Common goldeneye may avoid some areas within 100 m of the Project. This potential avoidance is expected to occur across a local geographic extent.

In the Application Case, the minimum cumulative noise level (i.e., existing conditions plus the Project) during Construction and Operations in the noise RSA is predicted to be 26 dBA during the nighttime and the maximum cumulative noise level is predicted to be 45 dBA during the daytime (Section 7.3.5.1). These values are below the noise level of 63 dBA that studies have shown may negatively affect waterbirds (Section 14.3.9.1).

The precise threshold for avoidance of habitat by common goldeneye due to sensory disturbance is not known. Therefore, to address this uncertainty, it was assumed that noise would reduce the quality of nesting or stopover habitat, leading to avoidance by common goldeneye. Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment use and general mine activity would be highest. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance would be predicted to occur for the 43-year lifespan of the Project and be reversible 5 years after Closure (i.e., a duration of 48 years).

14.5.9.1.2 Habitat Distribution

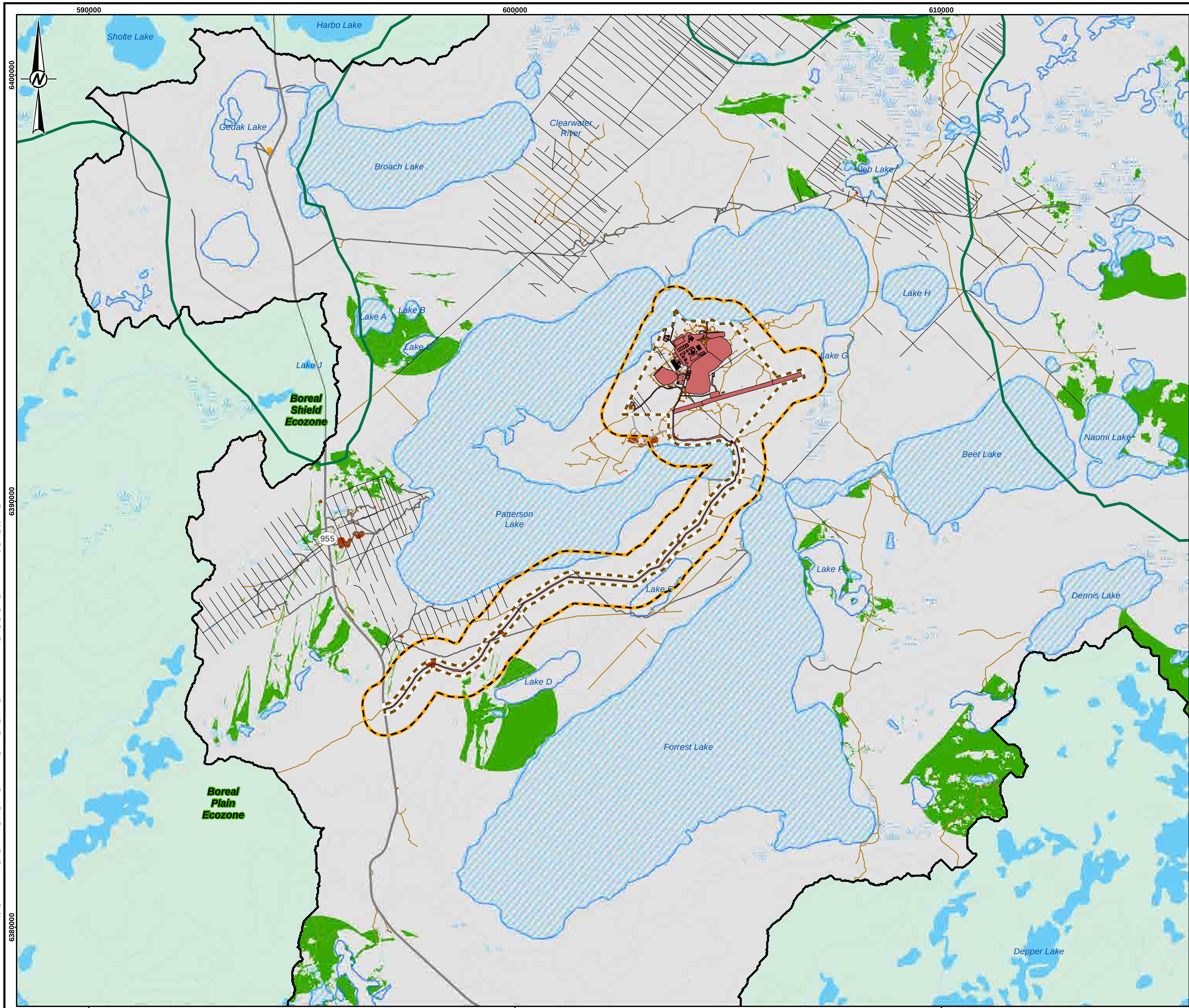
Habitat Arrangement and Connectivity

The maximum disturbance area would remove suitable common goldeneye habitat in the LSA (i.e., local geographic extent; Figure 14.5-32) and Project activities would likely cause some animals to avoid to the LSA. Suitable habitats that are within 100 m of human developments with high levels of activity were assigned an unsuitable rank (Section 14.3.9.1). The loss of suitable habitat is small and expected to occur along the west portion of the access road (Figure 14.5-32). Given the minimal loss of suitable nesting habitat created by the Project relative to what is available in the RSA, it is predicted that there would be a negligible change in the distribution of nesting habitat within the RSA for common goldeneye (Figure 14.5-33). Suitable habitat would remain concentrated in the northeast portion of the RSA, with additional patches located as described in Section 14.3.9.2, Habitat Distribution (Figure 14.5-33).

Common goldeneye is a highly mobile species and capable of flying over disturbed land cover to reach preferred habitats; however, local movement patterns for common goldeneye passing through the LSA may change within 100 m of the maximum disturbance area (i.e., within the LSA) as the species could avoid areas with increased sensory disturbance. While local movements within the LSA may be altered, these changes are not expected in the broader RSA. Habitat distribution and connectivity in the RSA would remain relatively unchanged from existing conditions, and the Project is not expected to impede access to other patches of suitable habitat. Small changes in local movement patterns would be continuous and occur from Construction to beyond the Active Closure Stage until functional common goldeneye habitat is regenerated and sensory disturbance is no longer expected to influence common goldeneye behaviour (Section 14.5.9.1.1, Habitat Availability).

Linear Features

The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-33). The current density of anthropogenic disturbance is likely causing negligible adverse effects on common goldeneye movement and habitat connectivity (Section 14.3.9.2). The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to relative to existing conditions (Section 14.4.2). The anticipated increase in Project-related vehicle traffic could have minor effects on the movement of common goldeneye that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Overall, the Project is predicted to result in small changes to movement and habitat connectivity relative to Base Case in the LSA and RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

COMMON GOLDENEYE NESTING HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

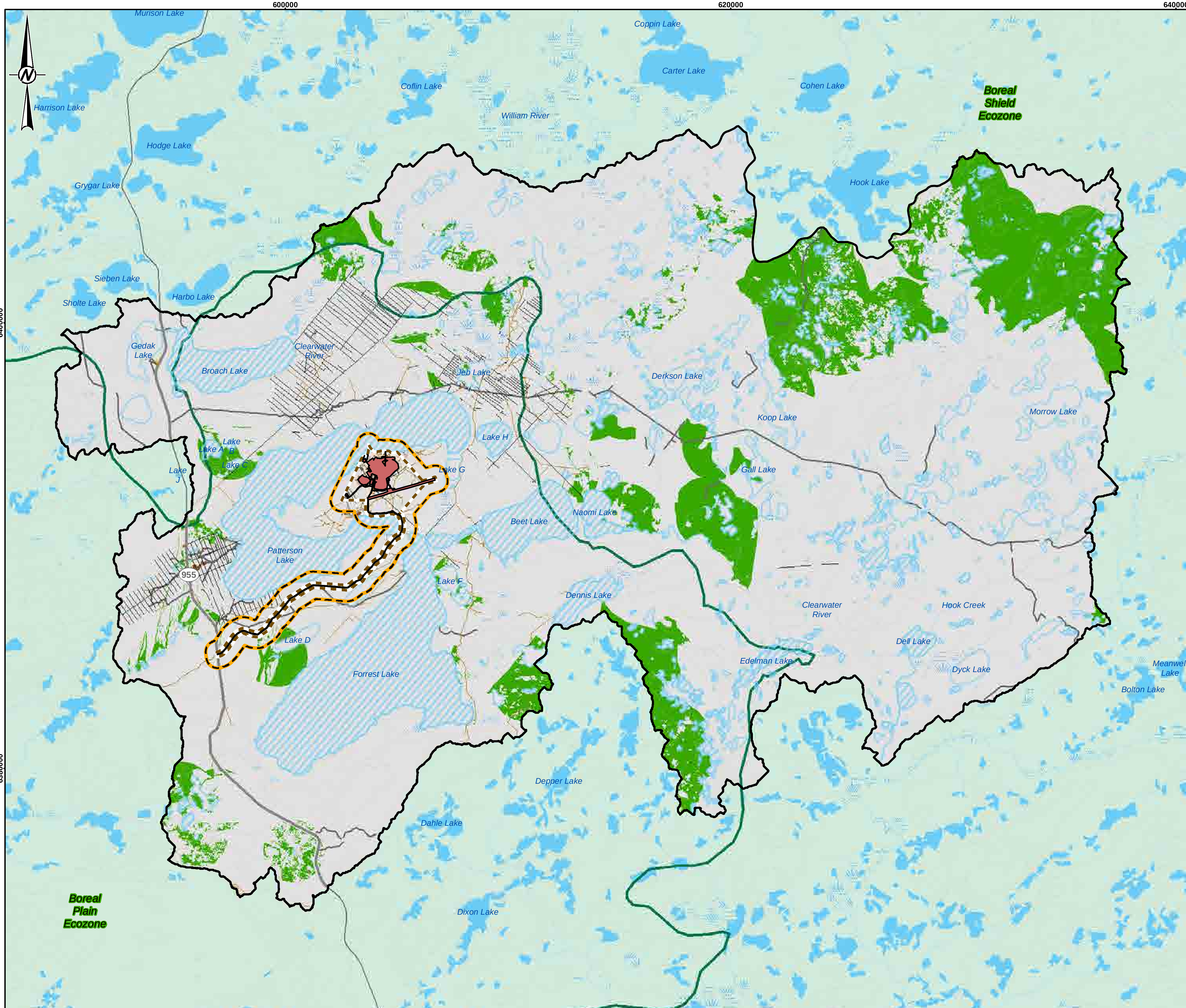
CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-32**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

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COMMON GOLDENEYE NESTING HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

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REVIEW	JV	2023-02-09		

14.5.9.1.3 Survival and Reproduction

Breeding Territory and Population Status

The calculated losses of suitable common goldeneye nesting habitat in the RSA represent less than 0.1% of suitable habitat in the Application Case. The loss of potential suitable nesting habitat may affect reproductive success if individuals are displaced into lower quality habitat. Based on a breeding territory of 0.09 pairs/ha (Eadie et al. 2020), the 3.5 ha loss of suitable habitat in the Application Case represents a small proportion (⅓ or 0.3) of one breeding territory for common goldeneye. Therefore, the potential loss of suitable nesting habitat would unlikely displace more than a single breeding pair. These changes are expected to be well within the resilience and adaptive capacity limits of common goldeneye. Habitat loss would therefore be unlikely to have a measurable effect on the common goldeneye population in the RSA (probability of effect is not expected but not impossible).

Vital Rates

The Project could affect common goldeneye survival through sensory disturbance. As discussed in Section 14.5.9.1.1, cumulative noise levels from existing and Project-related noise during Construction and Operations are not predicted to exceed a maximum of 45 dBA. Noise disturbance during Construction and Operations could affect common goldeneye reproduction in the LSA if it results in nesting females deserting their clutches, which research indicates can happen if the disturbance is during the first two weeks of incubation (Eadie et al. 2020).

Although common goldeneye may avoid areas associated with high levels of human presence and noise, this avoidance is unlikely to influence survival or reproduction because habitat removal resulting from the Project would be minimal and habitat would remain abundant in the RSA. Because nesting habitat may not be the primary limiting factor for the population (Section 14.3.9.1), common goldeneye are expected to be able to shift their home ranges to exclude areas of high disturbance. Changes in habitat from the Project are unlikely to have a measurable effect on survival and reproduction of the common goldeneye population nesting in the RSA.

14.5.9.2 Reasonably Foreseeable Development Case

14.5.9.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable common goldeneye nesting habitat in the RSA. This loss includes the removal of 114.6 ha (0.9%) of suitable habitat in the RSA (i.e., regional geographic extent; Table 14.5-30). The predicted suitable habitat loss is associated with a corresponding increase in the amount of habitat considered not suitable (Table 14.5-30). The Project contribution to future suitable habitat loss is 3.5 ha (Table 14.5-29), representing 3% of the quantified cumulative effect. The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. Effects from changes in the availability of wetland habitat and upland habitat affected by permanent features would be irreversible.

Table 14.5-30: Changes to Common Goldeneye Nesting Habitat Availability in the Regional Study Area for the Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
Suitable	13,103.9	12,989.3	-114.6	-0.9
Not suitable	94,386.8	94,501.4	114.6	0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 60 to 80 years for functional common goldeneye habitat to be regenerated (i.e., mature upland ecosites; Section 14.5.9.1.1). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 95 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As described for the Application Case, indirect loss of common goldeneye habitat from sensory disturbance may lead to nest site abandonment and indirect losses of common goldeneye nesting habitat. In the RFD Case, cumulative noise levels from existing conditions, Project Construction, and Fission Patterson Lake South Property noise levels during construction and full-scale operations (i.e., maximum value for each receptor) are predicted to range from a minimum of 26 dBA during the nighttime period, which represents an increase of 0 dBA relative to existing conditions, to a maximum of 45 dBA, which represents an increase of 3 dBA relative to existing conditions (Section 7.3.5.2). The spatial extent of the increase in noise is predicted be within 10 km of the maximum disturbance area. This increase is expected to result in a negligible effect on habitat availability for common goldeneye in the RSA.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

Wetland ecosystem availability and condition may be affected by climate change in the RFD Case. Based on the climate change assumptions presented in Section 14.2.5, the direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. Common goldeneye nests may be located up to 1.3 km away from water, primarily between 1.5 ha and 20 ha in size (Eadie et al. 2020) though preference for nesting along the shoreline has been found (Pöysä et al. 1999). Climate change induced reductions in the condition, size, or abundance of wetlands and waterbodies could negatively affect common goldeneye nesting habitat availability in the RSA. However, given that common goldeneye prefer a range of waterbodies between 1.5 ha and 20 ha, the reduction in size of waterbodies could result in an overall small loss of habitat.

Fire frequency is expected to increase as a result of weather and climate patterns (Hart et al. 2019). Common goldeneye breed in trees that are old enough to provide suitable nest cavities along wetlands, lakes, and rivers. With a projected increase in mature forest ecosites lost to forest fire, the availability of suitable nesting habitat for common goldeneye is expected to decrease with climate change.

A reduction of habitat availability due to a potential reduction in the size and number of wetlands or waterbodies on the landscape, or increased wildfire resulting in removal of mature trees able to support common goldeneye nesting cavities is expected to have a negative effect on the availability of common goldeneye nesting habitat at the beyond regional geographic extent. The magnitude of habitat change induced by climate change is uncertain; thus, the effects on common goldeneye abundance in the RSA are unknown. It was assumed that climate change would increase adverse effects on habitat availability.

14.5.9.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

Addition of the Fission Patterson Lake South Property would result in a reduction of suitable habitat in the RSA (i.e., regional geographic extent). Suitable habitat is uncommon and patchy in the RSA with larger patches of suitable habitat concentrated in the northeast portion of the RSA in the RFD Case but would be similar to the habitat distribution at Base Case (Figure 14.5-34). Additional losses of suitable nesting habitat for common goldeneye attributed to the Fission Patterson Lake South Property would occur on both sides of Highway 955 in the western portion of the RSA, west of Patterson Lake. The loss of suitable nesting habitat is expected to result in minor losses to nesting habitat connectivity for common goldeneye in this portion of the RSA.

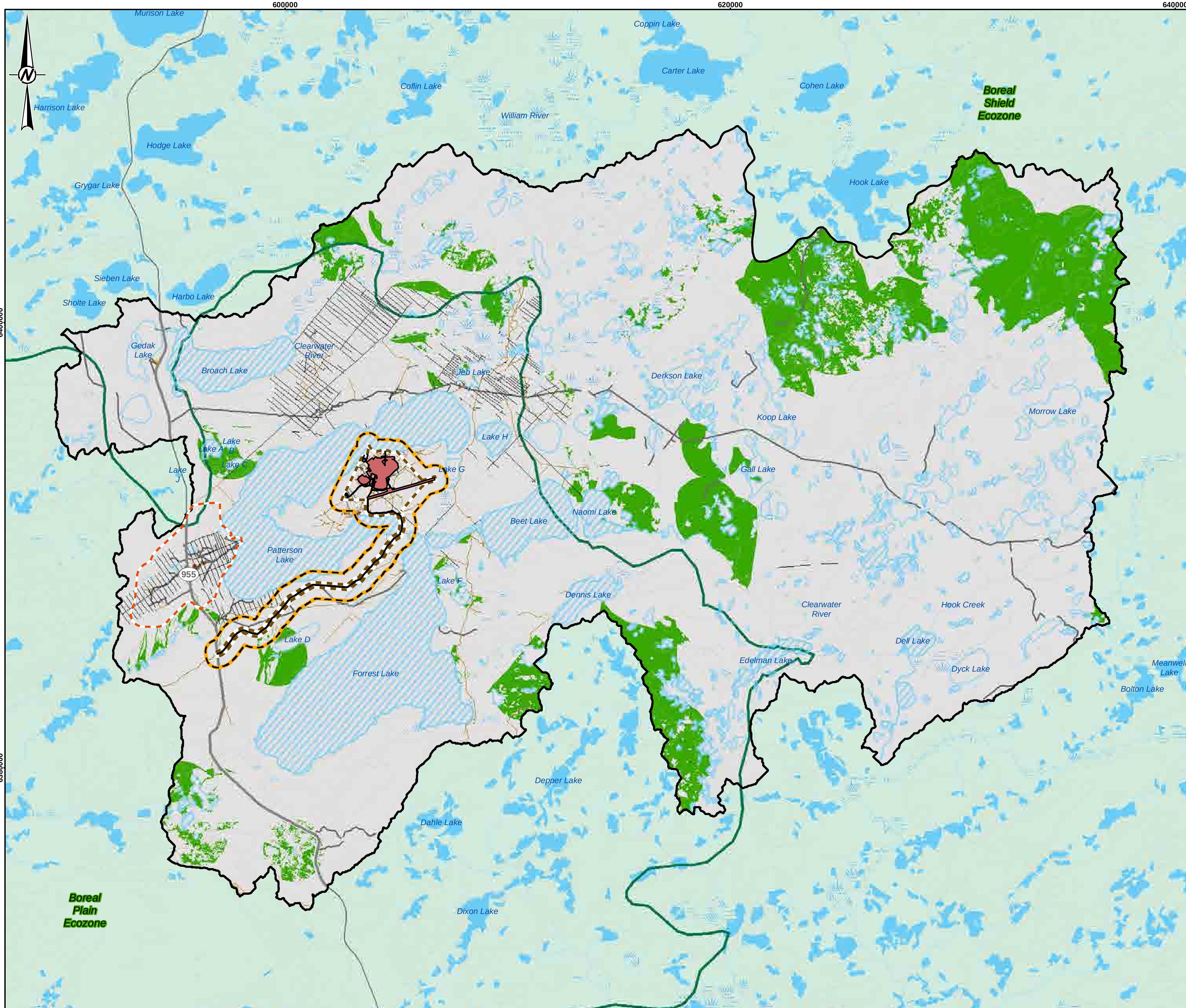
Common goldeneye is a mobile species and capable of flying over disturbed land cover to reach preferred habitats. Small changes in movement patterns and habitat connectivity may change for common goldeneye in the area of Patterson Lake due to increased sensory disturbance from the two developments relative to Base Case conditions. While local movements in these areas may be altered, changes to flight routes selected by common goldeneye are not expected to be altered across the RSA. The largest patches of high suitability nesting habitat in the RSA remain intact; the majority of suitable nesting and stopover habitat in the RSA would remain well connected for common goldeneye in the RFD Case.

Linear Features

The current density of anthropogenic disturbance is likely causing negligible adverse effects on common goldeneye movement and habitat connectivity (Section 14.3.9.2). The Fission Patterson Lake South Property is expected to require a similar number of vehicles to the Project and incrementally increase the number of vehicles on Highway 955 above the Application Case (Section 14.5.9.1.2, Habitat Distribution). The anticipated vehicle traffic in the RFD Case could have minor effects on the movement of common goldeneye that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Overall, the RFD Case is predicted to result in small changes to movement and habitat connectivity relative to the Base Case in the area around Patterson Lake.

Climate Change

As with habitat availability, climate change and wildfire may contribute to changes in the distribution of common goldeneye nesting habitat. An increase in the frequency and intensity of wildfires could alter the distribution of mature forest habitat, which could change where nesting habitat is available. A reduction in the size and availability of wetlands as a result of climate change could also change where suitable habitat occurs throughout the RSA. Common goldeneye are expected to adjust movements between habitat patches given the species' high mobility if climate change alters the configuration of land cover within the RSA.



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)
WATERCOURSE
OPEN WATER (WITHIN THE RSA)
WATERBODY (WITHIN THE RSA)
WATERBODY (OUTSIDE OF RSA)
WETLAND
WOODED AREA
ECOZONE BOUNDARY
LOCAL STUDY AREA
REGIONAL STUDY AREA
PROPOSED PROJECT FOOTPRINT
MAXIMUM DISTURBANCE AREA
PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

ACCESS ROAD
CUTLINE/SEISMIC
SECONDARY HIGHWAY
ROUGH ROAD
TRAIL
NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

SUITABLE
NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

COMMON GOLDENEYE NESTING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.5-34	
REVIEW	JV	2023-02-09		

14.5.9.2.3 Survival and Reproduction

Breeding Territory and Population Status

Quantified losses of suitable nesting habitat for common goldeneye in the RFD Case represent a 0.9% decrease in available suitable habitat in the RSA. Reduction of habitat quality on breeding grounds may occur through removal of suitable cavity-producing trees. Based on a breeding territory of 0.09 pairs/ha (Eadie et al. 2020), the 114.6 ha loss of suitable habitat in the RFD Case represents approximately 10 breeding territories for common goldeneye. This estimate conservatively assumes that suitable habitat for common goldeneye would be fully saturated with breeding pairs. Although the estimated loss of habitat could influence the local abundance of common goldeneye around Patterson Lake, suitable habitat would remain largely intact and available in the RSA for breeding pairs, which is expected to result in negligible effects on the population.

Vital Rates

As discussed in Section 14.5.9.1.1, Habitat Availability, cumulative noise levels from existing and development-related noise are not predicted to exceed a maximum of 45 dBA within 10 km of the maximum disturbance area. The increase in sensory disturbance from the Project and Fission Patterson Lake South Property may possibly have a localized measurable effect on common goldeneye survival and reproduction (i.e., probability of effect may occur but is not likely). Cumulative changes in habitat from the Project and Fission Patterson Lake South Property may result in a small measurable change to the population abundance and distribution of common goldeneye around Patterson Lake. Cumulative habitat loss due to sensory disturbance in the RFD Case should be reversible five years after closure of one of the projects or when there is no temporal overlap between projects.

Climate Change

Climate change is expected to alter the onset of spring and summer resulting in spring and summer beginning earlier in the growing season. Plasticity (i.e., the ability to adapt to environment) in the timing of breeding is important in the population response of common goldeneye to climate-induced changes (Messmer et al. 2021). Common goldeneye, an early nesting species, showed strong plasticity in response to spring temperature and was able to adjust timing for nesting to match annual spring phenology cues (e.g., changes in temperature and daylight; Drever and Clark 2007; Oja and Pöysä 2007; Clark et al. 2014), which is expected to reduce potential effects on population resilience (Messmer et al. 2021). Further, early breeding goldeneye females have also been found to produce more recruited offspring in early and late spring than late-breeding individuals (Clark et al. 2014). Earlier onset of spring conditions as a result of climate change may have positive effects on reproductive success of common goldeneye.

Climate change induced reductions in the condition or abundance of wetlands and waterbodies could negatively affect common goldeneye survival and reproductive output in the RSA. A loss of nesting habitat associated with waterbodies and wetlands could reduce the number of breeding pairs the RSA could support, leading to declines in overall abundance of common goldeneye. Common goldeneye breed in trees mature enough to provide suitable nest cavities along wetlands, lakes, and rivers. An increased frequency of forest fires projected for the region under climate change scenarios could also lead to reduced nesting habitat availability and associated reproductive rates should fires affect a greater proportion of the terrestrial land cover.

Future climate extreme projections for the Project are summarized in Section 14.2.5. The projected future climate extremes indicate a future that is likely to be warmer and wetter on an annual basis. Precipitation is projected to increase, resulting in increased annual total wet-day precipitation, and very wet and extremely wet days. Common causes of mortality for common goldeneye include rain and cold weather after hatching. While cold weather is not predicted, wetter conditions may cause increased mortality to common goldeneye, though effects from a change in precipitation are uncertain.

Climate change is already having an effect on migratory behaviour of waterfowl in North America and around the world (Gunnarsson et al. 2012; Guillemain et al. 2013; Notaro et al. 2016). Waterfowl, including common goldeneye, are altering aspects of their annual migratory flights in response to climate change, including the timing of migration initiation, chosen flight paths, and overwintering locations (Gunnarsson et al. 2012; Notaro et al. 2016). Changes to migration behaviour can have broader implications for survival for waterfowl in the RSA. For example, if waterfowl that breed in the Project RSA are able to travel shorter distances to reach temperate overwintering grounds, this change would result in less energy expended and reduce the risks of mortality associated with making longer migratory movement. The magnitude of changes to survival and reproduction induced by climate change is uncertain. It was conservatively assumed that climate change could increase adverse effects on survival and reproduction of common goldeneye.

14.5.9.3 Residual Effects Classification and Determination of Significance

14.5.9.3.1 Classification Summary

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation (Table 14.5-31). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on common goldeneye. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-31: Classification of Residual Effects on Common Goldeneye Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 3.5 ha removal of suitable nesting habitat, representing a <0.1% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 114.6 ha removal of suitable nesting habitat, representing a 0.9% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (i.e., up to 100 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [includes 100 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 60-80 years to establish late seral stage forests ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property

Table 14.5-31: Classification of Residual Effects on Common Goldeneye Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 60-80 years to establish late seral stage forests ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ One breeding pair may be affected by habitat loss (i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ Loss of 114.6 ha of suitable habitat represents approximately 10 breeding territories (i.e., low magnitude) ▪ Small measurable change in common goldeneye abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Beyond regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 60-80 years to establish late seral stage forests ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property

Table 14.5-31: Classification of Residual Effects on Common Goldeneye Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Survival and reproduction	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; RSA = regional study area; WRSAs = waste rock storage areas; < = less than.

14.5.9.3.2 Significance Determination

Habitat Availability and Distribution

Suitable nesting habitat for common goldeneye is naturally limited in the LSA by the presence of large fish-bearing lakes and recent fires. In the RSA, suitable habitat is also influenced by fire and is patchily distributed with a higher concentration of suitable habitat in the northeast portion of the RSA. Existing anthropogenic disturbance is low (0.4%) and is aggregated in the northwest portion of the RSA and includes Highway 955, the existing exploration camp and access road, trails, and seismic lines / cutlines. Existing anthropogenic disturbance is not predicted to functionally affect movement and habitat connectivity given the high mobility of common goldeneye; however, fire disturbance has resulted in a large amount of unsuitable habitat in the RSA and likely affects the species' movement and distribution in the Base Case. The available information suggests that common goldeneye in the RSA is self-sustaining and ecologically effective under existing conditions.

In the Application Case, the Project is expected to result in a loss of 3.5 ha of suitable habitat, representing less than 0.1% of suitable habitat in the RSA. Changes to habitat availability would likely have limited effects because common goldeneye is a highly mobile species, habitat removal due to the Project is minimal, and 99% of suitable habitat would remain in the RSA. Further, nesting habitat is likely not a primary limiting factor for the population as common goldeneye will use both mature deciduous and coniferous trees within 1.3 km of wetlands and waterbodies. Common goldeneye may avoid the Project, though the species has been observed to be moderately tolerant of sensory disturbance. Overall, the amount of habitat loss due to the Project is not expected to have a measurable effect on common goldeneye abundance as it would unlikely displace more than a single breeding pair. Functional habitat for common goldeneye is predicted to become available 60 to 80 years after the end of the Active Closure Stage when mature forest habitats are regenerated. The Project would be located in a portion of the RSA that contains an aggregation of existing anthropogenic disturbance and is predicted to result in small and localized changes to movement and habitat connectivity relative to the Base Case.

In the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable common goldeneye habitat in the RSA by 0.9%, which could negatively influence the nesting habitat of 10 breeding pairs. The Fission Patterson Lake South Property would also be developed in an area of existing disturbance, and the distribution and connectivity of suitable habitat in the RSA would remain largely unchanged relative to Base Case conditions. Cumulative effects from the two projects would be likely but uncertain given that the Fission Patterson Lake South Property has recently entered the formal regulatory process.

Wetlands are considered one of the ecosystems most sensitive to predicted changes in temperature and to the related alterations in precipitation and timing and volume of snowmelt (Section 14.2.5). The direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. However, if wetlands are reduced, a reduction in common goldeneye nesting habitat may occur because common goldeneye nests primarily occur up to 1.3 km away from waterbodies, between 1.5 ha and 20 ha in size. An increase in the intensity and frequency of wildfires due to climate change could also reduce the amount of suitable nesting habitat by decreasing the availability of trees mature enough to provide suitable nest cavities.

Survival and Reproduction

Common goldeneye is not a federally listed or provincially tracked species, nor is it a species under consideration by the COSEWIC. Under existing conditions, common goldeneye populations in Saskatchewan appear to be stable. Development may result in negligible and small measurable changes to the population abundance and distribution of common goldeneye in the Application Case and the RFD Case, respectively, but the changes should be reversible and localized around the area of Patterson Lake. Climate change may have a positive or adverse effect on survival and reproduction of common goldeneye; therefore, the potential effects are uncertain.

Summary of Significance Determination

Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of common goldeneye populations overlapping the RSA. The weight of evidence from the analysis of the primary pathways and associated mitigation indicates common goldeneye would remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints). Therefore, the residual effects from the Project on the common goldeneye are predicted to be not significant.

Regional changes to the abundance and distribution of common goldeneye from the cumulative effects of the Project and Fission Patterson Lake South Property are predicted in the RFD Case. However, the changes would mostly be observed in the area of Patterson Lake as habitat in most of the RSA would remain undisturbed. Common goldeneye is a highly mobile species and can accommodate moderate levels of anthropogenic disturbance. In the Base Case, the RSA has a low level of anthropogenic disturbance that is highly aggregated in the western portion of the study area where development of the two projects would occur. Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Common goldeneye is predicted to remain self-sustaining and ecologically effective in the RFD Case. Overall, the residual effects from the Project and Fission Patterson Lake South Property on common goldeneye are predicted to be not significant. Effects from climate change are potentially adverse but are not expected to significantly influence the abundance and distribution of common goldeneye and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.10 Mallard

14.5.10.1 Application Case

The residual effects analysis for mallard focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of mallard habitat and affect mallard abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect mallard habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter mallard movement and behaviour and adversely affect mallard habitat availability and mallard abundance and distribution.

14.5.10.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Construction of Project infrastructure would reduce the availability of suitable mallard nesting habitat in the LSA and RSA. A loss of 142.1 ha of high suitability habitat is predicted in the LSA, which represents a change of 0.5% of high suitability habitat in the RSA (Table 14.5-32). No loss of moderate suitability habitat is predicted as a result of the Project. The remaining habitat loss would occur in areas of low habitat suitability (0.2%). Overall, the Project would disturb 187.2 ha (0.3%) of suitable nesting habitat in the RSA relative to the Base Case. The predicted habitat losses are associated with a corresponding increase in the amount of poor suitability habitat (Table 14.5-32). The majority of changes to mallard habitat availability in the Application Case would result from direct removal of habitat; however, some additional indirect losses of habitat due to sensory disturbance would be anticipated for this species. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and to be continuous from Construction through Closure.

The loss of nesting habitat in the RSA is also likely representative of potential losses to stopover habitat for migrating individuals that do not breed in the RSA. Given the abundance and extent of available waterbodies in the RSA that could be used for stopover habitat during migration, the small loss of suitable riparian and wetland habitat due to the Project is not expected to influence migrating individuals. The size and abundance of alternative waterbodies in the RSA could provide multiple options for stopover locations should individuals avoid habitat in proximity to the maximum disturbance area. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Table 14.5-32: Changes to Mallard Nesting Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
High	29,103.9	28,961.8	-142.1	-0.5
Moderate	96.8	96.8	0.0	0.0
Low	24,432.6	24,387.5	-45.1	-0.2
Poor	53,857.4	54,044.6	187.2	0.3

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the upland ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). The WRSAs are not anticipated to disturb wetland ecosystems (Section 13.5.2.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1.1). Effects from habitat loss are predicted be reversible after the Active Closure Stage. In upland habitats, functional habitat for mallard is expected to become available 6 to 10 years after the Active Closure Stage because the species often nests in dense shrubby or grassy vegetation (Drilling et al. 2020; i.e., a duration of 43 years).

Sensory Disturbance

Although mallard is known to be resilient to disturbance (Section 14.3.10.1, Habitat Availability), sensory disturbance associated with site preparation or Operations may still lead to indirect changes in mallard nesting habitat. Mallards were conservatively assumed to avoid some areas within 100 m of the Project within the LSA (i.e., local geographic extent).

Noise levels greater than 63 dBA may negatively affect some waterbird species (Conomy et al. 1998), though other species have been reported to tolerate noise levels of 55 dBA to 100 dBA (Black et al. 1984). In the Application Case, the minimum cumulative noise level (i.e., existing conditions plus the Project) during Construction and Operations in the noise RSA is predicted to be 26 dBA during the nighttime and the maximum cumulative noise level is predicted to be 45 dBA during the daytime (Section 7.3.5.1).

While the precise threshold for avoidance of habitat by mallard due to sensory disturbance is not known, avoidance of noisy areas was assumed to be less for mallards than some other waterbird species. Although habitat would not be directly removed, the quality of nesting or stopover habitat could be reduced, leading to avoidance by mallard. Sensory disturbance effects from the Project would most likely occur during Construction and the Active Closure Stage when heavy equipment use and the number of people on site would be highest. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible 5 years after Closure (i.e., a duration of 48 years).

14.5.10.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

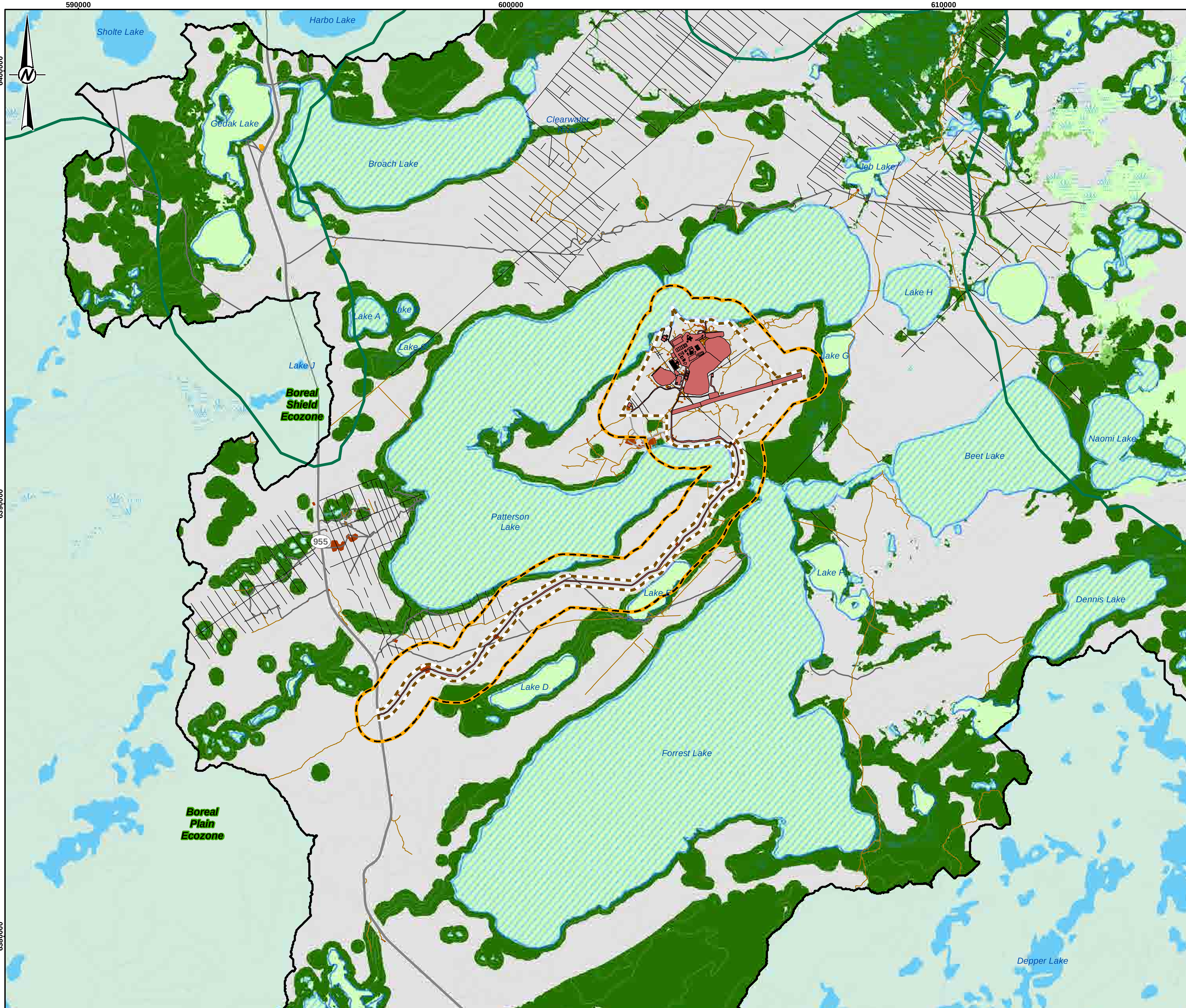
The maximum disturbance area would remove suitable mallard habitat in the LSA (i.e., local geographic extent; Figure 14.5-35), and Project activities would likely cause some birds to avoid to the LSA. Suitable habitats that are within 100 m of human developments with high levels of activity were assigned an unsuitable (i.e., poor quality) rank as a precautionary approach (Appendix 14B). The loss of 0.3% of suitable habitat would occur along the margins of Patterson Lake and in a patch of regenerating burned treed bog that occurs in the southwest margin of the maximum disturbance area (Figure 14.5-35). Given the minimal loss of suitable nesting habitat relative to what is available in the RSA, and because mallard do not exhibit strong breeding site fidelity (Section 14.3.10.2, Habitat Distribution), any change in the distribution of nesting habitat within the RSA for mallard would have negligible effects (Figure 14.5-36). Suitable nesting habitat remains widespread and abundant in the RSA in the Application Case. The largest and most connected patches of high suitability habitat in the south and southwest portions of the RSA are expected to remain unaffected by the Project in the Application Case (Figure 14.5-36).

At a local scale, mallard may alter movement corridors in the LSA, particularly during periods of high levels of activity at the Project (i.e., Construction and the Active Closure Stage). Mallards are capable of flying large distances between suitable habitat patches and are expected to be resilient to changes in habitat connectivity in the LSA and RSA. High suitability habitat available in other portions of Patterson Lake and other nearby waterbodies would remain available and accessible to mallards.

Linear Features

The existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-33). The expansion of the access road is not expected to increase movement barriers in the LSA compared to Base Case because the road is already present on the landscape and mallards generally do not avoid roadways when selecting habitat in their breeding range (Skaggs et al. 2020).

The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (Section 14.4.2). The anticipated increase in Project-related vehicle traffic on Highway 955 during Construction, Operations, and Closure is not expected to have a measurable effect on mallard habitat connectivity in the RSA. The Project is not expected to interfere with migrating individuals passing over the LSA and RSA. The current density of anthropogenic disturbance is likely causing negligible adverse effects on mallard movement and habitat connectivity (Section 14.3.10.2). The Project would not increase the density of existing linear features and is predicted to also result in negligible changes to movement and habitat connectivity relative to Base Case in the LSA and RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF LSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MALLARD NESTING HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

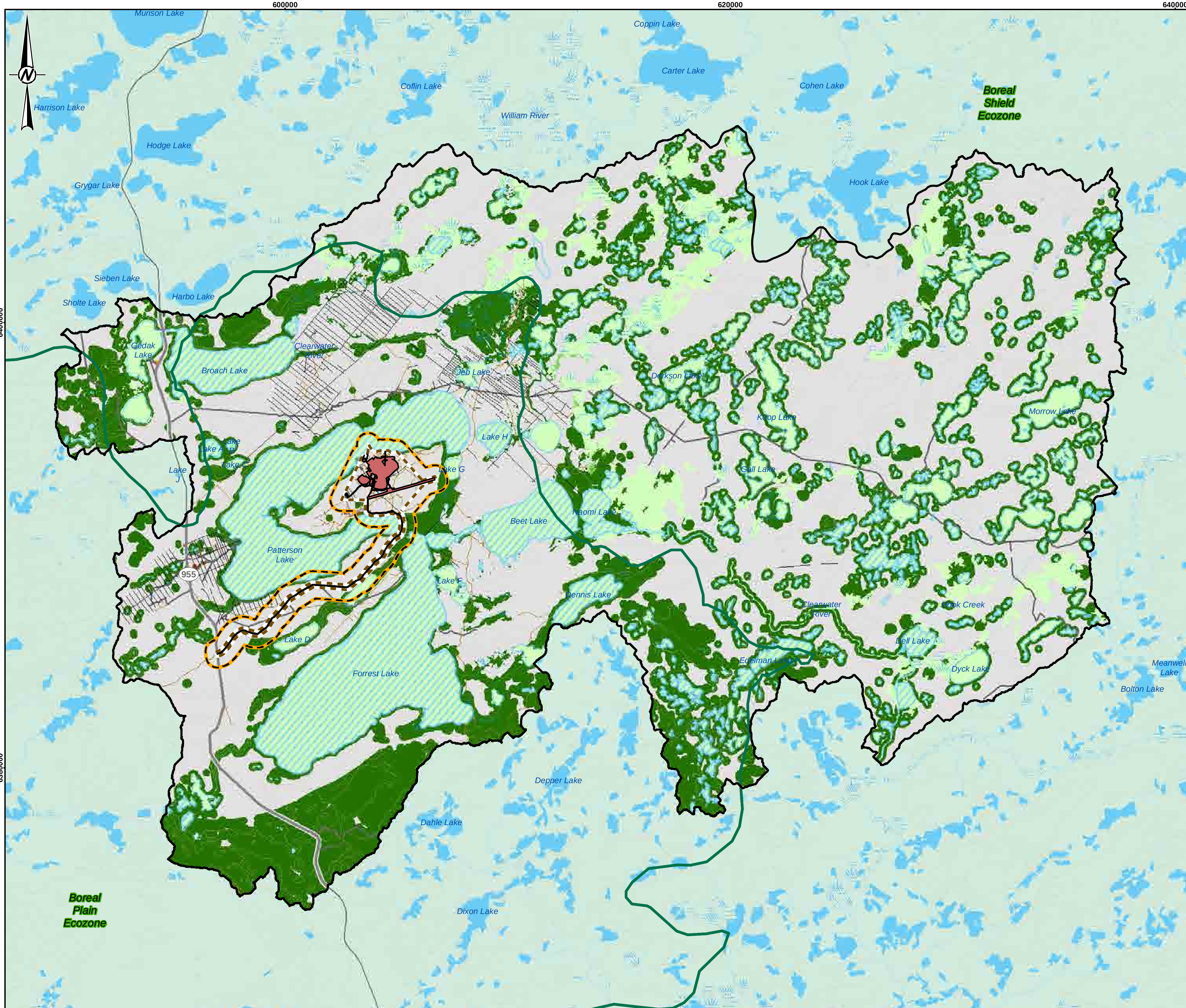
CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-35**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MALLARD NESTING HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	**FIGURE 14.5-36**	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

14.5.10.1.3 Survival and Reproduction

Vital Rates and Population Status

The Project could affect mallard survival through habitat loss and sensory disturbance. Removal of suitable nesting habitat in Application Case is expected to displace some breeding pairs from the LSA, leading to a negligible and localized reduction in reproduction in the Application Case. However, mallards are known to have high reproductive potential and can re-nest if the first nest fails (Section 14.3.10.3, Survival and Reproduction). Given the small amount of habitat loss relative to the abundance of high suitability nesting habitat elsewhere in the RSA, Project-related habitat loss is not expected to influence the reproductive rate of the regional population (i.e., effect is not expected but not impossible) and is predicted to be reversible.

As discussed in Section 14.3.10.3, sensory disturbance associated with the Project could lead to declines in survival or reproduction if individuals alter their behaviour in response to noise or stimuli. Sensory disturbance associated with the Project (e.g., noise, passing vehicles, presence of people) could result in reduced survival among adults occupying breeding or stopover habitat near the maximum disturbance area. Increased human activity in the LSA associated with the Project could lead to reduced reproduction rates for breeding pairs that choose to nest near the maximum disturbance area. Alternatively, as described in Section 14.3.10.1, mallards are also considered relatively tolerant of anthropogenic disturbance and often occupy habitats within human-modified landscapes. The Project is expected to result in a small reduction in mallard reproduction in the LSA; however, these localized effects are predicted to not have wider consequences for the population occupying the RSA (i.e., probability of the effect is unlikely). The effects of Project-related sensory disturbance are expected to extend to five years beyond Closure (i.e., a duration of 48 years).

14.5.10.2 Reasonably Foreseeable Development Case

14.5.10.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable nesting habitat for mallard. This loss includes the removal of 520.6 ha (1.8%) of high suitability habitat, no moderate suitability habitat, and 99.6 ha (0.4%) of low suitability in the RSA (Table 14.5-33). Overall, the Project and Fission Patterson Lake South Property would disturb 620.2 ha (1.1%) of suitable nesting habitat in the RSA relative to the Base Case. These estimates include indirect losses of mallard nesting habitat as a result of avoidance behaviour in proximity to development footprints. The Project contribution to future loss of habitat is 187.2 ha (Table 14.5-32), representing 30.2% of the quantified cumulative effect. The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed habitat. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regularly process. Effects from changes in the availability of wetland habitat and to upland habitat affected by permanent features would be irreversible.

Table 14.5-33: Changes to Mallard Nesting Habitat Availability in the Regional Study Area for the Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
High	29,103.9	28,583.2	-520.6	-1.8
Moderate	96.8	96.8	0.0	0.0
Low	24,432.6	24,333.1	-99.6	-0.4
Poor	53,857.4	54,477.6	620.2	1.2

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 6 to 10 years for functional mallard habitat to be regenerated (i.e., early seral stage upland ecosites; Section 14.5.10.1.1, Habitat Availability). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 25 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

In the RFD Case, cumulative noise levels from existing conditions, Project Construction, and Fission Patterson Lake South Property noise levels during construction and full-scale operations (i.e., maximum value for each receptor) are predicted to be 45 dBA, which represents an increase of 3 dBA relative to existing conditions (Section 7.3.5.2). Avoidance within 100 m of high disturbance activities at the Project and the Fission Patterson Lake South Property may occur due to sensory disturbance.

The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

As discussed in Section 14.2.5, wetland ecosystem availability and condition may be affected by climate change in the RFD Case. The direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. Mallards require a readily available food supply and small area of open water for roosting and nesting (Drilling et al. 2020). A reduction in wetland availability and condition on the landscape is expected to have adverse effects on the availability of mallard breeding and stopover habitat (Loesch et al. 2012). Climate change is also expected to alter lake productivity in the boreal region of North America, but effects vary widely depending on lake size and air temperature and relationships between phytoplankton and zooplankton (Arnott et al. 2003; Corcoran et al. 2008). The magnitude of the effect of climate change on mallard habitat availability or habitat quality is uncertain because climate change predictions are based on simulations that can be highly variable.

Increased wildfire activity could also result from changes in long-term precipitation patterns in the RSA. Mallard populations in the western boreal forest appear to be resilient to forest fires, with no changes in abundance noted between pre- and post-fire periods for fires of all sizes (Lewis et al. 2016). As such, changes to wildfire regimes are not anticipated to have a large influence on the mallard population that overlaps the RSA.

A reduction of habitat availability due to a potential reduction in the size of wetlands or waterbodies on the landscape is expected to have a negative effect on the availability of mallard nesting habitat at the beyond regional geographic extent. However, the magnitude of habitat change induced by climate change is uncertain, thus the effects on mallard abundance in the RSA are unknown. It was conservatively assumed that climate change would increase adverse effects on habitat availability.

14.5.10.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

In the RFD Case, suitable nesting habitat for mallard remains widespread and abundant in the RSA (Figure 14.5-37). Additional losses of suitable nesting habitat attributed to the Fission Patterson Lake South Property would occur on both sides of Highway 955 in the western portion of the RSA. The Fission Patterson Lake South Property is expected to affect high suitability habitat on the western margins of Patterson Lake, as well as scattered patches of wetland habitat associated with a creek that occurs west of the lake (Figure 14.5-37). The loss of the wetland habitat to the west of Patterson Lake is expected to result in a minor decrease to nesting habitat connectivity for mallard in this portion of the RSA. In the RFD Case, the largest patches of high suitability nesting habitat in the RSA would remain intact. Localized changes in the movement patterns of mallard are possible around the Project footprint and around the Fission Patterson Lake South Property footprint; however, abundant suitable nesting and stopover habitat in the RSA would remain available and well connected.

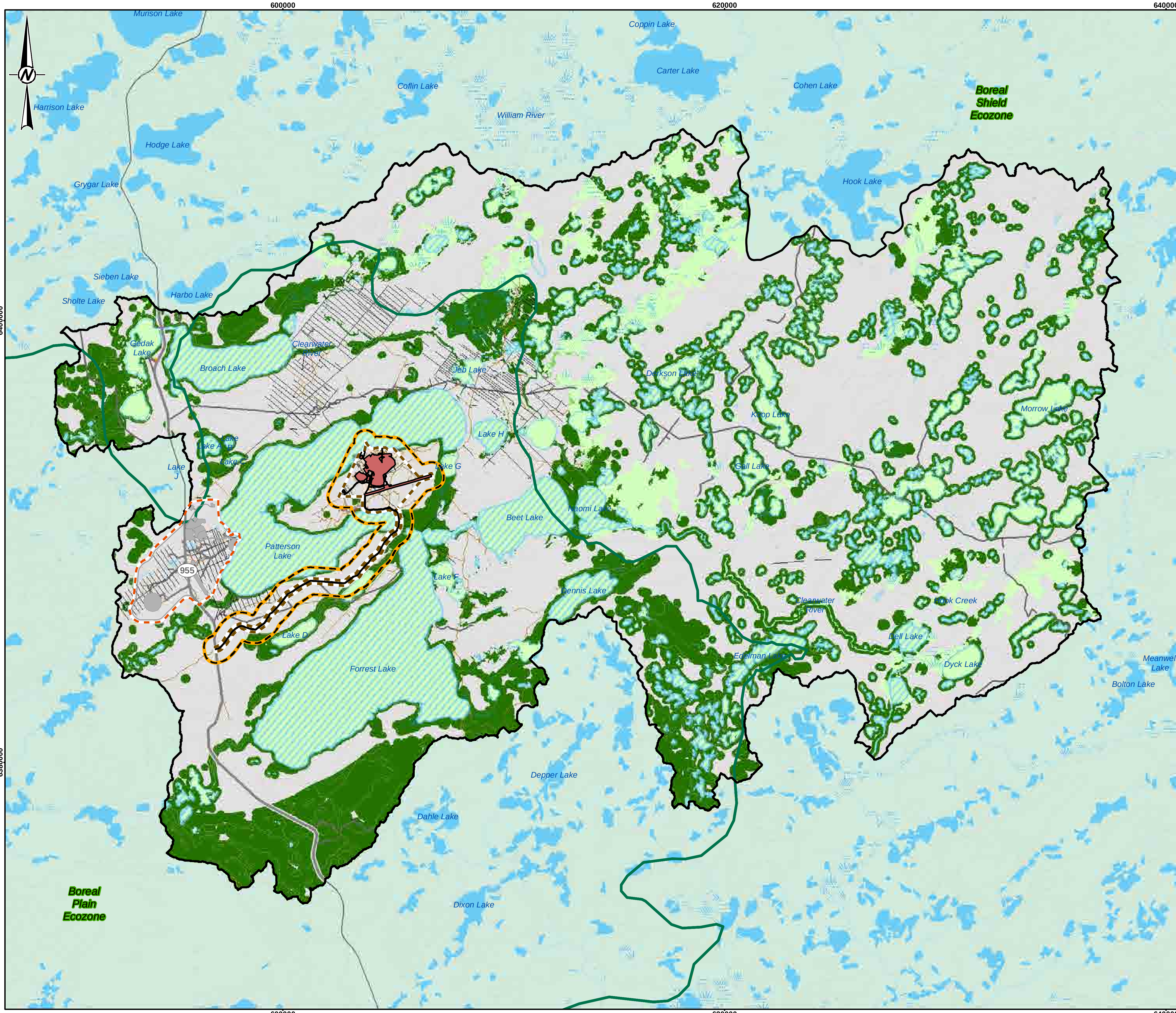
Mallard is a highly mobile species and capable of flying over disturbed land cover to reach preferred habitats. Small changes in movement patterns and habitat connectivity may change for mallards nesting in the area of Patterson Lake due to increased sensory disturbance from the two developments relative to Base Case conditions. However, the Project and the Fission Patterson Lake South Property are not expected to measurably change mallard movement or habitat distribution in the RSA.

Linear Features

The current density of anthropogenic disturbance is likely causing negligible adverse effects on mallard movement and habitat connectivity (Section 14.3.10.2). The Fission Patterson Lake South Property is expected to require a similar number of vehicles to the Project and incrementally increase the number of vehicles on Highway 955 above the Application Case (Section 14.5.10.1.2, Habitat Distribution). The anticipated vehicle traffic in the RFD Case could have minor effects on the movement of mallard that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect). Overall, the RFD Case is predicted to result in small changes to movement and habitat connectivity relative to the Base Case in area around Patterson Lake.

Climate Change

As with habitat availability, further alterations in the arrangement and connectivity of nesting habitat in the RSA could result from climate-induced effects. A reduction in the availability and condition of wetlands as a result of climate change could change where suitable habitat occurs throughout the RSA. Mallard is expected to adjust movements between habitat patches given the species' high mobility if climate change alters the configuration of land cover within the RSA. The magnitude and location of these potential effects are uncertain. It was assumed that climate change effects could increase adverse effects on habitat distribution and connectivity.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

MALLARD NESTING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-37**	
REVIEW	JV	2023-02-09		

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14.5.10.2.3 Survival and Reproduction

Vital Rates and Population Status

Quantified losses of suitable nesting habitat for mallard in the RFD Case represent a 1.1% decrease in available suitable habitat; however, suitable habitat remains intact and common across the RSA. Given the limited loss of nesting habitat relative to available habitat in the RSA, and the species' adaptability in its habitat preferences, estimated losses in the RFD Case may possibly have a localized measurable effect on mallard survival and reproduction but are not likely (i.e., probability of effect is possible). Cumulative changes in habitat from the Project and Fission Patterson Lake South Property may result in a small measurable change to the abundance and distribution of mallard around Patterson Lake. Cumulative habitat loss due to sensory disturbance in the RFD Case should be reversible five years after closure of one of the projects or when there is no temporal overlap between projects.

Climate Change

Climate change induced reductions in the availability or condition of wetlands and waterbodies in the RFD Case could negatively affect mallard survival and reproductive output in the RSA. Mallards primarily establish their nests in terrestrial environments in close proximity to waterbodies and wetlands or within dense emergent vegetation of waterbodies (Drilling et al. 2020). A loss of nesting habitat associated with a decline in waterbodies and wetlands would reduce the number of breeding pairs the RSA could support, leading to a decline in overall abundance of mallard in the RSA. However, an increased frequency of forest fires projected for the region is not anticipated to negatively affect mallard upland habitat availability in the RFD Case, as pre- and post-fire areas have similar mallard abundance (Lewis et al. 2016).

Climate change is already having an effect on migratory behaviour of waterfowl in North America and around the world (Guillemain et al. 2013; Gunnarsson et al. 2012; Notaro et al. 2016). Waterfowl, including mallards, are altering aspects of their annual migratory flights in response to climate change, including the timing of migration initiation, chosen flight paths, and overwintering locations (Gunnarsson et al. 2012; Notaro et al. 2016). Changes to migration behaviour can have broader implications for survival for waterfowl in the RSA. For example, if waterfowl that breed in the RSA are able to travel shorter distances to reach temperate overwintering grounds, this would result in less energy expended and reduce the risks of mortality associated with making longer migratory movement. Changes in climate that affect survival and reproduction would have effects beyond the RSA scale; however, the magnitude of changes to survival and reproduction induced by climate change is uncertain. It was conservatively assumed that effects from climate change are expected to result in a small measurable change to mallard abundance and distribution in the RSA.

14.5.10.3 Residual Effects Classification and Determination of Significance

14.5.10.3.1 Classification Summary

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation (Table 14.5-34). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1), and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on mallard. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case were determined according to the methods described in Section 14.2.9.

Table 14.5-34: Classification of Residual Effects on Mallard Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 142.1 ha removal of high suitability nesting habitat, representing a 0.5% reduction in the RSA (i.e., low magnitude) ▪ No removal of moderate suitability nesting habitat ▪ 45.1 ha removal of low suitability nesting habitat, representing a 0.2% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 520.6 ha removal of high suitability nesting habitat, representing a 1.8% reduction in the RSA (i.e., low magnitude) ▪ No removal of moderate suitability nesting habitat ▪ 99.6 ha removal of low suitability nesting habitat, representing a 0.4% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (up to 100 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [includes 100 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 43 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish nesting habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due high mobility of species)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 43 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation plus 6-10 years to establish nesting habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous

Table 14.5-34: Classification of Residual Effects on Mallard Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat distribution	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ Small measurable change in mallard abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 43 years = 33 years (start of Construction to end of the Active Closure Stage), plus 6-10 years to establish nesting habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; RSA = regional study area; WRSAs = waste rock storage areas.

14.5.10.3.2 Significance Determination

Habitat Availability and Distribution

A loss of 142.1 ha of suitable mallard breeding habitat is predicted in the Application Case. This loss represents 0.5% of the available suitable habitat at the scale of the RSA. It also accounts for indirect losses of habitat due to sensory disturbance that may or may not affect the nesting behaviour of this relatively disturbance-tolerant species. Functional habitat for mallard is predicted to become available 6 years to 10 years after the end of the Active Closure Stage. Removal of suitable nesting habitat is expected to displace some breeding pairs from the LSA, leading to a negligible and localized reduction in reproduction in the Application Case. However, mallards are known to have high reproductive potential and can re-nest if the first nest fails (Section 14.3.10.3). Given the small amount of habitat loss relative to the abundance of high suitability nesting habitat elsewhere in the RSA, the Project-related habitat loss is not expected to influence the reproductive rate of the population.

The majority of suitable habitat loss is expected to occur in burned treed bog along the margins of Patterson Lake, which would alter habitat distribution conditions for mallard in this portion of the LSA. Changes to habitat distribution conditions would be continuous and would last for at least 39 years before functional habitat has been reclaimed. Suitable nesting habitat would remain widespread and abundant elsewhere in the RSA in the Application Case. The largest and most connected patches of high suitability habitat in the south and southwest portions of the RSA are expected to remain unaffected by the Project. Given the high mobility of the species, effects of the Project on habitat distribution would be restricted to the LSA in the Application Case and are expected to be of low magnitude.

In the RFD Case, the Project and the Fission Patterson Lake South Property would reduce the availability of high suitability nesting habitat for mallard in the RSA by 520.6 ha, which represents 1.8% of all high suitability breeding habitat available in the RSA under existing conditions. These estimates include indirect losses of mallard nesting habitat as a result of avoidance behaviour in proximity to development footprints. The contribution by the Project to future loss of habitat is 187.2 ha, representing 30.2% of the quantified cumulative effect. Direct and indirect loss of suitable breeding habitat for mallard is expected to be regional in scale and reversible following habitat restoration. Climate change and its effect on forest fires and drought has the potential to result in additional loss of habitat availability in the RSA for mallard. The magnitude of the effect of climate change on mallard habitat availability is uncertain.

Similar to the Application Case, habitat distribution conditions for mallard in the RFD Case are expected to be negatively affected in localized areas surrounding the Project and the Fission Patterson Lake South Property. Effects are expected to be continuous, reversible following the restoration of functional habitat, and of low magnitude (i.e., small measurable changes). The RSA is characterized by abundant and widespread permanent waterbodies and wetlands that represent high suitability breeding habitat for mallard. Despite anticipated changes to habitat distribution in the RFD Case, suitable habitat in the RSA is expected to remain widespread and connected on the landscape. Climate change is expected to have some effect on the distribution of ephemeral wetlands on the landscape.

Survival and Reproduction

Mallard is the most abundant duck species in North America and can be found in almost any wetland or waterbody habitat varying from lakes to ephemeral wetlands. Mallard is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021), nor is it a species under consideration by the COSEWIC (Government of Canada 2023). Breeding population estimates for mallard in Saskatchewan increased between 2007 (8.4 million birds) and 2016 (11.8 million birds; Government of Saskatchewan 2017). Development is not expected to have a measurable effect on mallard survival and reproduction in both the Application Case and the RFD Case.

Climate change effects on migration may have positive effects on mallard, though changes to habitat availability are expected to have a negative effect on mallard survival and reproduction in the RFD Case. Changes in climate that affect survival and reproduction would have effects beyond the RSA scale; however, the magnitude of change to survival and reproduction induced by climate change is uncertain.

Summary of Significance Determination

Mallard is predicted to remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints). Overall, the incremental changes to mallard habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the regional population. Therefore, the residual effects from the Project on mallard are predicted to be not significant.

Mallard is a resilient and adaptable species with strong population trends in North America and western Canada. While there are negative effects anticipated for the species in the RSA in the RFD Case, the magnitude of the effects is expected to be small, and mallard is predicted to remain self-sustaining and ecologically effective (i.e., there is no predicted change in the assessment endpoints). Overall, the cumulative changes to mallard habitat availability, habitat distribution, and survival and reproduction from previous and existing developments, the Project, and the Fission Patterson Lake South Property in the RFD Case are expected to remain within the resilience and adaptability limits of the regional population. Therefore, the residual effects from the Project and the Fission Patterson Lake South Property on the mallard are predicted to be not significant. Effects from climate change are potentially adverse but are not expected to significantly influence the abundance and distribution of mallard and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.11 Canadian Toad

14.5.11.1 Application Case

The residual effects analysis for Canadian toad focused on evaluating the following pathways:

W-01: Habitat loss:

- Direct removal or alteration of soil and vegetation can cause loss of Canadian toad habitat and affect Canadian toad abundance and distribution.

W-02: Habitat alteration:

- Alteration of final terrain and soil conditions, and/or plant species composition, could change the types of ecosystems that can be reclaimed on the landscape and adversely affect Canadian toad habitat availability and distribution, and survival and reproduction.

W-03: Sensory disturbance:

- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise) can alter Canadian toad movement and behaviour and adversely affect toad habitat availability and toad abundance and distribution.

14.5.11.1.1 Habitat Availability

Direct Habitat Loss and Alteration

Overwintering and Dispersal Habitats

The availability of upland habitats associated with sandy and well-drained soils is high in the LSA and RSA, suggesting that hibernation habitat may not be limited. However, overwintering habitat is a key factor influencing the distribution of Canadian toad and the Project has the potential to remove Canadian toad overwintering habitat during vegetation clearing, grading, or earth moving activities. Removal of overwintering habitat may affect the availability of habitat for Canadian toad in the area of Patterson Lake.

In upland habitats, functional habitat for Canadian toad is expected to become available 6 to 10 years after the Active Closure Stage when vegetation would be established enough to provide shelter for foraging individuals. The duration of effects on hibernation habitat are uncertain but would likely occur until mature forested habitat is present on the landscape. It would take 60 to 80 years beyond the Active Closure Stage for ELC units to establish mature forest types that are present under existing conditions. The effect of direct losses to hibernacula would be reversible.

Breeding Habitat

A loss of 27 ha of suitable Canadian toad breeding habitat is predicted for the LSA, representing approximately 0.2% of the available suitable breeding habitat in the RSA (Table 14.5-35). Approximately 15,300 ha of suitable breeding habitat would remain in the RSA in the Application Case. The effect from direct habitat loss would be certain, confined to the maximum disturbance area, and continuous from Construction through Closure.

Land clearing and vegetation removal could cause direct loss in wetland habitat used for breeding or degradation of breeding habitat through water drawdown or increased sedimentation. The Project would potentially result in the direct removal of established breeding ponds, as well as potential overwintering sites (i.e., hibernacula). Construction in previously disturbed areas, such as along the existing ditches of the access road, may alter temporary pockets of standing water or wet drainages that could be important for amphibian breeding and dispersal, respectively. The current footprint of disturbance was designed to avoid wetlands as much as practical, but a wetland offset plan would be developed, if required, to adhere to the Federal Policy on Wetland Conservation (Government of Canada 1991) to have no net loss of wetland functions. For the assessment, losses to wetland habitat are conservatively assumed to be irreversible.

Table 14.5-35: Changes to Canadian Toad Breeding Habitat Availability in the Regional Study Area at Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent Change (%)
Suitable	15,325.8	15,298.6	-27.0	-0.2
Not suitable	92,164.9	9,2192.1	27.0	<0.1

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
< = less than.

During Construction, removal of vegetation and ground recontouring may lead to the creation of ephemeral pools of water on the landscape, which could be exploited by Canadian toads in the area. An increase in the occurrence of standing water on the landscape would theoretically increase the number of potential breeding sites for Canadian toads but not necessarily increase the number of high-quality breeding sites. Man-made ephemeral bodies of water can act as ecological sinks for breeding amphibians (i.e., habitats that are occupied by a population because they are perceived to be suitable but actually lead to population declines) because of their unpredictable hydroperiod (i.e., time of the year when ponds hold water; Stevens et al. 2006).

Breeding habitat would also be potentially affected by adverse effects on beavers. For example, beaver dam removal or elimination of pest beavers could reduce the availability of Canadian toad breeding habitat.

While permanent features of the Project (e.g., WRSAs) would be reclaimed, vegetation communities anticipated to establish on these features would likely not be representative of the upland ecosites not influenced by the Project; therefore, effects are conservatively considered permanent and irreversible (Section 13.5.1.1.1). The WRSAs are not anticipated to disturb wetland ecosystems (Section 13.5.2.1.1). NexGen would undertake progressive reclamation of areas no longer required for Project activities, as well as decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclamation is predicted to reverse effects on disturbed ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with similar function to natural ecosystems not influenced by the Project; however, vegetation ecosystems (i.e., wildlife habitat) would most likely differ to some degree from those present before disturbance (Section 13.5.1.1).

Canadian toad will breed in ephemeral pools with limited emergent vegetation (Russell and Bauer 2000), which are also expected to be present on the landscape at 6 to 10 years after the Active Closure Stage. Functional habitat for Canadian toad is expected to become available 6 to 10 years after the Active Closure Stage when vegetation would be established enough to provide shelter for foraging individuals (i.e., a duration of 43 years). The quality of breeding habitat present at Closure may be low if it does not occur in proximity to suitable foraging and hibernation habitat (i.e., Canadian toads rely on interconnected breeding, foraging, and hibernation habitat).

Sensory Disturbance

As discussed in Section 14.3.11.1, Habitat Availability, sensory disturbance on the landscape could potentially lead to a decline in the quality of Canadian toad breeding habitat. Indirect habitat loss associated with the Project would primarily occur during the breeding season, in May and June when noise disturbance could disrupt advertisement calls made by males. Literature on ZOIs for Canadian toad is limited; however, suitable breeding habitats within 90 m of human developments with high and medium levels of activity (e.g., Highway 955, existing access road,) were assigned a suitability rank of poor (Table 14.3-16) based on the ENV (2017) recommended setback distances. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3), but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, effects from sensory disturbance are predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., a duration of 48 years).

14.5.11.1.2 Habitat Distribution

Habitat Arrangement and Connectivity

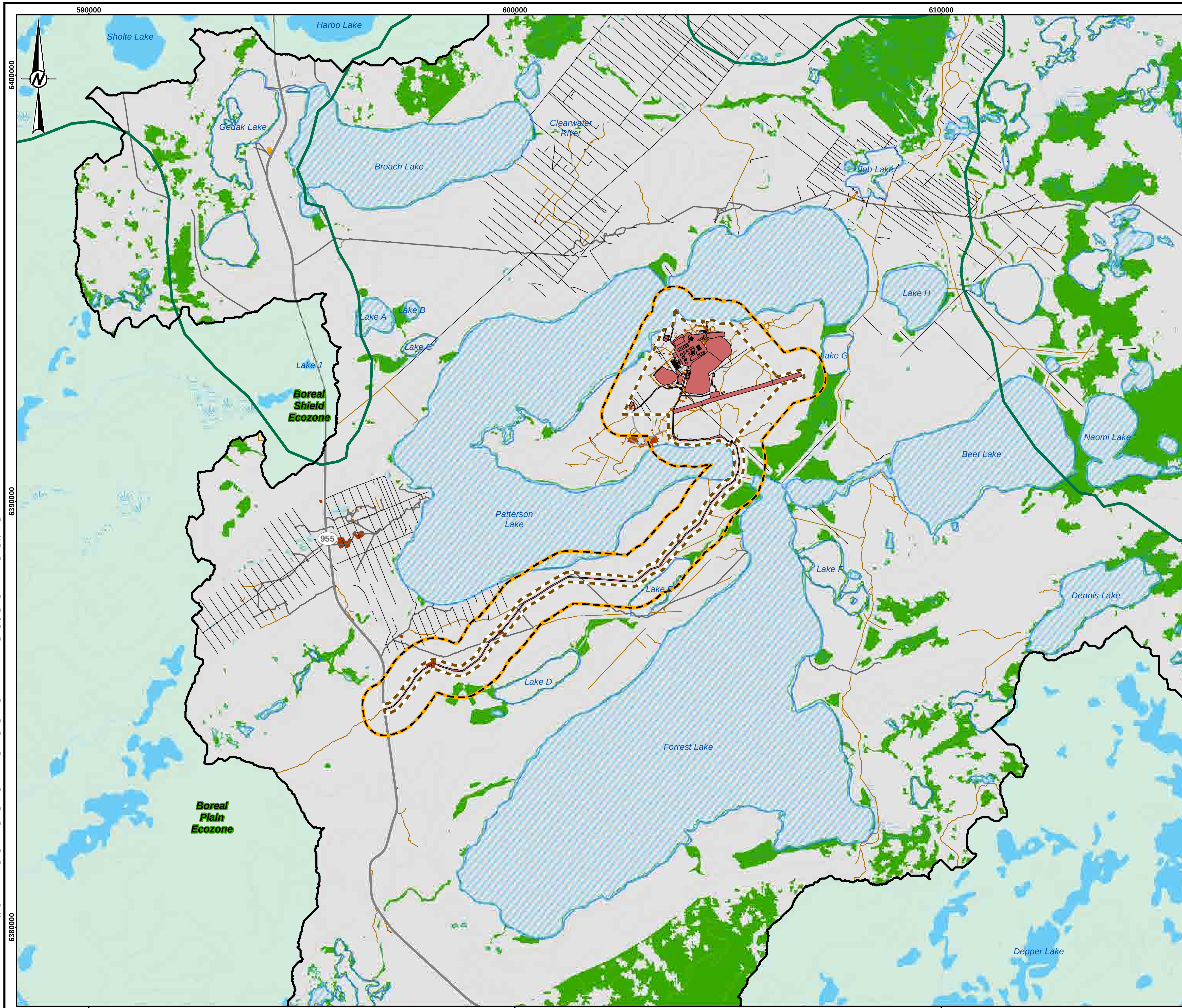
Suitable Canadian toad breeding habitat is predicted to be removed during site clearing within the LSA; however, much of the disturbance would alter existing unsuitable habitat (Figure 14.3-24 and Figure 14.5-38). Physical barriers to movement (e.g., soil berms, rock piles) or perceived barriers to movement created during Construction and Operations could also limit access to important terrestrial habitats for this species. Canadian toads tend to avoid large expanses of open, exposed habitat; therefore, the Project is expected to create some localized changes to habitat distribution such that toad movement within the LSA would be constrained. The distribution and connectivity of suitable habitat in the RSA would remain unchanged in the Application Case relative to the Base Case (Figure 14.5-39).

The largest concentration of breeding habitat identified in the LSA, between Forrest Lake and Patterson Lake to the east of the Project footprint, would remain intact in the Application Case (Figure 14.5-38); however, adjacent terrestrial habitats could be altered by the Project footprint. The existing access road to the west of these larger patches of suitable breeding habitat for Canadian toad would be upgraded, which could have an effect on young-of-the-year or dispersal or adult migration from natal breeding ponds; however, the road would be more than 1.5 km from the highest suitability breeding habitat patches. Therefore, considering the limited movement of Canadian toad (i.e., generally under 2 km), adverse effects in this area may be limited. Components of the Project footprint that occur near the eastern shore of Patterson Lake could affect dispersal movements for individuals moving east from potential breeding areas on the east margin of the lake. Predicted changes in movement patterns at the local scale would be continuous until habitat is reclaimed but are not expected to extend beyond the LSA boundaries.

Linear Features

The existing access road from Highway 955 likely already poses a barrier to movement for migrating or dispersing Canadian toads given the lack of vegetation cover would leave individuals exposed while crossing. The Project is expected to increase the number of vehicles on Highway 955 by 13%, 2%, and 11% during Construction, Operations, and the Active Closure Stage, respectively, relative to existing conditions (Section 14.4.2). This increase in vehicle traffic could have minor effects on the movement of Canadian toad that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect).

The access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip. The Project would be in a portion of the RSA that contains an aggregation of existing linear and non-linear features near Highway 955 (Figure 14.5-38) and would not change the density of linear features in the LSA and RSA. The planned widening of the existing access road for the Project would likely increase the barrier to movement for Canadian toad, leading to some localized changes to movement patterns. Overall, the Project is expected to have a small measurable and localized influence on Canadian toad movement and habitat connectivity.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 2 4

1:90,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

CANADIAN TOAD BREEDING HABITAT IN THE LOCAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09	FIGURE 14.5-38	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

25mm

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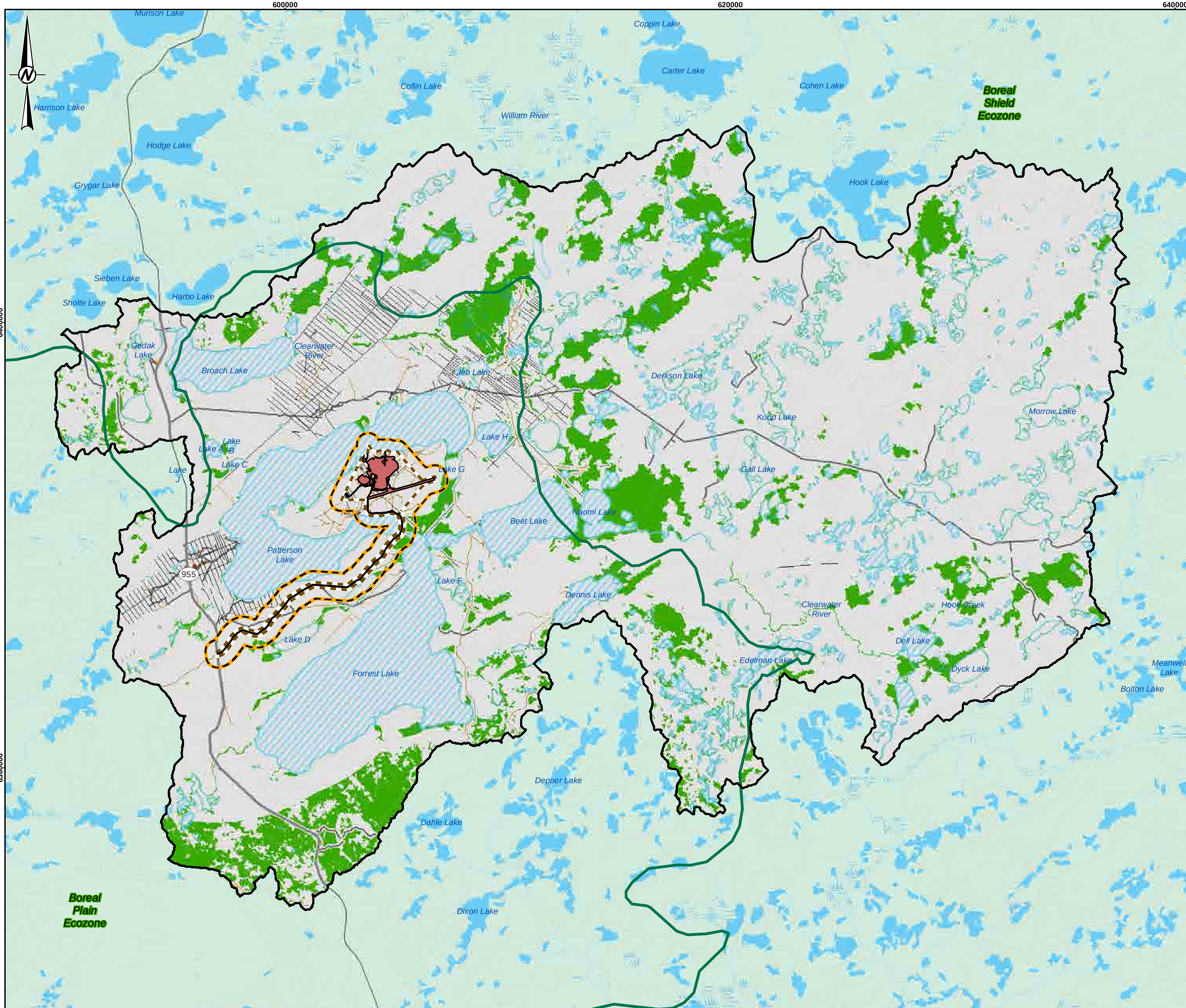

LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

CANADIAN TOAD BREEDING HABITAT IN THE REGIONAL STUDY AREA, APPLICATION CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14.5-39**	
REVIEW	JV	2023-02-09		

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14.5.11.1.3 Survival and Reproduction

Vital Rates

The Project has the potential to directly affect Canadian toad reproduction. Direct removal of wetlands as a result of the Project would reduce the availability of breeding habitat for Canadian toad and therefore could reduce reproduction in the population. Breeding success in the LSA could also be reduced if the hydroperiod or water quality in these ponds were adversely altered by the Project.

The calculated losses of Canadian toad breeding habitat in the RSA represent 0.2% of all available suitable habitat in the Application Case. An increase in noise disturbance during Construction and Operations could lead to declines in reproduction for Canadian toads breeding in proximity to construction activities. These changes are expected to be well within the resilience and adaptive capacity limits of Canadian toad (i.e., low magnitude effects on survival and reproduction). Direct habitat loss caused by the Project is therefore not expected to have a measurable effect on Canadian toad survival and reproduction rates at the population level. Sensory disturbance effects on Canadian toad reproduction and habitat quality are expected to extend five years beyond Closure but should be confined to a local geographic extent and would be reversible.

Threats to Survival

Amphibian species are vulnerable to direct mortality because their lifecycles often include at least one life stage with limited movement capabilities. The young-of-the-year (i.e., metamorphs) of many amphibian species will occupy wetland margins and associated vegetation following their emergence from breeding ponds (Semlitsch 2008). Because of their limited movement capabilities and inability to avoid heavy machinery or vegetation-clearing equipment, amphibian young-of-the-year are susceptible to incidental take (i.e., mortality) if site preparation activities occur during the summer months and in proximity to breeding ponds.

Mortality of Canadian toads could also occur if land clearing and soil recontouring occurs during the winter and directly removes hibernacula used by the species. Loss of hibernacula can have measurable effects on the population because they can be associated with a large number of individuals. Disturbance to hibernacula by the Project could have a measurable effect on the local abundance of Canadian toad, but would be unlikely (i.e., probability of effect of the effect is not expected but not impossible). Construction of the Project is expected to alter the distribution and abundance of land cover types (i.e., forest cover) that provides refuge for Canadian toads during migratory or dispersal movements. With a reduced cover from the elements and from predation, mortality rates among migrating individuals could potentially increase locally as a result of the Project.

Disease

An increase in human activity in the LSA during Construction and Operations could result in an increased risk of introduction of fungal infections and disease that could affect Canadian toad survival. Project construction equipment would be inspected prior to arriving on site and cleaned if required. These mitigation measures are anticipated to minimize the risk of introducing disease to Canadian toad and other amphibians that inhabit the LSA and RSA.

14.5.11.2 Reasonably Foreseeable Development Case

14.5.11.2.1 Habitat Availability

Direct Habitat Loss and Alteration

The Project and the Fission Patterson Lake South Property would reduce the availability of suitable Canadian toad habitat in the RSA by 47.1 ha (0.3%) compared to conditions in the Base Case (Table 14.5-36). Similar to the Project, the Fission Patterson Lake South Property would largely disturb existing unsuitable breeding habitat. The predicted habitat losses are associated with a corresponding increase in the amount of unsuitable habitat (Table 14.5-36). The Project contribution to future suitable habitat loss is 27.0 ha (Table 14.5-35), representing 57.4% of the quantified cumulative effect.

Table 14.5-36: Changes to Canadian Toad Breeding Habitat Availability in the Regional Study Area at Reasonably Foreseeable Development Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent Change (%)
Suitable	15,325.8	15,278.7	-47.1	-0.3
Not suitable	92,164.9	92,212.0	47.1	0.3

Note: Some numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
RFD = reasonably foreseeable development.

The cumulative effects from the decrease in habitat availability are continuous and reversible for reclaimed upland habitat but irreversible for wetland habitat and permanent features. Cumulative effects from the two projects are likely but uncertain (i.e., probable) since the Fission Patterson Lake South Property has recently entered the formal regulatory process. As described in Section 14.2.5, the duration of effects from direct habitat loss from the two projects would be 15 years, plus 6 to 10 years for functional mallard habitat to be regenerated (i.e., early seral stage upland ecosites; Section 14.5.11.1.1, Habitat Availability). Assuming that habitat loss from the Fission Patterson Lake South Property would completely overlap habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 25 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Sensory Disturbance

As described for the Application Case, indirect loss of Canadian toad habitat is likely greatest during the breeding season (i.e., May and June), when noise disturbance could disrupt advertisement calls made by males. The duration of cumulative effects from sensory disturbance for the RFD Case would depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. As described in Section 14.2.5, the duration of cumulative effects from sensory disturbance for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Climate Change

In addition to development, natural factors such as climate change may contribute cumulatively to influence habitat availability for Canadian toad. Due to a longer, warmer growing season, forest productivity may increase, but also may be limited by soil moisture availability (Sauchyn et al. 2009). Climate change is predicted to alter precipitation patterns and the occurrence of drought, both of which can change the hydroperiod of temporary wetlands on the landscape (Beebee 1995). Studies have shown that climate change is already leading to amphibian declines in temperate ecosystems where the quality of breeding habitat is declining because of drought and the hastened drying of ephemeral pools during the breeding season (McMenamin et al. 2008). Heat waves, droughts, and regional weather patterns (e.g., high-pressure ridges) can increase the risk and alter the behaviour of forest fires and are anticipated to increase fire frequency (Hart et al. 2019).

A summary of climate change effects were presented in Section 14.2.5, and the direction and magnitude of changes to wetland ecosystem availability due to climate change are uncertain. Changes in the occurrence of drought and long-term precipitation patterns in the RSA may lead to declines in the availability and/or quality of Canadian toad breeding habitat. A greater frequency or severity of drought conditions in the RSA could lead to declines in the presence of ephemeral wetlands on the landscape that Canadian toad could exploit as breeding habitat. Increased wildfire activity could also result from changes in long-term precipitation patterns in the RSA. A review of the effects of wildfire on western toad populations, a similar species to Canadian toad, indicated that wildfire can have positive effects on western toad colonization of wetlands, and can increase gene flow on the landscape compared to pre-burned conditions (Hossack and Pilliod 2011). Wildfires that affect heavily forested areas can increase landscape permeability and encourage dispersal and movement on the landscape for wetland-breeding species that are highly terrestrial outside of the breeding season (Hossack and Pilliod 2011). Given the uncertainty, it was conservatively assumed that climate change would have a negative cumulative effect on habitat availability.

The magnitude of the effect of climate change on Canadian toad habitat availability is unknown because climate change predictions are based on simulations that can be highly variable. It was conservatively assumed that climate change would increase adverse effects on habitat availability.

14.5.11.2.2 Habitat Distribution

Habitat Arrangement and Connectivity

In the RSA, the RFD Case would remove Canadian toad habitat and result in some additional fragmentation on the landscape. Non-linear disturbance features such as mines, forest clearings, and recent burns would likely act as perceived movement barriers for Canadian toad because the species tends to avoid open, exposed habitat while travelling through the landscape. Localized changes in the movement patterns of Canadian toad are likely around the Project footprint and the Fission Patterson Lake South Property footprint; however, the distribution of suitable breeding habitat would remain unchanged in the RFD Case relative to the Base Case (i.e., the two projects disturb 47.1 ha or 0.3% of suitable habitat; Figure 14.3-25 and Figure 14.5-40).

The Project and Fission Patterson Lake South Property may increase the amount of standing water on the landscape if water pools in the ditches of proposed roads. Amphibians often rely on patches of standing water to avoid desiccation while travelling through the landscape (Bull 2009; Todd et al. 2009), so an increased presence of standing water may help reduce the anticipated decline in habitat connectivity associated with disturbed areas.

Linear Features

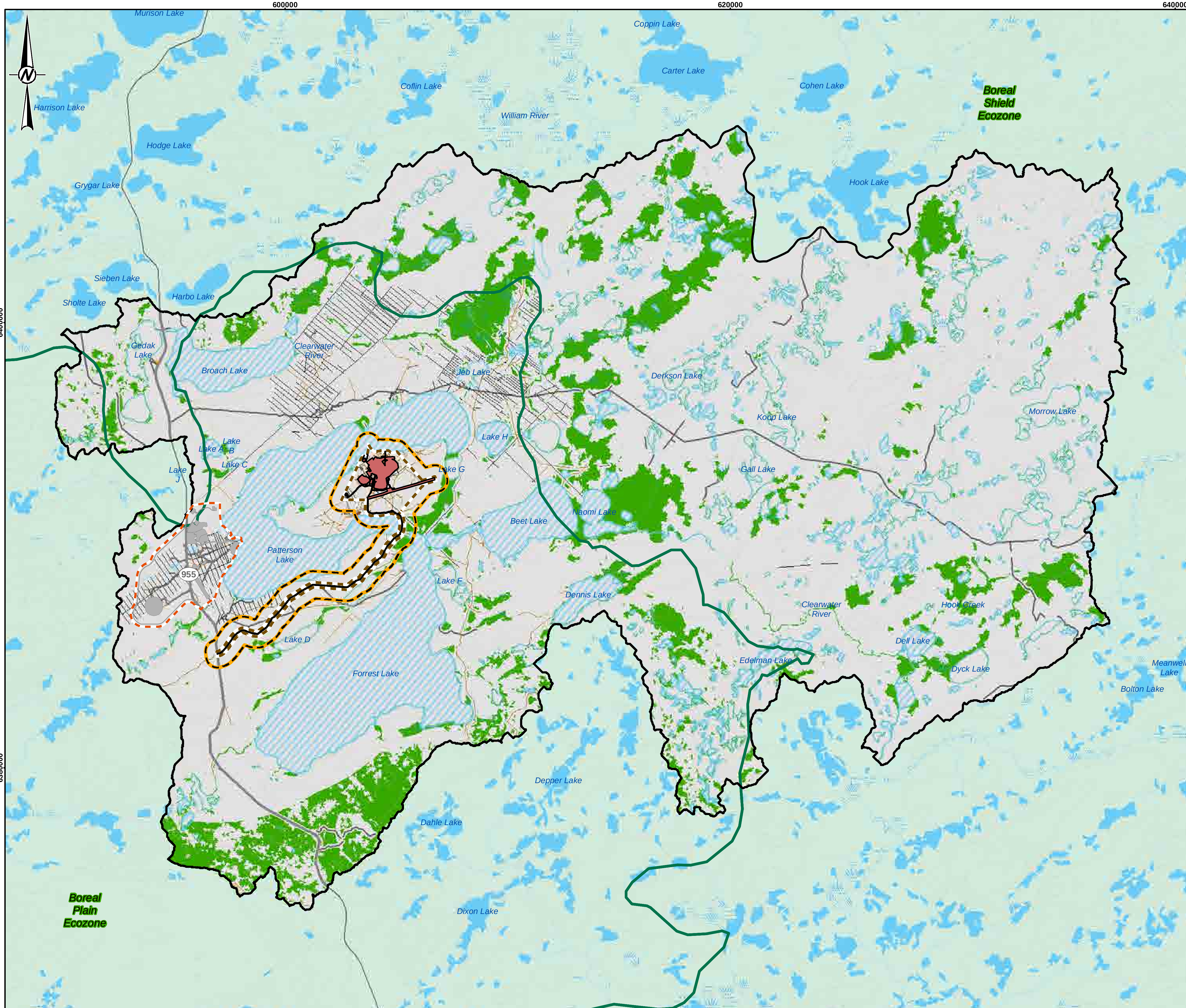
The incremental increase in traffic on Highway 955 in the RFD Case relative to the Application Case would continue to have minor effects on the movement of Canadian toad that use habitat within and outside the western portion of the RSA (i.e., regional to beyond regional effect).

In general, suitable habitat for Canadian toad remains widespread and connected in the RSA in the RFD Case because the greatest densities of suitable habitat occur outside of areas that are expected to be affected by development (Figure 14.5-40). Overall, the RFD Case is predicted to result in measurable changes to movement and habitat connectivity relative to the Base Case in area around Patterson Lake.

Climate Change

As with habitat availability, further alterations in the arrangement and connectivity of breeding and overwintering habitat in the RSA could result from climate-induced effects. A reduction in the availability and condition of wetlands as a result of climate change could change where suitable habitat occurs throughout the RSA.

Future wildfires in the RSA have the potential to alter habitat connectivity on the landscape for Canadian toad. As noted in Section 14.5.11.2.1, Habitat Availability, wildfire can have positive effects on western toad colonization of wetlands and can increase gene flow on the landscape compared to pre-burned conditions (Hossack and Pilliod 2011). Wildfires that affect heavily forested areas can increase landscape permeability and encourage dispersal and movement on the landscape for wetland-breeding species that are highly terrestrial outside of the breeding season (Hossack and Pilliod 2011). Given the uncertainty in direction, it was conservatively assumed that climate change would have a negative cumulative effect on habitat distribution.



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)
WATERCOURSE
OPEN WATER (WITHIN THE RSA)
WATERBODY (WITHIN THE RSA)
WATERBODY (OUTSIDE OF RSA)
WETLAND
WOODED AREA
ECOZONE BOUNDARY
LOCAL STUDY AREA
REGIONAL STUDY AREA
FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA
PROPOSED PROJECT FOOTPRINT
MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

ACCESS ROAD
CUTLINE/SEISMIC
SECONDARY HIGHWAY
ROUGH ROAD
TRAIL
NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

SUITABLE
NOT SUITABLE

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
CANADIAN TOAD BREEDING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	NO	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	VMB	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14.5-40	
REVIEW	JV	2023-02-09		

14.5.11.2.3 Survival and Reproduction

Vital Rates

Quantified losses of suitable breeding habitat for Canadian toad in the RFD Case represent a 0.3% decline in available suitable habitat, and subsequently suitable habitat remains largely unchanged in the RSA relative to the Base Case. In the RFD Case, it is expected that cumulative effects, including anticipated loss of habitat, would remain within the resilience and adaptability limits of Canadian toad. Canadian toad populations in the RSA are expected to remain self-sustaining and ecologically effective in the RFD Case.

An increase in the level of anthropogenic disturbance within the RSA in the RFD Case would result in higher sensory disturbance on the landscape, which could further interfere with advertisement calls by male Canadian toads. The quality of breeding habitat in proximity to a noise source would potentially be degraded if females are unable to hear calls, which may reduce reproduction and the fecundity of individuals (Bee and Swanson 2007). Effects on survival and reproduction may occur, but are unlikely (i.e., probability of occurrence is possible). Cumulative changes in habitat from the Project and Fission Patterson Lake South Property may result in a small measurable change to the population abundance and distribution of Canadian toad around Patterson Lake. Cumulative habitat loss due to sensory disturbance in the RFD Case would be reversible five years after closure of one of the projects or when there is no temporal overlap between projects.

Threats to Survival

Additional land clearing associated with the RFD Case could lead to higher mortality among Canadian toads in the RSA if hibernacula are disturbed while animals are occupying the habitat (i.e., between October and May) or if breeding wetlands and the surrounding habitats are disturbed during the active season (i.e., May to October). Implementing effective mitigation measures for protecting Canadian toad hibernation sites is difficult given that the habitat features are underground, are very rarely identified in the field, and land clearing can be undertaken in winter. Loss of hibernacula can have measurable effects on the population because they can be associated with a large number of individuals. Disturbance to hibernacula by the Project and Fission Patterson Lake South Property could have a moderate magnitude effect on the abundance of Canadian toad in the area of Patterson Lake, but would be unlikely (i.e., probability of effect of the effect is not expected, but not impossible).

The incremental increase in the amount of open, exposed habitat on the landscape in the RFD Case could further negatively influence Canadian toad survival during migratory or dispersal movements. The Project and the Fission Patterson Lake South Property could reduce Canadian toad survival in areas where forested or vegetated land cover are replaced by open, disturbed land cover and increase risk of predation/desiccation (Rittenhouse et al. 2008).

Disease

The incremental increase in human activity in the RFD Case could result in an increased risk of introduction of fungal infections and disease; however, it was assumed that both projects would implement equipment inspections to minimize soil and organic material to minimize the risk of transfer of disease to the LSA and RSA.

Climate Change

Changes to the hydroperiod of breeding wetlands because of climate change or because of nearby anthropogenic disturbance could lead to reduced reproduction among Canadian toads and other amphibians. Premature drying of breeding ponds can lead to mass mortality events among the young-of-the-year if tadpoles are unable to mature and metamorphose before the pond loses its water (Amburgey et al. 2016). Climate change may change surface water elevations in some waterbodies (Section 9.4.1). Although seasonal deficits may occur (i.e., drought), they would be anticipated to occur within the natural variability and resiliency of wetland ecosystems and would not affect overall ecosystem availability (Section 13.5.2.2.1). Changes to amphibian breeding pond availability and condition could affect Canadian toad survival and reproduction rates (Beebee 1995). Recent research and modelling have indicated that climate change alone is likely not the driving force behind widespread declines in amphibian populations observed in North America (Miller et al. 2018). While climate change can exacerbate amphibian declines in sensitive areas (e.g., in mountainous regions) in other parts of the continent, climate change is believed to generally be buffering amphibian populations from decline (Miller et al. 2018).

Climate change in northern environments could lead to altered disease dynamics due to the expansion in range of potential disease host species into these northern areas. Schock et al. (2010) also indicate that the lifecycle of chytrid fungus is tightly dictated by temperature and humidity conditions, which are both expected to change in northern Canada under all climate change scenarios. A higher incidence of chytrid fungus and ranavirus in northern amphibian populations could lead to reduced survival for Canadian toad populations in the RSA. Recent studies have shown that Canadian toads may be less susceptible to morbidity or mortality from ranavirus than other amphibian species (Forzán et al. 2019), suggesting that effects from potential higher incidence of this disease may not have a measurable effect on Canadian toad survival.

The magnitude of habitat change and incidence of disease induced by climate change is uncertain, and thus the effects on the Canadian toad population inhabiting the RSA are also uncertain. It was conservatively assumed that climate change effects could increase adverse effects on survival and reproduction.

14.5.11.3 Residual Effects Classification and Determination of Significance

14.5.11.3.1 Classification Summary

Residual effects were classified for the Application Case and the RFD Case after the implementation of effective mitigation (Table 14.5-37). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of the effect occurring following the methods described in Section 14.2.9. Effective implementation of mitigation summarized in Section 14.4 (Table 14.4-1), and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on Canadian toad. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in Section 14.2.9.

Table 14.5-37: Classification of Residual Effects on Canadian Toad Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 27.0 ha removal of suitable breeding habitat, representing a 0.2% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 47.1 ha removal of suitable breeding habitat representing a 0.3% reduction in the RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (i.e., up to 90 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [includes 90 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: loss of wetland breeding habitat and upland habitat covered by permanent features (e.g., WRSAs) ▪ Long-term (direct habitat loss): 43 years = 33 years (start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish suitable foraging habitat; perhaps longer for hibernation habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: loss of wetland breeding habitat and upland habitat covered by permanent features ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features, wetlands) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small measurable change to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low to moderate magnitude due to limited dispersal and mobility)	▪ Measurable change in regional habitat connectivity due to direct habitat loss from developments (i.e., moderate magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: loss of wetland breeding habitat and upland habitat covered by permanent features ▪ Long-term (direct habitat loss): 43 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish suitable foraging habitat; perhaps longer for hibernation habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: loss of wetland breeding habitat and upland habitat covered by permanent features ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed upland habitat) ▪ Irreversible (habitat covered by permanent features, wetlands) ▪ Irreversible (climate change)

Table 14.5-37: Classification of Residual Effects on Canadian Toad Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat distribution	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Potential low to moderate change in local abundance if hibernation sites are removed while occupied (i.e., low to moderate magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ Potential moderate change in abundance in the area of Patterson Lake if hibernation sites are removed while occupied (i.e., moderate magnitude) ▪ Small measurable change in Canadian toad abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: loss of wetland breeding habitat and upland habitat covered by permanent features (e.g., WRSAs) ▪ Long-term (direct habitat loss): 43 years = 33 years (i.e., start of Construction to end of the Active Closure Stage), or earlier with progressive reclamation, plus 6-10 years to establish suitable upland habitat; perhaps longer for hibernation habitat ▪ Long-term (sensory disturbance): 48 years = 43 years (start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: loss of wetland breeding habitat and upland habitat covered by permanent features ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 25 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Patterson Lake South Property): habitat availability and distribution ▪ Unlikely (Project and Patterson Lake South Property): loss of hibernacula ▪ Possible (climate change)

RSA = regional study area; WRSAs = waste rock storage areas; RFD = reasonably foreseeable development.

14.5.11.3.2 Significance Determination

Habitat Availability and Distribution

Suitable breeding habitat for Canadian toad in the RSA is currently patchy but well distributed and relatively well connected to upland habitat due to the limited and aggregated pattern of existing anthropogenic disturbance in the Base Case. In the Application Case, the Project is expected to result in a loss of 27.0 ha of suitable breeding habitat, representing 0.2% of this habitat in the RSA. Changes to habitat availability are likely to have limited effects given the small anticipated loss of habitat relative to what is available to the regional population in the rest of the RSA. Functional upland foraging habitat for Canadian toad is predicted to become available 6 years to 10 years beyond the end of the Active Closure Stage or earlier through progressive reclamation. Loss of wetland breeding habitat is expected to be irreversible. Quantifying the effect of any potential loss of hibernation habitat in the LSA is difficult given the lack of information on Canadian toad hibernation site characteristics, density, and availability on the landscape in the boreal region. Loss of upland habitat could decrease the abundance of Canadian toad in the LSA should hibernation sites be destroyed during Construction, but the effect is expected to be unlikely. Given that the Project footprint is small, the species has a high reproductive output, and the RSA would presumably support many other hibernation sites, Project-related effects from changes to hibernation habitat availability are not expected to exceed the resilience and adaptability limits of Canadian toad population(s) overlapping the RSA.

The Project could result in some changes to local movement patterns around Patterson Lake and Forrest Lake as Canadian toads move from breeding sites to upland habitats, which they would occupy during the active season and hibernation period, respectively. Remaining patches of contiguous, undisturbed breeding habitat would remain in areas surrounding the LSA and should continue to provide landscape connectivity and facilitate Canadian toad movement within the RSA. These remaining patches of undisturbed breeding habitat are also largely surrounded by suitable upland habitat, which promotes habitat connectivity between the aquatic and terrestrial land cover that this species relies on as part of its life history.

In the RFD Case, the combined effects of the Project and the Fission Patterson Lake South Property are expected to reduce the amount of suitable breeding habitat for Canadian toad in the RSA. There would be a 0.3% reduction in suitable breeding habitat from these developments. While some wetland habitat would be lost through development, an abundance of other wetlands and waterbodies with the potential to support Canadian toad reproduction would remain in the RSA in the RFD Case.

With climate change, reductions in the size and occurrence of wetlands due to increased occurrence of wildfire, lower precipitation, and higher evaporation may cause a reduction in Canadian toad habitat because the species breeds in a variety of wetland types, including ephemeral ponds, which may become less abundant on the landscape.

Survival and Reproduction

Canadian toad is not a provincially tracked or federally listed species (Government of Canada 2023; SKCDC 2021) and is considered Not at Risk by COSEWIC (Government of Canada 2023). Limited information is available on the current population size of Canadian toad in Canada or in Saskatchewan because of a lack of province-wide monitoring effort and the species' cryptic nature (Hamilton et al. 1998); however, recent declines in populations have been recorded in the Alberta portion of their North American range (Hamilton et al. 1998).

Canadian toad is considered an explosive breeder with high fecundity and reproductive output. Therefore, incremental and cumulative changes in habitat from the Project and the Fission Patterson Lake South Property are not expected to have a measurable effect on Canadian toad survival and reproduction in the Application Case and the RFD Case, respectively.

Climate change is expected to increase the North American range of ranavirus and chytrid fungus, which are both known to have detrimental effects on the survival and reproduction of many amphibian species. Canadian toad is known to be less susceptible to ranavirus than other amphibians, which could limit potential adverse effects.

Summary of Significance Determination

Canadian toads are strong dispersers relative to other amphibian species, have a high reproductive output, and are relatively flexible in their habitat selection during the active season. Incremental changes to Canadian toad habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within its resilience and adaptability limits. Canadian toad is predicted to remain self-sustaining and ecologically effective in the Application Case (i.e., there is no predicted change in the assessment endpoints). Therefore, the residual effects from the Project on Canadian toad are predicted to be not significant.

Habitat loss, considered a major contributor to declines in North American toad species, is predicted to be 0.3% of existing breeding habitat in the RSA in the RFD Case. Accordingly, cumulative effects from previous and existing developments, the Project, and the Fission Patterson Lake South Property in the RFD Case are expected to remain within the species' resilience and adaptability limits. Canadian toad is predicted to remain self-sustaining and ecologically effective in the RFD Case. Overall, the residual effects from the Project and the Fission Patterson Lake South Property on the Canadian toad VC are predicted to be not significant. Effects related to climate change are uncertain and mostly predicted to be adverse but are not expected to significantly influence the abundance and distribution of Canadian toad and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14.5.12 Additional Species at Risk Screening Assessments

A screening-level assessment (Appendix 14A, Species at Risk Screening Assessment) was completed for seven other federally listed species with potential to occur in the LSA: northern myotis (*Myotis septentrionalis*), common nighthawk (*Chordeiles minor*), barn swallow (*Hirundo rustica*), Ashton cuckoo bumble bee (previously gypsy cuckoo bumble bee; *Bombus bohemicus*), yellow-banded bumble bee (*Bombus terricola*), transverse lady beetle (*Coccinella transversoguttata*), and nine-spotted lady beetle (*Coccinella novemnotata*). The screening-level assessment was completed to meet requirements under Section 79 of the SARA. The screening-level assessment included a summary of existing conditions and tabulation of the classification of predicted Project and cumulative residual effects and determination of significance.

In addition, even though these species were not selected as VCs, the effects analysis also considered these species by way of being represented by other VCs. Effects on northern myotis were represented by little brown myotis, and upland and wetland ecosystems (Section 14.5.6, Little Brown Myotis, Section 13.5.1, Upland Ecosystems, and Section 13.5.2, respectively). Effects on common nighthawk and barn swallow were represented by olive-sided flycatcher, upland, wetland, and riparian ecosystems (Section 14.5.7, Olive-sided Flycatcher, Section 13.5.1, Section 13.5.2, and Section 13.5.3, Riparian Ecosystems, respectively). Effects on Ashton cuckoo bumble bee, yellow-banded bumble bee, transverse lady beetle, and nine-spotted lady beetle were represented by upland ecosystems (Section 13.5.1 Upland Ecosystems). Effects on the representative ecosystem VCs are linked to the types of changes in habitats that the bat, bird, or insect species use.

Under the SARA, it is important to identify if there are any effects on critical habitat for species listed on Schedule 1 of the SARA. No critical habitat for northern myotis has been defined or identified in the RSA (Environment Canada 2018). Common nighthawk is a provincially tracked species listed as "Apparently Secure" (S4B/S4M) in Saskatchewan, indicating that the species is uncommon but not rare (SKCDC 2020, 2021). Critical habitat has not been explicitly defined as part of the protection of common nighthawk through the SARA (Environment Canada 2016; COSEWIC 2018). Barn swallow was downgraded from "Threatened" to "Special Concern" by COSEWIC in May 2021 due to the relative stability of Canadian population numbers recorded between 2000 and 2019 (Government of Canada 2023). Barn swallow is a provincially tracked species listed as "Apparently Secure" (S4B/S4M) in Saskatchewan, indicating that the species is uncommon but not rare (SKCDC 2020, 2021). No critical habitat has been defined or identified for barn swallow in the RSA. No critical habitat has been defined or identified for Ashton cuckoo bumble bee, yellow-banded bumble bee, transverse lady beetle, and nine-spotted lady beetle in the RSA.

The screening-level assessments for barn swallow, common nighthawk, northern myotis, Ashton cuckoo bumble bee, yellow-banded bumble bee, transverse lady beetle, and nine-spotted lady beetle concluded that there would be negligible residual effects from Project development activities and the populations of these species would continue to be self-sustaining and ecologically effective (Appendix 14A).

14.5.13 Effects on Biodiversity

Wildlife biodiversity is inclusive of wildlife and the ecosystems that they occupy. It includes all levels of organization, from genes to landscapes, and the ecological processes through which these levels are connected. Effects on biodiversity have been evaluated based on the assessment completed for the wildlife VCs, several of which were selected because they are strong ecological indicators of broader species assemblages and ecosystems (Section 14.2.2.1). For example, effects on little brown myotis are representative of effects on late successional stage forests that support many wildlife species and high levels of biodiversity.

Wildlife biodiversity is strongly tied to the extent, connectivity, and fragmentation of ecosystems on the landscape. Section 13.5.5, Effects on Biodiversity, outlines key indicators for vegetation and ecosystem biodiversity in the RSA. In the RFD Case, the Project and the Fission Patterson Lake South Property are predicted to remove 2,318.1 ha (3.1%) of upland ELC units in the RSA (Section 13.5.1.2, Reasonably Foreseeable Development Case). Similar to the Application Case, many of these changes are predicted to occur within burned ELC units with structural diversity and relatively high species richness for both vegetation and wildlife species.

Loss of wetland ecosystems, excluding open water, in the RFD Case is predicted to be 55.7 ha (i.e., 0.4% of RSA), which may disproportionately affect biodiversity even though wetland habitat loss is smaller compared to the change in upland ecosystems. Wetlands in the boreal region are generally associated with high wildlife and vegetation species richness (Baschuk et al. 2012; Brazner and MacKinnon 2020). The loss of wetlands is conservatively assumed to be permanent and irreversible; however, projected wetland losses are minor relative to the availability of wetlands that occur elsewhere in in the RSA, and wetlands are expected to remain well connected in the RFD Case (Section 13.5.2.2.2, Ecosystem Distribution). In addition, the existing access road would be upgraded to safely accommodate large vehicles and equipment and an existing site road realigned to avoid the wetland west of the proposed airstrip (Section 14.4). It is anticipated that any affected wetland ecosystems would be reclaimed to the extent possible in an attempt to achieve no net loss of wetland functions, consistent with the guideline of the Federal Policy on Wetland Conservation (Government of Canada 1991).

Mature forests are recognized for their contribution to biodiversity values and ecological function not found in younger-aged stands, including important habitat for many wildlife species (Franklin 1993). Mature forests create microhabitats for specialist wildlife species in the tree canopy as well as on the forest floor through the use of coarse woody debris (Government of British Columbia 1997; Paillet et al. 2018). Species diversity and structural characteristics of mature forests (e.g., large living and dead trees, and large gaps) develop slowly and are difficult to replace once lost. Mature forest patches constitute unique and structurally diverse ecosystems that provide some of the highest quality habitat available for plants and wildlife (Timoney 2001; Harper et al. 2003).

The residual effects on loss of habitat for wildlife and biodiversity are reversible over the long term for some natural ecosystems and communities that would regenerate or can be reclaimed, but irreversible for others. For example, mature forest would eventually return to the landscape given sufficient time (e.g., 60 to 100 years). However, organic wetlands that experience soil disturbance are not predicted to recover within a defined timeframe and the loss of wetland-associated wildlife and biodiversity is conservatively considered irreversible.

Project disturbance would be within a portion of the RSA that contains an aggregation of existing linear and non-linear features in the proximity of Highway 955. Use of existing anthropogenic disturbance for the Project is predicted to reduce the overall loss of biodiversity but also limit the level of new habitat fragmentation and edge effects.

Reclamation is predicted to reverse effects on most disturbed upland ELC units and provide adequate material for the development of productive soils, which would support the establishment and succession of vegetation communities with a similar function to natural ecosystems not influenced by the Project. Reclaimed upland and wetland ecosystems would most likely differ in structural complexity relative to habitats not influenced by the Project but the objective would be to provide conditions suitable for similar wildlife assemblages through progressive seral stages (i.e., regenerating to mature and late-stage forest).

The Project's Caribou Mitigation and Offsetting Plan would be expected to provide a net increase in caribou habitat compared to Base Case conditions (Section 14.5.1), which would in turn have a positive benefit on biodiversity. As described in Section 14.2.2.1.1.1, Indicator, Umbrella, or Keystone Species Considerations, woodland caribou have large home ranges and may act as an umbrella species. Habitat management / restoration that is focused on an umbrella species is likely to result in the protection of multiple co-occurring lower-order taxon species, including birds and small mammals (Bichet et al. 2016; Drever et al. 2019) and improve the overall biodiversity of the boreal forest.

14.6 Prediction Confidence and Uncertainty

Scientific inference is associated with uncertainty, and prediction confidence (i.e., level of confidence in assessment results) depends on the level of uncertainty and the way it is addressed. Primary factors affecting confidence in the predictions made in the wildlife and wildlife habitat assessment include:

- availability and accuracy of baseline data;
- accuracy of ecosystem maps and associated wildlife habitat models;
- level of understanding of the strength of primary pathways in terms of the effects they are likely to have on each VC;
- level of certainty associated with the effectiveness of proposed mitigations, where applicable;
- level of understanding of baseline conditions, range of natural variation, and resilience of VC populations; and
- level of understanding of the cumulative drivers of change in measurement indicators and associated effects on populations, including uncertainty in climate change projections with respect to weather, hydrological patterns/cycles, and fire frequency and intensity, and the associated responses of vegetation ecosystems and wildlife VCs.

Uncertainty was managed by:

- reviewing historical data and relevant studies completed in the LSA and RSA and boreal caribou ranges;
- completing quality assurance and quality control of baseline data;
- assuming that wildlife VCs and species at risk would be present in potential habitats where they may occur but were not observed;
- using the best available land cover data for ELC mapping in the LSA and RSA and caribou ranges;

- review of wildlife habitat models by external subject matter experts and use of standard government caribou habitat models, methods, and procedures;
- using data to make inferences about biological and ecological interactions and mechanisms of change;
- using the maximum disturbance area to account for potential future Project refinements, which increased confidence that effects were not underestimated;
- comparing assessment results to relevant published scientific literature; and
- addressing climate change using a precautionary approach as necessary. Where there was ambiguity in the response of a VC to climate change, the assessment considered a precautionary outcome for each effects criterion (e.g., negative effect of climate change on wildlife VCs). However, where potential effects of climate change were better understood, VC responses were based on available scientific evidence.

Overall, there is a moderate to high degree of confidence in predictions related to the changes to wildlife VCs, and best management practices during the Project lifespan would be implemented to mitigate effects on wildlife and wildlife habitat. There is some uncertainty regarding the quantity, distribution, and ecological function of reclaimed ecosites (i.e., wildlife habitat) during and after Closure. Uncertainty was primarily and appropriately addressed by making assumptions that conservatively overestimated rather than underestimated potential effects (i.e., a precautionary assessment), such as expecting that reclaimed vegetation communities would likely not have the same structure as natural ecosites but would be ecologically functional for wildlife. Monitoring would be used to address residual uncertainty by evaluating the progress of reclamation activities. Different approaches and methods would be implemented, if necessary, to establish a trajectory towards the successful regeneration and succession of vegetation ecosystems that are functionally similar to natural plant communities and wildlife habitat in the region.

14.7 Monitoring, Follow-Up, and Adaptive Management

Monitoring programs would be used to:

- evaluate the effectiveness of the environmental protection measures (e.g., construction monitoring and mitigation to avoid destruction of migratory bird nests and birds), and modify or enhance mitigation measures as necessary;
- identify unanticipated negative effects, including possible accidents and malfunctions;
- assess the success of plant community establishment following reclamation; and
- contribute to the overall continual improvement of the Project.

The Environmental Monitoring Plan would be implemented to assess effects on wildlife and wildlife habitat and apply adaptive management where necessary. Monitoring results would be used to adjust or adapt mitigation measures or reclamation approaches used to limit Project effects on wildlife (i.e., adaptive management). Surveillance monitoring completed as part of the Environmental Monitoring Plan would be used to determine the efficacy of mitigation measures proposed in Section 14.4 and to guide any future measures that could be implemented in subsequent Project phases. For example, waste management and site surveillance monitoring would be completed to avoid attraction of wildlife to the Project and associated risks of adverse human-wildlife interactions. Potential problem areas at the Project would be identified as part of monitoring, which could lead to the implementation of targeted mitigation measures in these areas to limit human-wildlife conflicts.

A Caribou Mitigation and Offsetting Plan would be developed and implemented for the Project, whereby offsets would be used to reduce the residual effects on woodland caribou and provide a net increase in functional habitat for caribou. Offsets may be achieved through a financial mechanism, or through management actions that protect or enhance existing biodiversity (Poulton 2014). Offset requirements to date for woodland caribou in Canada have primarily focused on habitat restoration, but in some cases financial compensation or alternative measures have been incorporated. The approach to the Caribou Mitigation and Offsetting Plan and mechanism of offsetting would follow Canadian and international best practices and would be determined through discussions with provincial regulators, federal regulators, and Indigenous Groups following submission of the EIS.

The Preliminary Decommissioning and Reclamation Plan, along with monitoring, would assist in revising or adding mitigation measures and defining the specific parameters to be used during Closure to allow for successful long-term reclamation and establishment of vegetation communities that contribute to the maintenance of self-sustaining and ecologically effective wildlife populations and biodiversity.

In addition, Environmental Committees (i.e., one per primary Indigenous Group) composed of two NexGen and two Indigenous Group representatives would be established to act in an oversight manner to monitor the environmental performance of the Project and verify the parties are implementing the regulatory and environmental commitments made in respect of the Project.

Indigenous Groups have made recommendations related to mitigating the effects of the Project on the environment, including community-led long-term environmental testing and monitoring during Construction and Operations of the proposed Project (TSD IV: MN-S; TSD V.2: CRDN; YNLRO 2019). NexGen has committed to provide funding for the lifespan of the Project for a full-time independent Indigenous Monitor chosen by each primary Indigenous Group; this Indigenous Monitor would have access to conduct environmental sampling for the Project, subject to the Indigenous Monitor complying with appropriate health and safety and other reasonable site-specific policies. The Indigenous Monitor would be able to report openly and without restriction to the Environmental Committee and Indigenous Group’s community members on the performance of the Project. The Indigenous Monitor would also provide regular reports to the Environmental Committee.

14.8 Key Findings

The objectives of Section 14 were to provide a detailed and comprehensive assessment of potential Project-specific effects and cumulative effects from the proposed Project, other previous and existing developments, and RFDs on wildlife and wildlife habitat. Wildlife and wildlife habitat serve important roles in the function of the terrestrial ecosystem and are an important resource culturally, economically, and traditionally to local Indigenous Groups. Indigenous Groups spoke of the importance of hunting and trapping for subsistence, survival, and livelihood, and highlighted hunting and trapping as an important aspect of community well-being and a foundation of culture.

Effects on wildlife and wildlife habitat were assessed for 11 VCs, which were identified based on several factors including but not limited to the potential level of interaction between the Project and the VCs, the sensitivity of the VCs to potential effects of the Project, species conservation status or concern, and feedback from Indigenous Groups. In addition, screening-level assessments were completed for effects on seven non-VC species of conservation concern detected during baseline studies or with potential to occur in the LSA (i.e., barn swallow, common nighthawk, northern myotis, Ashton cuckoo bumble bee, yellow-banded bumble bee, transverse lady beetle, and nine-spotted lady beetle) to address the requirement to assess effects on listed species under Section 79(2) of the SARA.

Section 14 met the main objectives of the Terms of Reference for the Project issued by the ENV and CNSC by providing a detailed and comprehensive assessment of potential Project-specific effects and cumulative effects from the Project and other developments on wildlife and wildlife habitat.

A summary of key findings for wildlife and wildlife habitat is provided below:

- Development of the physical Project footprint and associated activities (primary pathways) were predicted to result in habitat loss, habitat alteration, and sensory disturbance for all VCs during Construction, Operations, and Closure. During Operations and Closure, habitats would be restored to the extent possible through progressive and final reclamation. Some residual effects would be irreversible: potential changes to wetlands (if required) and permanent alteration of the landscape from WRSAs. Residual effects associated with all other reclaimed habitat would be reversible, with the duration of effects being VC-specific and dependent on the time required to establish functional habitat.
- The total potential maximum disturbance area of the Project would be 981 ha. Table 14.8-1 presents a summary of the areas of existing high, moderate, and low suitability habitats for the modelled life requisites (e.g., special requirements of an animal for sustaining and perpetuating the species such as nesting, hibernation, calving) for each VC, as well as the predicted changes in suitable habitat for the Application and RFD cases. For context, the corresponding total area of high, moderate, and low suitability habitats in the RSA is presented for each VC, with the exception of caribou for which areas are presented for the home range scale. The magnitude of loss from the proposed Project would be less than 1.5% of suitable habitats in the RSA for all VCs. Cumulative habitat loss in the RFD Case would be less than 3.5% of suitable habitat in the RSA for all VCs. The main mitigations for habitat loss are minimizing the Project footprint, re-aligning the site road within the Project footprint west of the airstrip to avoid a wetland, minimizing sensory disturbance (e.g., dust, noise), and progressive and final reclamation.
- Habitat distribution for all VCs in the Application Case and the RFD Case would remain well connected throughout the RSA. Proposed mitigations designed to help preserve habitat distribution include wildlife encounter protocols, limiting snowbank heights along the access road, enforced speed limits, and signage to minimize potential disruption of connectivity and movement around and across Project infrastructure.
- Further mitigations such as scheduling work to avoid sensitive areas/periods, enclosing equipment, using noise suppression equipment, and wildlife protection policies would minimize sensory disturbance to wildlife. These measures, combined with minimizing habitat loss, would limit effects on survival and reproduction of wildlife.
- All VC populations except woodland caribou would be expected to remain self-sustaining and ecologically effective; therefore, with the exception of woodland caribou, the residual effects from habitat disturbance, habitat alteration, and sensory disturbance from the physical footprint and associated Project activities in both the Application Case and RFD Case are considered not significant for all VCs. With respect to woodland caribou, the implementation of the Caribou Mitigation and Offsetting Plan would result in the Project-specific residual adverse effects to be not significant.

Table 14.8-1: Summary of Suitable Habitat Loss by Valued Component

VC	Life Requisite (seasonal requirement)	Habitat Suitability Rating	Base Case Area in RSA (ha)	Application Case Change in Area (ha)	Application Case% Change	RFD Case Change in Area (ha)	RFD Case% Change
Woodland caribou	All seasons	High	2,821.0	-7.5	-0.3	-13.2	-0.5
		Moderate	2,540.9	-24.6	-1.0	53.7	-2.1
		Low	72.5	-0.3	-0.4	-1.4	-1.9
Moose	All seasons	High	12,556.8	-56.7	-0.5	-308.9	-2.5
		Moderate	58,996.2	-732.0	-1.2	-2,085.2	-3.5
		Low	12,655.0	-26.5	-0.2	-57.7	-0.4
Grey wolf	Snow-Free period	High	36,245.2	-146.8	-0.4	-389.1	-1.1
		Moderate	4,716.3	-68.1	-1.4	-217.5	-4.6
		Low	47,515.9	-731.9	-1.5	-1,847.4	-3.9
	Winter	High	11,555.4	-82.0	-0.7	-231.4	-2.0
		Moderate	3,408.7	-32.3	-0.9	-61.0	-1.8
		Low	54,638.4	-731.9	-1.3	-1,847.4	-3.4
Black bear	Spring	High	1,464.8	-63.2	-4.3	-195.2	-13.3
		Moderate	10,252.0	-42.1	-0.4	-77.7	-0.8
		Low	76,679.6	-841.5	-1.1	-2,181.1	-2.8
	Fall	High	54,795.6	-759.3	-1.4	-1,886.1	-3.4
		Moderate	161.5	-23.3	-14.4	-41.6	-25.8
		Low	32,212.7	-128.4	-0.4	-369.8	-1.1
Beaver	Beaver lodge	High	1,529.3	-7.4	-0.5	-21.6	-1.4
		Moderate	1,583.8	0.0	0.0	-2.9	-0.2
		Low	30,285.8	-28.8	-0.1	-179.1	-0.6
Little brown myotis	Roosting	High	127.8	0.0	0.0	-27.1	-21.2
		Moderate	989.5	< -0.1	0.0	<-0.1	0.0
		Low	21,080.7	-114.7	-0.5	-313.2	-1.5
Olive-sided flycatcher	Nesting	High	3,750.6	-4.1	-0.1	-4.1	-0.1
		Moderate	20,896.1	-90.3	-0.4	-235.1	-1.1
		Low	45,038.5	-535.3	-1.2	-1,434.8	-3.2
Rusty blackbird	Nesting	High	403.0	-0.2	-0.1	-0.2	0.0
		Moderate	516.5	-0.1	0.0	-0.1	0.0
		Low	13,528.2	-31.0	-0.2	-49.1	-0.4
Common goldeneye	Nesting	Suitable	13,103.9	-3.5	0.0	-114.6	-0.9
Mallard	Nesting	High	29,103.9	-142.1	-0.5	-520.6	-1.8
		Moderate	96.8	0.0	0.0	0.0	0.0
		Low	24,432.6	-45.1	-0.2	-99.6	-0.4
Canadian toad	Breeding	Suitable	15,325.8	-27.0	-0.2	-47.1	-0.3

Note: Base Case area for woodland caribou is for the caribou home range rather than the wildlife RSA. Habitat suitability modelling for common goldeneye and Canadian toad rated habitat as suitable or unsuitable.
RFD = reasonably foreseeable development; RSA = regional study area; VC = valued component; < = less than.

- Under existing conditions, woodland caribou is Threatened under SARA and not considered to be self-sustaining and ecologically effective in the SK2 West range in Saskatchewan as the provincial management threshold of limiting the amount of natural and anthropogenic disturbance to a maximum of 35% has already been exceeded; most of this disturbance is due to forest fires. Therefore, any amount of incremental habitat loss from any development, including residual losses of habitat associated with the proposed Project, is considered significant for woodland caribou. NexGen is committed to offsetting residual effects. Through engagement with provincial regulators, federal regulators, and Indigenous Groups, NexGen would develop a Caribou Mitigation and Offsetting Plan to offset potential adverse effects from the Project. With the implementation of the Caribou Mitigation and Offsetting Plan, the contribution of Project-specific adverse residual effects are predicted to be **not significant**.
- The effects of future climate change and associated effects (e.g., forest fire pattern changes) on wildlife VCs were considered in the assessment. Climate change is projected to decrease the availability of wetlands and moister ecosystems (i.e., black spruce/Labrador tea/feathermoss and white birch - white spruce - balsam fir) and could exacerbate reductions in habitat for VCs. Upland ecosystems may become drier and more prone to forest fire, which would further exacerbate effects on VCs relying on mature forests. While the predictions of induced effects from climate change are uncertain, it is anticipated that all VCs except for woodland caribou would remain self-sustaining and ecologically effective.

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Appendix 14A Species at Risk Screening Assessment

Abbreviations and Units of Measure

Abbreviation	Definition
BBS	Breeding Bird Survey
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
HSI	Habitat Suitability Index
LSA	local study area
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
SAR	species at risk
SARA	*Species at Risk Act*
VC	valued component
WNS	white nose syndrome

Unit	Definition
%	percent
cm	centimetre
ha	hectare
km	kilometre
m	metre

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14A1 Purpose And Approach

The Environmental Impact Statement (EIS) Section 14, Wildlife and Wildlife Habitat, provides a comprehensive characterization of existing conditions, evaluation of effects pathways and mitigation, residual effects analysis and classification, and determination of significance on the wildlife valued components (VCs) selected for the Project. Several of the wildlife VCs chosen as part of the EIS were selected due to their status as species at risk (SAR) combined with several other criteria such as presence in the area, degree of predicted interaction with the Project, habitat requirements, and cultural/economic value to Indigenous communities. EIS Section 14.2.2, Valued Components, Measurement Indicators, and Assessment Endpoints, provides rationale for the inclusion or exclusion of the comprehensive candidate list of potential wildlife VCs. In cases where effects would be similar for multiple wildlife species, only one species was selected as a VC for the Rook I Project (Project) to reduce assessment redundancy.

Baseline surveys detected seven SAR within the local study area (LSA) and regional study area (RSA): woodland caribou (*Rangifer tarandus caribou*), olive-sided flycatcher (*Contopus cooperi*), common nighthawk (*Chordeiles minor*), little brown myotis (*Myotis lucifugus*), northern myotis (*Myotis septentrionalis*), rusty blackbird (*Euphagus carolinus*), and barn swallow (*Hirundo rustica*) (Annex VIII.1, Wildlife Baseline Report 1 [Mammals, Waterfowl, and Raptors]; Annex VIII.2 Wildlife Baseline Report 2 (Amphibians, Birds, and Bats) and Annex VIII.3, Wildlife Baseline Report 3 [Bird Migration and Bats]). Woodland caribou, little brown myotis, olive-sided flycatcher, and rusty blackbird were included as Project VCs. Seven SAR were excluded from the final list of 11 VCs selected for the Project to avoid redundancy in the assessment: northern myotis, common nighthawk, barn swallow, Ashton (formerly gypsy) cuckoo bumble bee (*Bombus bohemicus*), yellow-banded bumble bee (*Bombus terricola*), transverse lady beetle (*Coccinella transversalis*), and nine-spotted lady beetle (*Coccinella novemnotata*).

These seven SAR were identified as candidates for a screening level assessment for the Project due to their conservation status and/or because they were detected in the LSA during baseline surveys. The following provides a summary of existing conditions for three measurement indicators described in EIS Section 14.2.2.2, Measurement Indicators: habitat availability, habitat distribution, and survival and reproduction. A tabulation of the classification of predicted residual effects, and determination of significance for each of the seven SAR, is also provided. The overall approach and format of the screening level assessment is consistent with the comprehensive assessment completed for the wildlife VCs included in Section 14 but is abbreviated to a high-level description of anticipated Project effects for the Application Case and Reasonably Foreseeable Development (RFD) Case. A simplified process of determining suitable habitat in the RSA for each assessment case was completed for the seven SAR. Details on the approach and methods for assigning 'suitable' habitat for each of the seven species is provided in Attachment 14A-1, Habitat Suitability Determination for Barn Swallow, Common Nighthawk, and Northern Myotis, Ashton Cuckoo Bumble Bee, Yellow-banded Bumble Bee, Transverse Lady Beetle, and Nine-spotted Lady Beetle and follows the approach and methods provided in Appendix 14B, Wildlife Habitat Models.

The following Project interactions were determined to be primary pathways for wildlife VCs assessed in EIS Section 14 and the seven SAR assessed here as part of this ecological screening process:

- Direct removal/alteration of soil and vegetation can cause loss of wildlife habitat and affect wildlife abundance and distribution.

- Alteration of final terrain and soil conditions, and/or plant species composition could change the types of ecosystems that can be reclaimed on the landscape, and adversely affect wildlife habitat availability and distribution, and survival and reproduction.
- Sensory disturbance (e.g., presence of people, lights, dust, smells, noise, vibrations) can alter wildlife movement and behaviour and adversely affect wildlife habitat availability and wildlife abundance and distribution.

The following sections characterize existing conditions and analyze the primary pathways and associated changes in measurement indicators (i.e., habitat availability, habitat distribution, survival and reproduction) for each of the three SAR. Following the methods described in Section 14, residual effects were classified and significance was determined for both the Application Case and the RFD Case, which included an assessment of potential effects from climate change.

14A2 Barn Swallow

14A2.1 Existing Conditions

14A2.1.1 Habitat Availability

Barn swallow is an aerial insectivore that relies on forest gaps for foraging (COSEWIC 2011). The species typically uses open, human-modified habitat for foraging and often constructs their nests on anthropogenic structures like outbuildings or houses (Brown and Brown 2020). Their home ranges are typically established in proximity to a waterbody and with access to mud to form their nest structures (COSEWIC 2011; Brown and Brown 2020). Prior to European settlement in North America, nest sites were likely confined to cliffs and caves but now predominately occur on anthropogenic structures such as bridges, tunnels, culverts, and buildings (COSEWIC 2011).

Barn swallow primarily feed on flying insects and typically forage in grass-dominated land cover or farmyards where these prey items are most abundant (Brown and Brown 2020). European settlement in North America is believed to have led to an increase in barn swallow habitat across the continent compared to pre-settlement conditions largely due to the clearing of forested habitat to support agriculture (COSEWIC 2011). In the boreal portions of their range, where anthropogenic disturbance is low, suitable breeding habitat for barn swallows is confined to areas of recent disturbance (i.e., recent burn) and in open habitats associated with rivers, waterbodies, and marshes (COSEWIC 2011).

Suitable habitat for barn swallow was identified and mapped across the LSA and RSA at Base Case through the development of a habitat suitability index (HSI) model (Attachment 14A-1). Using land cover mapping for the RSA, all habitat types were classified as either “suitable” or “not suitable”; a full list of land cover types considered suitable for barn swallow is provided in Attachment 14A-1, Table 1. Suitable habitat for barn swallow includes recent burns and young forest, open grass-covered areas and wetlands, and existing disturbance. According to the HSI model, the LSA has an estimated 565.7 ha (20% of total area) of suitable barn swallow habitat and 2,265.9 ha (80% of total area) of not suitable habitat. In the RSA, suitable and not suitable habitat was estimated at 36,647.8 ha (34.1% of total area) and 70,842.9 ha (65.9% of total area), respectively.

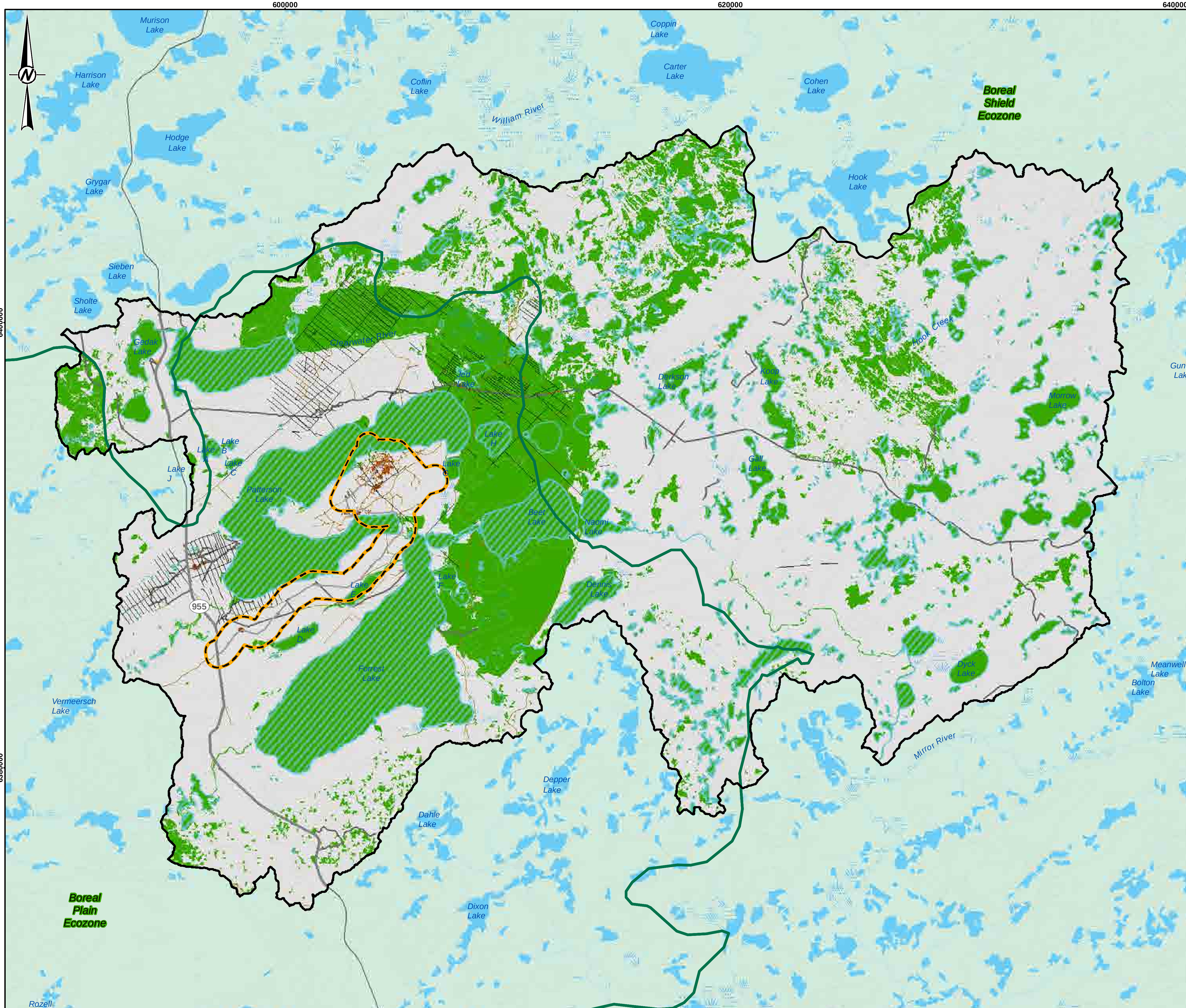
14A2.1.2 Habitat Distribution

The barn swallow is the most widely distributed swallow species in the world and breeds in all Canadian provinces and territories except Nunavut (COSEWIC 2011; Brown and Brown 2020). The current North American distribution of the barn swallow is believed to be much larger than pre-European levels due to the increase of open foraging habitat created by anthropogenic disturbance and the construction of barns and wooden structures in many portions of their range (COSEWIC 2011). According to the Boreal Songbird Initiative, an estimated 8% of the North American population of barn swallow breed within the boreal regions of Canada (Boreal Songbird Initiative 2021). Individuals that breed in Canada typically migrate from Central or South America during their annual cycle (Hobson et al. 2015).

Barn swallows maintain and defend small territories immediately surrounding their nest sites during the breeding season (0.01 ha; Brown and Brown 2020; fRI Research 2021a) but their functional home range, including foraging habitat, is much larger. Information on home range size in the boreal portion of the range of the species is limited; however, a study in West Virginia found that individuals foraged within 1.2 km of their nesting sites (Samuel 1971), which would represent a functional home range of approximately 450 ha. Individuals in Europe typically forage within 500 m of their nesting sites (approximate home range size of 78.5 ha) (Møller 1987). The species will sometimes nest in colonies with active nests as close as 10 cm apart (Brown and Brown 2020).

Suitable habitat for barn swallow in the LSA and RSA is largely comprised of recent burned land cover and areas surrounding waterbodies and open wetlands (Figure 14A-1). Most of the suitable habitat in the LSA occurs along uplands adjacent to Patterson Lake and surrounding two small waterbodies that occur south and east of the existing access road. Large patches of recently burned upland habitat to the east of the LSA comprise most of the contiguous suitable barn swallow habitat in the RSA at Base Case. Highway 955 and the existing access road represent unsuitable habitat, but likely have little to no influence on habitat connectivity. Barn swallow are tolerant of human activity and have high mobility with the ability to flyover these linear features.

Barn swallows were observed at two locations in the LSA during baseline surveys. Both observations were recorded near the edges of waterbodies: one south of Patterson Lake and the other between Patterson Lake and Forrest Lake, near the existing access road (Annex VIII.1).



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)
WATERCOURSE
OPEN WATER (WITHIN THE RSA)
WATERBODY (WITHIN THE RSA)
WATERBODY (OUTSIDE OF RSA)
WETLAND
WOODED
ECOZONE BOUNDARY
LOCAL STUDY
REGIONAL STUDY

DISTURBANCE CLASS

ACCESS ROAD
CUTLINE/SEISMIC
SECONDARY HIGHWAY
ROUGH ROAD
TRAIL
NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

SUITABLE
NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BARN SWALLOW HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MT	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14A-1**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

14A2.1.3 Survival and Reproduction

Barn swallow is listed as 'Special Concern' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and are classified as 'Threatened' under Schedule 1 of the *Species at Risk Act* (SARA) and the species at risk public registry (Government of Canada 2023). The species was downgraded from 'Threatened' to 'Special Concern' by COSEWIC in May 2021 due to the relative stability of Canadian population numbers recorded between 2000 and 2019 (Government of Canada 2023). Barn swallow are a provincially tracked species listed as 'Apparently Secure' (S4B/S4M) in Saskatchewan, indicating that the species is uncommon but not rare (SKCDC 2020, 2021).

Barn swallow is one of the most abundant species of birds in North America with an estimated United States (US) and Canada population size of 41,000,000 individuals during the period of 2005 to 2014 (Brown and Brown 2020). According to the COSEWIC status report, the Canadian population is estimated at 6.4 million adult individuals, which declined substantially from pre-1990s values (COSEWIC 2011). Recent trends suggest that the Canadian population has stabilized and still occurs at a level much higher than what was expected in Canada prior to European settlement (COSEWIC 2011; Put et al. 2021). Long-term (1970 to 2018) annual population declines have been highest in western and eastern Canada, and lowest in central Canada (Alberta, Saskatchewan, Manitoba), which have also shown the highest estimated population sizes in recent years (Put et al. 2021).

Recorded values for adult survival rate range from 0.338 to 0.350 (Brown and Brown 2020). Barn swallows often produce two broods per year with clutch sizes varying from three to eight eggs (Brown and Brown 2020). Clutch sizes tend to increase with higher latitudes. Chick survival rate is variable depending on the size of the clutch and if individuals produce two broods in a year. Reproductive values reported in the literature vary but are generally higher for populations that raise two broods in a breeding season compared to those that raise one brood (Brown and Brown 2020). Smith and Montgomerie (1991) reported a reproductive output of 4.2 surviving fledglings/adult male for a population in Ontario raising two broods while a two-brood population in Manitoba produced 6.9 fledglings/breeding pair in Manitoba (Barclay 1988). Put et al. (2021) observed an average of 3.6 young produced/nest across 2,685 nests monitored in British Columbia, Ontario, and New Brunswick.

The loss of habitat associated with converting conventional farming to modern farming techniques is one of the greatest causes of recent declines in population size in Canada (COSEWIC 2011; Brown and Brown 2020). Declines in insect populations and climate-related stressors (e.g., cold snaps) are also believed to have contributed to population declines of barn swallow in North America. Long-term declines for the species breeding in Canada have been attributed to detrimental conditions experienced during migration and in wintering grounds (Hobson et al. 2015; Michel et al. 2015; Nebel et al. 2020; Put et al. 2021).

14A2.2 Residual Effects and Determination of Significance

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation measures (Table 14A-1). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence of the effect occurring following the methods described in EIS Section 14.2.9, Residual Effects Classification and Determination of Significance. Effective implementation of mitigation summarized in EIS Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on barn swallow. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in EIS Section 14.2.9.

Table 14A-1: Classification of Residual Effects on Barn Swallow Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 101.3 ha of suitable habitat loss in RSA (0.3% of total available) (i.e., low magnitude) ▪ No predicted change in habitat quality from sensory disturbance	▪ 172.5 ha of suitable habitat loss in RSA (0.5% of total available) (i.e., low magnitude) ▪ No predicted change in habitat quality from sensory disturbance
	Geographic extent	▪ Maximum disturbance area	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years – 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Patterson Lake South Property) ▪ Possible (climate change effects)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change in habitat connectivity caused by habitat loss (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Maximum disturbance area	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years – 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 101.3 ha of habitat loss represents approximately one home range (78.5 – 450 ha; Samuel 1971; Møller 1987); however, habitat loss could displace several individuals if species is nesting communally in area (i.e., low magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 172.5 ha of habitat loss represents approximately one home range; however, habitat loss could displace several individuals if species is nesting communally in area (i.e., low magnitude) ▪ Small measurable change to barn swallow abundance and distribution around Patterson Lake area due to effects from development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years – 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change effects)

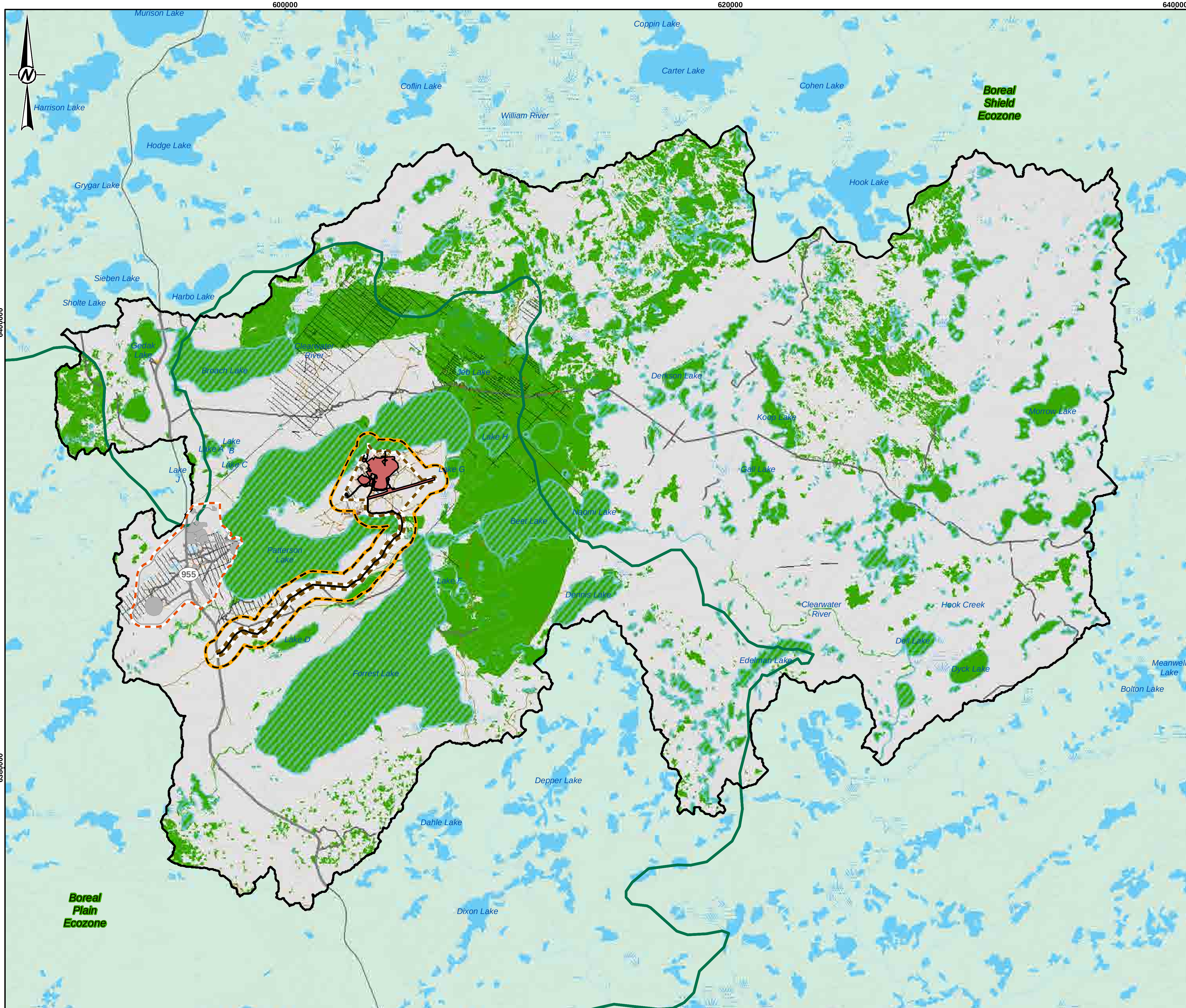
RSA = regional study area; RFD = reasonably foreseeable development; WRSA = waste rock storage area.

Barn swallow is classified as 'Special Concern' by COSEWIC, listed as 'Threatened' under Schedule 1 of the SARA, and are a provincially tracked species listed as 'Apparently Secure' (S4B/S4M) in Saskatchewan (Government of Canada 2023; SKCDC 2020, 2021). Although the breeding population in Canada has experienced declines for the past several decades, these declines have slowed in recent years and the current population size in North America is estimated to be significantly larger than the population size prior to European settlement (COSEWIC 2011). Barn swallow population declines in the prairie provinces have been weaker than those experienced elsewhere in Canada (Put et al. 2021) and the population in Saskatchewan is believed to be relatively stable. At Base Case, suitable habitat for barn swallow in the RSA is abundant (approximately 34% of RSA considered suitable habitat) and well connected on the landscape with few barriers to movement. The available information suggests that barn swallow in the RSA is self-sustaining and ecologically effective under existing conditions.

At Application Case, the Project is predicted to result in a loss of 101.3 ha of suitable barn swallow habitat, representing 0.3% of available suitable habitat in the RSA at Base Case. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and continuous from Construction through Closure (Table 14A-1). Additional habitat loss due to sensory disturbance is not expected due to the high tolerance of human disturbance in the breeding grounds of the species (COSEWIC 2011).

Effects from losses to wetland habitat that could be used for foraging and areas covered by permanent features (e.g., waste rock storage areas [WRSAs]) would be irreversible (Table 14A-1). However, there would be progressive reclamation of areas no longer required for Project activities and decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclaimed areas would likely provide foraging habitat (e.g., insect prey) for barn swallow within five years following the Active Closure Stage (i.e., similar to recent burn upland ELC units; Attachment 14A-1).

Changes to habitat availability are likely to have limited effects on the barn swallow population because remaining suitable habitat is abundant and widespread throughout the RSA (Figure 14A-2). Remaining patches of contiguous, undisturbed habitat would remain in areas surrounding the LSA and should continue to provide landscape connectivity (Figure 14A-2). The increase in traffic volume on Highway 955 of up to 13% relative to existing conditions and any increases along the access road should not influence habitat connectivity for barn swallow relative to existing conditions. Barn swallow are long-distance migrants with strong dispersal and movement capabilities and the changes in traffic volume and habitat configuration from the Project are not expected to create barriers to movement relative to existing conditions.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

BARN SWALLOW HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MT	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14A-2**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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The decrease in suitable breeding habitat in the RSA at Application Case could result in the loss of several home ranges if habitat removal occurs in a communal nesting site. However, the species is considered highly adaptable to changes in availability of breeding sites (COSEWIC 2011) and is expected to be resilient to the small amount of habitat loss in the RSA should breeding sites be affected. Creation of new nesting opportunities on anthropogenic structures is also possible. The loss of breeding and foraging habitat is predicted to have a small, measurable negative effect on the survival and reproduction of the population occupying the RSA. However, given the adaptive capacity and tolerance of barn swallow to human disturbance, the changes to survival and reproduction may occur but are unlikely (i.e., effect is not expected but not impossible). Effects are expected to be local in geographic extent, occur over the long term, and reversible (Table 14A-1).

The Project is not expected to have a measurable effect on barn swallow survival and reproduction after the effective implementation of environmental design features and mitigation (EIS Section 14.4, Table 14.4-1). Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the species. Barn swallow is predicted to remain self-sustaining and ecologically effective at Application Case (i.e., there is no predicted change in the assessment endpoints). The residual effects from the Project are considered not significant.

At the RFD Case, the Project and the Fission Patterson Lake South Property (Fission 2019, 2021) would combine to reduce the amount of suitable breeding habitat by 172.5 ha or 0.5% of the RSA. The change is expected to occur at a regional scale, continuously, and be reversible for reclaimed upland habitats. Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has not received regulatory approvals. The duration of effects from direct habitat loss from the two projects would be a function of the amount of temporal overlap between the start of construction to the end of active closure or decommissioning and the time required to establish barn swallow habitat. Incremental effects from direct habitat loss due to the Project were predicted to occur from Construction through the end of the Active Closure Stage plus five years to regenerate foraging habitat. At a minimum, habitat loss from the Fission Patterson Lake South Property would occur during a hypothetical or projected three-year construction period, seven-year operating period, and active decommissioning (Fission 2019, 2021).

The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years). The duration of effects from direct habitat loss for the Fission Patterson Lake South Property was therefore assumed to be from construction to the end of active decommissioning (i.e., 15 years) plus five years for functional barn swallow habitat to be regenerated. If assumed habitat loss from the Fission Patterson Lake South Property completely overlapped habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 20 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Future climate changes could reduce wetland habitat availability in the RSA but could also increase the amount of suitable upland breeding habitat for barn swallow if weather and fire disturbance patterns change as projected (EIS Section 22, Assessment of Effects of the Environment on the Project). Wetland ecosystem availability could be reduced in the RSA due to an increase of 2.4°C and 9.1% in annual mean temperature and evapotranspiration rate, respectively (EIS Section 9.2.6, Existing Conditions), although the extent of wetlands reduction is not known (EIS Section 13.5.2.2.1, Ecosystem Availability). Reductions in the size and occurrence of wetlands may decrease the availability of suitable habitat in the RSA for barn swallow at the RFD Case. An increase in forest fire frequency and intensity could lead to an increased availability of foraging habitat for barn swallow as forested habitat would be replaced by open, regenerating habitat. Changes in habitat availability and distribution due to climate change are possible and expected to occur at a beyond-regional scale; however, the direction and magnitude of changes are uncertain given the variability in climate change models (Table 14A-1). Losses or gains in suitable breeding and foraging habitat due to climate change would be irreversible.

Climate change may also affect the availability or emergence of insect prey species for barn swallow in their breeding, migratory, and wintering grounds (COSEWIC 2011; Nebel et al. 2020). If climate change leads to future shifts in the timing of emergence of their invertebrate prey base or a decline in abundance of prey, barn swallow could experience reduced survival and reproduction (Imlay et al. 2018; Nebel et al. 2020). As a long-distance migrant, the species is also vulnerable to climate change-related mortality because climate change can lead to more frequent and severe storms encountered during their annual migrations (COSEWIC 2011; Nebel et al. 2020). These storms can disrupt the abundance of insect prey available to birds, potentially leading to starvation, and can lead to higher energy expenditures for migrating individuals, ultimately reducing survival and reproductive output among adults (Nebel et al. 2020).

The anticipated loss of habitat attributed to the Project and Fission Patterson Lake South Property may possibly have small measurable influence the abundance and distribution of barn swallow around the area of Patterson Lake (i.e., effects may occur but are not likely). Habitat remains common and well connected in the RFD Case and should not limit barn swallow populations overlapping the RSA (Figure 14A-2). Accordingly, cumulative habitat effects from the Project and the Fission Patterson Lake South Property are expected to remain within the resilience and adaptability limits of the species.

Climate change effects and continued declines in prey abundance remain of concern for the North American barn swallow (COSEWIC 2011); however, population declines have become less steep throughout Canada in recent years and have been relatively low in Saskatchewan compared to other areas of the breeding range (Put et al. 2021). Given the anticipated stability of the population occupying the RSA, climate change related effects expected under the RFD Case are also expected to remain within the resilience and adaptability limits of the species.

Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Overall, the residual effects from the Project and Fission Patterson Lake South Property on barn swallow are predicted to be not significant. Effects from climate change are potentially adverse but are not expected to significantly influence the abundance and distribution of barn swallow and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14A3 Common Nighthawk

14A3.1 Existing Conditions

14A3.1.1 Habitat Availability

Common nighthawk breeds throughout much of Canada, using a variety of open and cleared as well as wetland land cover types for their breeding and nesting habitat (Environment Canada 2016). In the boreal region, the species will breed in forest openings, bogs and fens, early successional land cover created by anthropogenic disturbance and forest fires, and rock or sandy habitats (COSEWIC 2018; Knight and Bayne 2017). In the northeast boreal region of Alberta, Knight and Bayne (2017) found that common nighthawk nest site selection was strongly associated with the presence of bare ground and seismic lines on the landscape.

In Saskatchewan, the species occurs in highest abundance in open shrubland in the south of the province and forested habitat dominated by jack pine (*Pinus banksiana*) (Government of Saskatchewan 2020). Farrell et al. (2017) found that common nighthawk will readily occupy recent clear cuts and burns during the breeding season in the boreal portion of their range. Critical habitat has not been explicitly defined as part of the protection of the species through the SARA (Environment Canada 2016; COSEWIC 2018). Recent studies have indicated that the species shows relatively high levels of site fidelity in their breeding habitat, returning to similar breeding grounds year-after-year (Ng et al. 2018). Common nighthawk is relatively tolerant of anthropogenic disturbance and will occupy a variety of human-disturbed habitats including gravel pits, agricultural fields, seismic lines, and building rooftops (Environment Canada 2016; Knight and Bayne 2017).

Foraging habitat for the species is variable and believed to be largely driven by the density of invertebrate (e.g., insects) prey species (COSEWIC 2018). A large part of the diet for individuals studied in the boreal regions of Alberta was composed of beetles, which are high in nutritional content and commonly found in recently burned habitats (Knight et al. 2018).

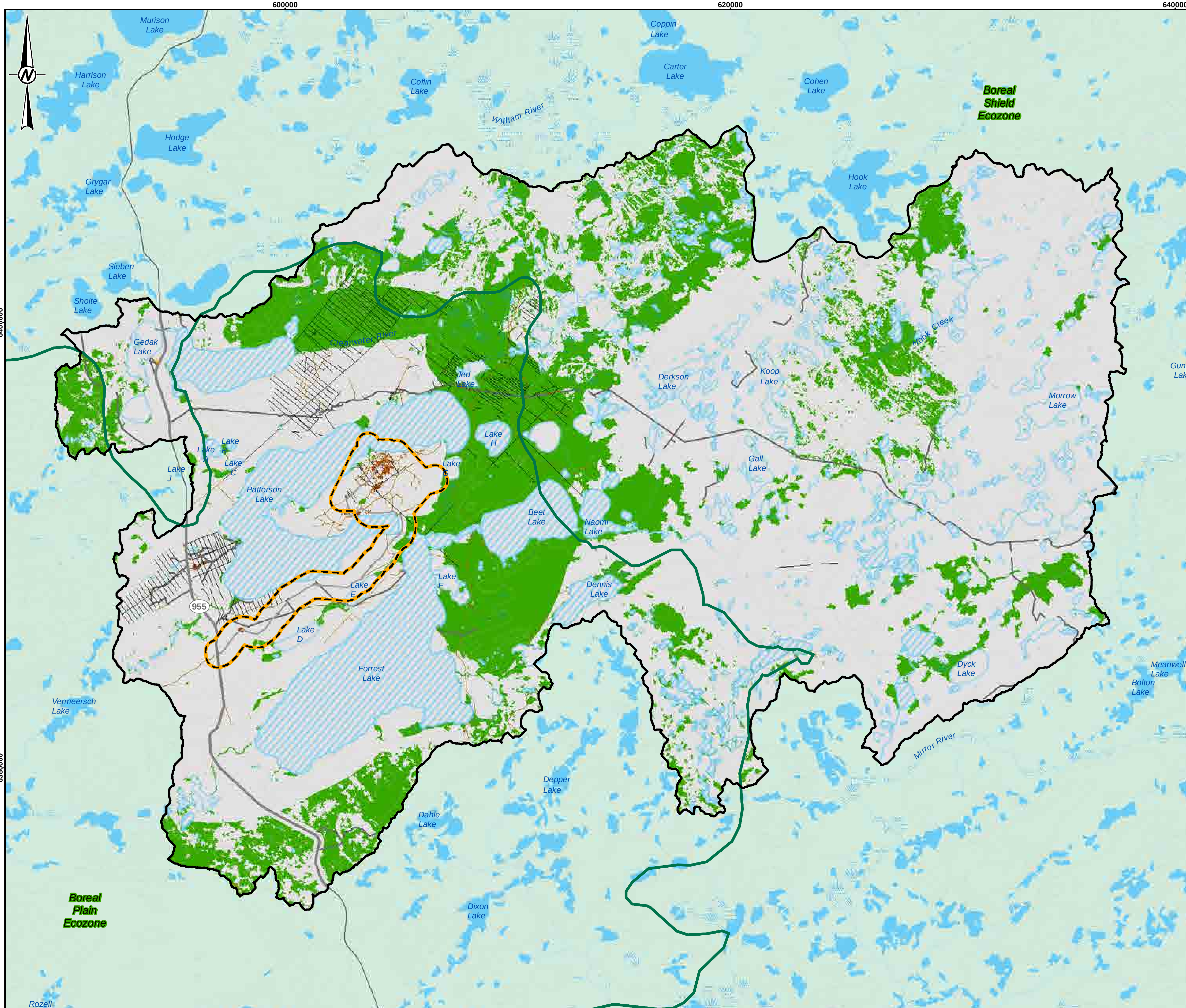
Suitable habitat for common nighthawk was identified and mapped across the LSA and RSA at Base Case through the development of a habitat suitability index (HSI) model (Attachment 14A-1). Using land cover mapping for the RSA, all habitat types were classified as either “suitable” or “not suitable”; a full list of land cover types considered suitable for common nighthawk is provided in Attachment 14A-1, Table 2. Suitable habitat for common nighthawk includes recent burns and young forest, open grass-covered areas and wetlands, shrubby and mature treed wetlands, and existing disturbance with low activity levels (e.g., cutlines, trails, clearings). Common nighthawk is expected to avoid habitats within 200 m of human developments with high activity levels (i.e., Highway 955, existing access road, mineral exploration). According to the HSI for common nighthawk, the LSA has an estimated 170.3 ha (6% of total area) of suitable breeding habitat and 2,661.2 ha (94% of total area) of not suitable habitat. In the RSA, suitable and not suitable habitat was estimated at 24,728.5 ha (23% of total area) and 82,762.2 ha (77% of total area), respectively.

14A3.1.2 Habitat Distribution

Common nighthawk is widely distributed in Canada and breed in all Canadian provinces and territories, except Nunavut and Newfoundland (COSEWIC 2018). The species is a long-distance migrant and travels from South American wintering grounds to breeding grounds throughout North America. Approximately 10% of the global population is believed to breed in Canada (COSEWIC 2018). In Saskatchewan, the species breeds in most parts of the province including the Boreal Shield and Boreal Plain ecozones. The species has strong dispersal and movement capabilities; however, it also demonstrates relatively strong site fidelity to breeding locations (Ng et al. 2018) and would therefore be vulnerable to changes in breeding habitat distribution. Approximate size of a nesting territory within a breeding home range is 28 ha (fRI Research 2021b).

At Base Case, suitable breeding habitat for common nighthawk is limited and patchy in the LSA but widespread and connected within the broader RSA (Figure 14A-3). The history of wildfire in the area has created large contiguous patches of suitable habitat in several portions of the LSA and RSA. The largest patches of intact and connected breeding habitat, according to the HSI model developed for the species, occurs in the eastern portion of the LSA, between the existing access road and Forrest Lake (Figure 14A-3). The largest patches of suitable habitat in the RSA occur to the east, northeast, and southeast of the LSA where forested habitat surrounding Patterson Lake and Forrest Lake were recently burned. Human activity and traffic associated with Highway 955, the existing access road, and mineral exploration are predicted to have a negative influence on movement and habitat connectivity of common nighthawk, particularly during periods of high activity or traffic volume.

Common nighthawk was detected at several locations within the LSA and RSA during baseline surveys (Annex VIII.1). Three observations of common nighthawk were made in the LSA in wetland or regenerating upland habitats surrounding Patterson and Forrest lakes. Observations in the RSA were made adjacent to Highway 955 (one observation) and in recently burned habitat approximately 7.5 km east of the main basin of Patterson Lake (two observations; (Annex VIII.1).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY
- REGIONAL STUDY

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)
1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
COMMON NIGHTHAWK HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT
wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MT	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09	FIGURE 14A-3	
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

14A3.1.3 Survival and Reproduction

Common nighthawk was recently re-classified as 'Special Concern' under Schedule 1 of SARA (Government of Canada 2023), which indicates that this species currently has a stable population trend. Common nighthawk is a provincially tracked species listed as 'Apparently Secure' (S4B/S4M) in Saskatchewan, indicating that the species is uncommon but not rare (SKCDC 2020, 2021).

In general, aerial insectivores such as common nighthawk has experienced the greatest declines in North American population size of any bird group since 1970 (ECCC 2019). According to the North American Breeding Bird Survey (BBS) of Canada, the Canadian common nighthawk population has experienced an annual decline of 2.26% from 1970 to 2017 and an annual decline of 1.12% between 2007 and 2017 (Smith et al. 2020). Uncertainty surrounding the trend estimates for this species is relatively high compared to other bird species monitored through the BBS due to the lack of survey coverage in the northern boreal regions of Canada, the point count methods used, and road-side biases (Environment Canada 2016). The steepest declines in population size have been documented in the southern portion of the Canadian range where agricultural conversion, forest succession, and pesticide use have had detrimental effects on the breeding populations occupying these areas. The breeding population in Canada was estimated to be 270,000 individuals in 2014 (COSEWIC 2018).

The lifespan of common nighthawk is believed to be between four and five years with the oldest individual recorded at nine years (Brigham et al. 2020). The species typically lays two eggs per clutch and generally lays one clutch per year (Brigham et al. 2020). Information on the survivorship of nestlings during the breeding season is limited. The main threats to common nighthawk populations are reductions in their prey base (insects), loss of breeding habitat due to anthropogenic disturbance, forest succession and fire suppression, collisions with vehicles and human structures, and loss of non-breeding habitat (Environment Canada 2016). Fire suppression, anthropogenic disturbance (e.g., roads, mineral exploration), mortality during migration, and loss of wintering habitat are likely the greatest threats to the common nighthawk population breeding in the boreal portions of the province of Saskatchewan.

14A3.2 Residual Effects and Determination of Significance

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation measures (Table 14A-2). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence of the effect occurring following the methods described in EIS Section 14.2.9. Effective implementation of mitigation summarized in EIS Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on common nighthawk. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in EIS Section 14.2.9.

Table 14A-2: Classification of Residual Effects on Common Nighthawk Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 78.3 ha suitable habitat loss in the RSA (0.3% of total available) (low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 135.9 ha removal of suitable habitat in RSA (0.5% of total available) (low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (up to 200 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [includes 200 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years - 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat ▪ Long-term (sensory disturbance): 48 years - 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable ((Project and Fission Patterson Lake South Property) ▪ Possible (climate change effects)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change in habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development will create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years - 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat ▪ Long-term (sensory disturbance): 48 years - 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 78.3 ha of habitat loss represents approximately 3 home ranges affected (i.e., low magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 135.9 ha of habitat loss represents 5 home ranges affected (i.e., low magnitude) ▪ Small measurable change in common nighthawk abundance and distribution around Patterson Lake area due to effects from development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 38 years - 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat ▪ Long-term (sensory disturbance): 48 years - 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered permanent features and loss wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RSA = regional study area; RFD = reasonably foreseeable development; WRSA = waste rock storage area.

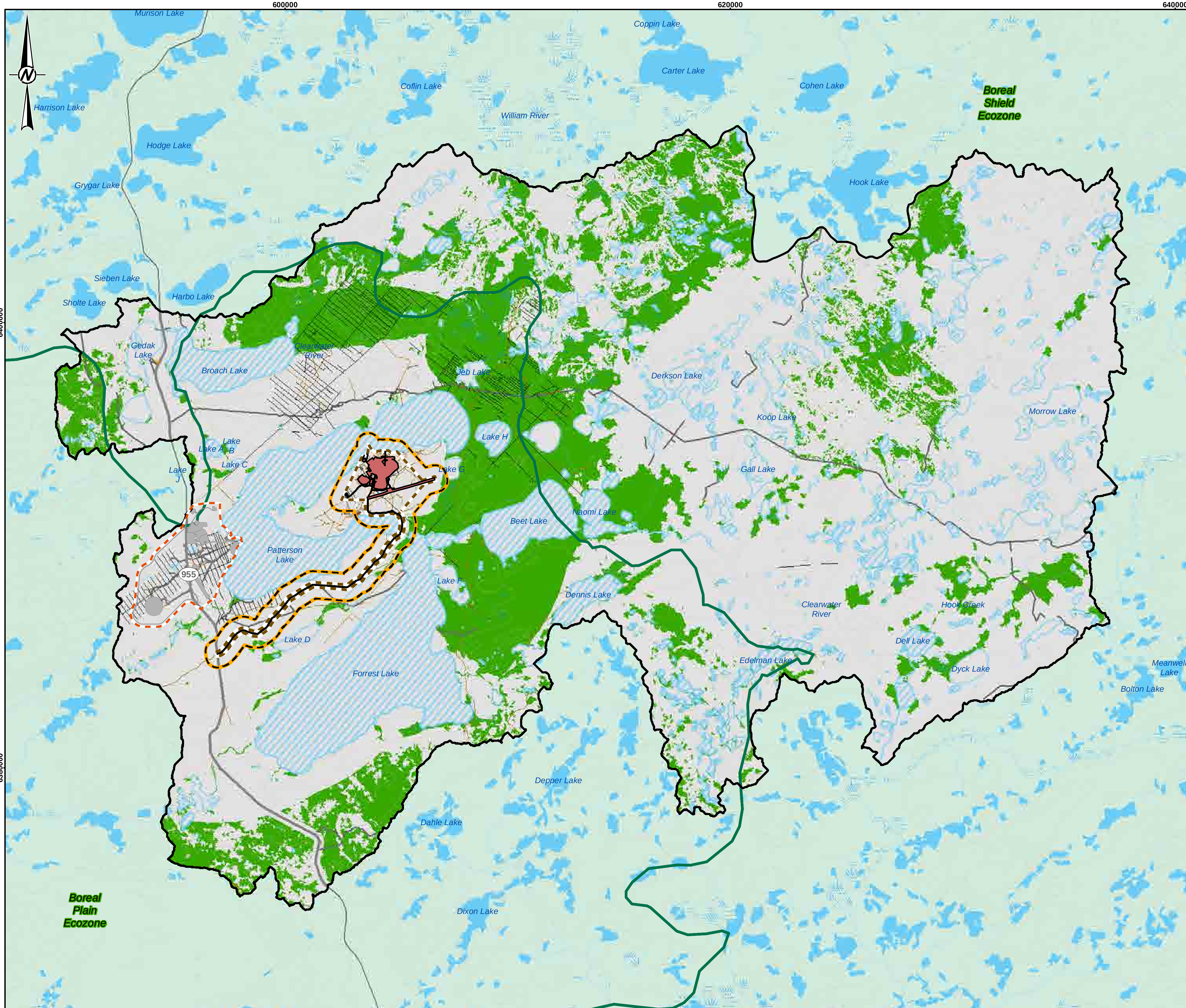
Common nighthawk is classified as 'Special Concern' by COSEWIC, listed as 'Special Concern' under Schedule 1 of the SARA and listed as 'Apparently Secure' (S4B/S4M) in Saskatchewan (Government of Canada 2023; SKCDC 2021; SKCDC 2020). While the breeding population in Canada has experienced declines for the past several decades, these declines have slowed in recent years with the population appearing to be more stable according to population assessment results since 2007 (Smith et al. 2020). Populations in the boreal portion of the Canadian range of the species appear to be stable and even increasing in some areas (Environment Canada 2016). At Base Case, suitable breeding habitat for common nighthawk in the RSA is abundant and well connected on the landscape with few barriers to movement (e.g., Highway 955, existing access road). The available information suggests that common nighthawk in the RSA is self-sustaining and ecologically effective under existing conditions.

At Application Case, the Project is expected to result in a loss of 78.3 ha of suitable habitat, representing 0.3% of available suitable habitat in the RSA at Base Case. Direct habitat loss is expected to be confined to the maximum disturbance area with some additional functional habitat loss occurring at the local scale (i.e., up to 200 m from the maximum disturbance area) due to sensory disturbance (Table 14A-2). The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and continuous from Construction through Closure.

Effects from losses to wetland habitat that could be used for foraging, and areas covered by permanent features (e.g., waste rock storage areas [WRSAs]) would be irreversible (Table 14A-2). However, there would be progressive reclamation of areas no longer required for Project activities and decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclaimed areas would likely provide foraging habitat (e.g., insect prey) for common nighthawk within five years following the Active Closure Stage (i.e., similar to recent burn upland ELC units; Attachment 14A-1) (i.e., a duration of 38 years).

Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment, blasting and general mine activity would be highest. Noise levels are expected to decrease following the Active Closure Stage (Section 7.3) but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, the duration of effects from sensory disturbance were predicted to occur for the 43-year lifespan of the Project and be reversible 5 years after Closure (i.e., duration is 48 years).

Changes to habitat availability are likely to have limited effects on the common nighthawk population because remaining suitable breeding and foraging habitat is abundant and widespread throughout the RSA (Figure 14A-4) and the species is tolerant of many forms of human disturbance, often nesting in disturbed habitat and near anthropogenic developments. Remaining patches of contiguous, undisturbed habitat will remain in areas surrounding the LSA and should continue to provide landscape connectivity (Figure 14A-4). Common nighthawk are long-distance migrants with high mobility; changes to habitat configuration on the landscape in the RSA are not expected to create barriers to movement for the species at Application Case.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

COMMON NIGHTHAWK HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MT	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	**FIGURE 14A-4**	
REVIEW	JV	2023-02-09		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

At Base Case, Highway 955 and the existing access road are predicted to have a negative influence on movement and habitat connectivity of common nighthawk, particularly during periods of high traffic volume. Common nighthawk may avoid habitats within 200 m of human developments with high levels of activity. The Project is expected to increase the number of vehicles on Highway 955 by up to 13% relative to existing conditions, which could affect the movement of common nighthawk that use habitat in and outside the western portion of the RSA (i.e., regional to beyond regional effect).

The loss of 78.3 ha of suitable breeding habitat in the RSA at Application Case represents approximately three nesting territories for the species, which is predicted to have a negligible effect on the survival and reproduction of the population occupying the RSA. Although common nighthawk is tolerant of human disturbance, the species also demonstrates relatively strong site fidelity to breeding locations (Ng et al. 2018). Breeding and foraging can occur near some types of anthropogenic disturbance, so the complete elimination of home ranges is not expected to occur but not impossible (i.e., unlikely). Effects are expected to be local in geographic extent, occur over the long term, and reversible (Table 14A-2).

The Project is not expected to have a measurable effect on common nighthawk survival and reproduction after the effective implementation of environmental design features and mitigation (EIS Section 14.4, Table 14.4-1). Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the species. Common nighthawk is predicted to remain self-sustaining and ecologically effective at Application Case (i.e., there is no predicted change in the assessment endpoints). The residual effects from the Project are therefore considered not significant.

At the RFD Case, the Project and the Fission Patterson Lake South Property would combine to reduce the amount of suitable breeding habitat by 135.9 ha or 0.5% of the RSA. The change is expected to occur at a regional scale, continuously, and be reversible for reclaimed upland habitats. Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has recently entered the formal regulatory process. Habitat remains common and well connected in the RFD Case and should not limit common nighthawk populations overlapping the RSA (Figure 14A-4). The combined effects of the two projects may possible result in a small measurable change in the abundance and distribution of common nighthawk around Patterson Lake (i.e., effects may occur but are not likely).

The duration of effects from direct habitat loss from the two projects would be a function of the amount of temporal overlap between the start of construction to end of active closure or decommissioning and the time required to establish common nighthawk habitat. Incremental effects from direct habitat loss due to the Project was predicted to occur from Construction through the end of the Active Closure Stage (i.e., 33 years) plus five years when reclaimed upland habitat is expected to provide forage habitat. The duration of effects from direct habitat loss for the Fission Patterson Lake South Property was therefore assumed to be from construction to the end of active decommissioning (i.e., 15 years; Section 14A2.2) plus five years to establish functional common nighthawk habitat. Assuming that habitat loss from the Fission Patterson Lake South Property completely overlaps habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 20 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

The duration of cumulative effects from sensory disturbance for the RFD Case would also depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. Sensory disturbance effects from the Project are conservatively predicted to occur from Construction to five years after Closure. Sensory disturbance effects from the Fission Patterson Lake South Property would occur, at a minimum, during a hypothetical or projected three-year construction period, seven-year operating period, and active decommissioning (Fission 2019, 2021). The anticipated start of construction and duration of active decommissioning and transitional monitoring (i.e., closure) at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of closure for the Fission Patterson Lake South Property would be similar to the Project (i.e., 15 years). The duration of sensory disturbance effects for the Fission Patterson Lake South Property was therefore assumed to be from construction to five years after closure (i.e., 30 years). If assumed sensory disturbance from the Fission Patterson Lake South Property completely overlapped sensory disturbance associated with the Project, the duration of cumulative effects for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Future climate changes could reduce wetland habitat availability in the RSA but could also increase the amount of suitable upland breeding habitat for common nighthawk if weather and fire disturbance patterns change as expected (EIS Section 22). Wetland ecosystem availability could be reduced in the RSA due to an increase of 2.4°C and 9.1% in annual mean temperature and evapotranspiration rate, respectively (EIS Section 9.2.6), although the extent of wetlands reduction is not known (EIS Section 13.5.2.2.1). Reductions in the size and occurrence of wetlands may decrease the availability of suitable breeding and foraging habitat in the RSA for common nighthawk at the RFD Case. An increase in forest fire activity could lead to an increase in availability of suitable breeding and foraging habitat for common nighthawk in the RSA as forested habitat would be replaced by open, regenerating habitat. Regenerating burns and open land cover types are characterized by high densities of prey items (i.e., beetles) and would provide microsite conditions preferred by common nighthawk for their nest sites (Environment Canada 2016; Knight et al. 2018).

Changes in habitat availability due to climate change are possible and are expected to occur at a beyond-regional scale; however, the direction and magnitude of changes are uncertain given the variation in climate models. Losses or gains in suitable breeding and foraging habitat due to climate change would be irreversible (Table 14A-2). Climate change may also potentially affect the availability of insect prey species for common nighthawk (Environment Canada 2016). If climate change leads to future changes in the timing of emergence of their invertebrate prey base or a decline in abundance of prey, common nighthawk could experience reduced survival and reproduction (Environment Canada 2016). As a long-distance migrant, the species is more vulnerable to climate change effects on survival rate among adults than other migratory birds that travel shorter distances as part of their annual cycle (Environment Canada 2016).

The common nighthawk in the boreal regions of Canada is estimated as being stable over the past two decades and the species is highly mobile and relatively tolerant of human disturbance. Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Overall, the residual effects from the Project and Fission Patterson Lake South Property on common nighthawk are predicted to be not significant. Effects from climate change are potentially adverse but are not expected to significantly influence the abundance and distribution of common nighthawk and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14A4 Northern Myotis

Northern myotis was not included as a VC for the Project; however, a detailed description of existing conditions and residual effects for little brown myotis (*Myotis lucifugus*), an ecologically similar species, is provided in EIS Section 14.3.6, Little Brown Myotis and EIS Section 14.5.6, Little Brown Myotis, respectively. Existing conditions and potential Project interactions and effects would be similar for the two species given the ecological requirements and threats common to both species.

14A4.1 Existing Conditions

14A4.1.1 Habitat Availability

Northern myotis are considered a forest-obligate species, which means that the species is more closely tied to forested habitat than other similar bat species such as little brown myotis (Environment Canada 2018). Similar to little brown myotis, hibernacula and maternity roost sites are considered the main limiting habitat features for northern myotis within their range (COSEWIC 2013). Critical habitat for northern myotis has only been partially identified for hibernacula. Critical habitat for maternity roosts and foraging have not yet been formally identified (Environment Canada 2018). In general, northern myotis habitat requirements for hibernation, roosting, and foraging are similar to little brown myotis (Environment Canada 2018).

Hibernacula

In winter, northern myotis hibernate in caves or mines where the open and accessible space extends below the frost line, and above zero temperatures and high humidity are relatively constant throughout the winter. In northern Saskatchewan, low survey effort and remote conditions have produced a knowledge gap about hibernacula locations, though known hibernaculum occur as far north as the Northwest Territories (COSEWIC 2013). A map of the known 192 bat hibernacula in Canada has been created by Environment and Climate Change Canada (ECCC) and is included in the Recovery Strategy (Environment Canada 2018). No known hibernacula identified by ECCC are within Saskatchewan (Environment Canada 2018). Within the Athabasca Basin in northern Saskatchewan, bats have been found within abandoned uranium mine satellite sites being reclaimed by the Saskatchewan Research Council and may use these sites as hibernacula (SRC 2019).

Natural hibernacula features, such as rock cliffs, may provide minor hibernacula in the RSA. Minor hibernacula that harbor smaller concentrations of bats are poorly understood but have the potential to play a large role in the recovery of the species from white nose syndrome (WNS).

Roosting and Foraging Habitat

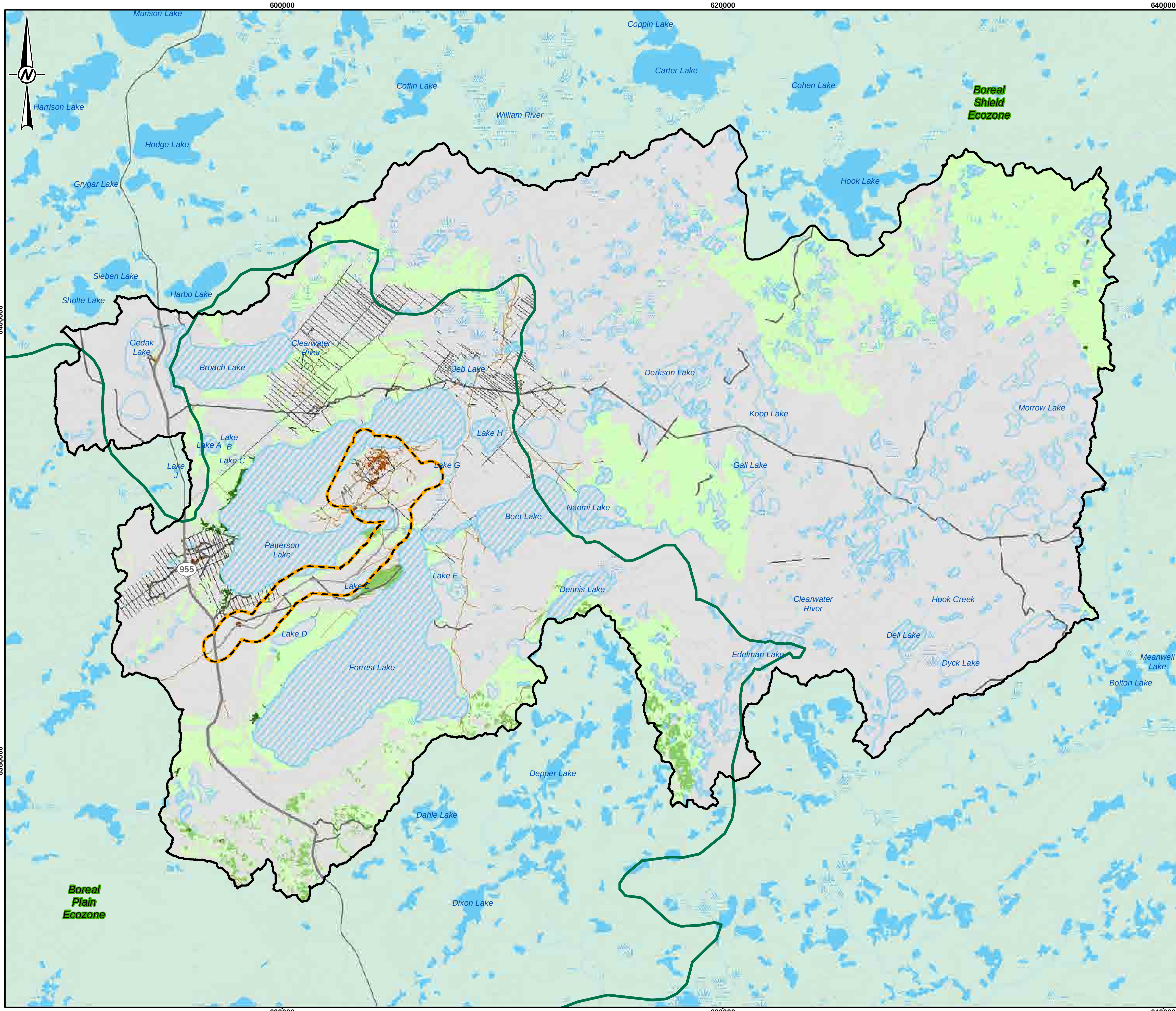
Female northern myotis communally roost in maternity colonies during the pup-rearing months of the summer. Maternity colonies typically occur in deciduous forest cover characterized by older, large-diameter trees with individuals usually occupying snags (dead or dying trees) with cavities (Vonhof and Wilkinson 1999; Environment Canada 2018). Males typically roost alone and use a larger variety of roosting sites than females; roosting sites can include crevices behind peeling bark of trees or in man-made structures (Caceres and Pybus 1997; Fabianek et al. 2015). Foraging habitat for both sexes is usually associated with forest patches and treed watercourses where the density of flying insects is high (Henderson and Broders 2008; Environment Canada 2018). Northern myotis as well as little brown myotis tend to prefer foraging habitat in mature forest where the vegetation structure is open and less cluttered than a regenerating forest stand (Luszcz and Barclay 2016). Northern myotis will also often use wetlands as foraging habitat (Government of Canada 2018).

Suitable habitat for northern myotis was identified and mapped across the LSA and RSA at Base Case through the development of a habitat suitability index (HSI) model (Attachment 14A-1). Using land cover mapping for the RSA, all habitat types were classified as either high, moderate, low, and poor; a full list of land cover types and associated suitability categories is provided in Table 3 (Attachment 14A-1). Given the similarities in the habitat requirements for roosting sites between little brown myotis and northern myotis, the model developed for little brown myotis was applied to northern myotis. The habitat suitability model predicted that the LSA and RSA contain little suitable roosting habitat at Base Case and mostly consists of habitat classified as poor and low suitability. The limited amount of moderate and high suitability habitat is related to the extent of fire disturbance and quantity of regenerating and young forest on the landscape. The LSA has an estimated 318.4 ha (11.2% of total area) of low suitability, 16.9 ha (0.6% of total area) of moderate suitability, and no high suitability bat roosting habitat. In the RSA, high, moderate, and low suitability roosting habitat are estimated at 127.8 ha (0.1% of total area), 989.5 ha (0.9% of total area), and 21,080.7 ha (19.6% of the total area), respectively.

14A4.1.2 Habitat Distribution

Northern myotis is widespread throughout North America and typically associated with deciduous or mixed wood forest cover that provide roosting and foraging habitat for the species (COSEWIC 2013). Northern myotis have been shown to avoid open areas when commuting from roosting habitat to foraging habitat and will follow narrow bands of trees to move around open fields (Henderson and Broders 2008). Linear disturbance features may act as barriers for this species because some bats are reluctant to cross open ground and some species avoid areas with lights such as roads (Berthinussen and Altringham 2012). Roads are thought to have greater barrier effects on bats than other linear disturbance such as rail lines and transmission lines because roads are usually wider and have more vehicle traffic (i.e., are associated with higher sensory disturbance) (Berthinussen and Altringham 2012).

Suitable roosting habitat for northern myotis is uncommon and patchily distributed in the LSA and RSA (Figure 14A-5). Existing human disturbance is aggregated in the northwest portion of the RSA and largely comprised of cutlines, seismic lines, trails, and small clearings, which are expected to have little influence on movement and habitat connectivity for northern myotis. Alternatively, Highway 955 and the existing access road may create partial barriers to movement, particularly during periods of high traffic volume. Low suitability roosting habitat for bats occurs in the RSA in large patches in the northeastern portion, east of Naomi Lake, and between and north of Broach and Patterson lakes (Figure 14A-5). Moderate suitability roosting habitat for bats occurs primarily along the northwestern edge of Forrest Lake, southwest of Edelman Lake, and in the far southwest corner of the RSA in proximity to Highway 955. High suitability roosting habitat is limited in the RSA to narrow strips of habitat along the western shores of Patterson Lake and in small, isolated patches in the far northeast portion of the RSA.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

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PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

NORTHERN MYOTIS ROOSTING HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MT	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09		
REVIEW	JV	2023-02-09		

FIGURE 14A-5

14A4.1.3 Survival and Reproduction

Northern myotis is a provincially tracked, vulnerable/rare species (S3) in Saskatchewan (SKCDC 2020, 2021). They are listed as Endangered under Schedule 1 of the federal SARA (Government of Canada 2023). The species listing under SARA is due to dramatic population declines caused by WNS. Females reach sexual maturity at the age of one and reproduce every year thereafter, typically producing one pup per year (COSEWIC 2013). Survivorship among northern myotis is poorly understood but estimates for little brown myotis, a similar species, recorded average survival rates of 0.82 for adult males and 0.71 for adult females in Ontario (Keen and Hitchcock 1980). Frick et al. (2010) recorded survival rates ranging from 0.63 to 0.90 for adult female little brown myotis and 0.23 to 0.46 for juvenile females in a New Hampshire population without WNS.

The greatest threat to survival of northern myotis is WNS, which can have devastating effects on bat populations. Bat populations affected by WNS often experience mass die-offs of adults because the disease disrupts hibernation patterns during the winter months (Government of Canada 2018). Where present, WNS is known to have caused a 94% overall decline in population numbers of hibernating Myotis bats in Nova Scotia, New Brunswick, Ontario, and Québec (Government of Canada 2018). The disease, caused by the *Pseudogymnoascus destructans* fungus, has not been recorded in Saskatchewan; however, a recent survey uncovered the fungus in southeastern Saskatchewan (Global News 2021). The fungus and associated disease are expected to spread to the western edge of the range of northern myotis (i.e., the Pacific coast of Canada) by approximately 2030 (COSEWIC 2013). It is believed that there are currently enough breeding individuals in the Prairies and western Canada, where WNS has not spread, to sustain the species in Canada or increase their abundances (Government of Canada 2018).

Given the present lack of spread of WNS in Saskatchewan, the greatest threat to survival for northern myotis in the province is likely the loss of hibernacula or roosting sites caused by natural or anthropogenic disturbance, collision with wind turbines, and the decline of insect prey species due to pesticide use (Environment Canada 2018). Industrial disturbance to individuals (e.g., forestry and mining) is currently considered as a medium to low level of concern relative to other threats facing the species (Government of Canada 2018). Sensory disturbance in the form of noise or light can also have negative effects on foraging success and survival (COSEWIC 2013).

14A4.2 Residual Effects and Determination of Significance

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation measures (Table 14A-3). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence of the effect occurring following the methods described in EIS Section 14.2.9. Effective implementation of mitigation summarized in EIS Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on northern myotis. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in EIS Section 14.2.9.

Table 14A-3: Classification of Residual Effects on Northern Myotis Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size – Application Case	Rating / Effect Size – RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 0 ha loss of high suitability roosting habitat ▪ Less than 0.1 ha loss of moderate suitability roosting habitat representing <0.1% of RSA (i.e., low magnitude) ▪ 114.7 ha loss of low suitability roosting habitat representing 0.5% of RSA (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations	▪ 27.1 ha removal of high suitability roosting habitat in RSA (21.2% of total available) (i.e., moderate magnitude) ▪ Less than 0.1 ha of moderate suitability roosting habitat in RSA (<0.1% of total available) (i.e., low magnitude) ▪ 313.2 ha loss of low suitability roosting habitat in RSA (1.5% of total available) (i.e., low magnitude) ▪ Reduction in functional habitat from sensory disturbance included in habitat calculations (i.e., occurs during period of overlap in sensory disturbance between projects)
	Geographic extent	▪ Maximum disturbance area: direct habitat loss ▪ Local: sensory disturbance (up to 100 m beyond the maximum disturbance area)	▪ Regional (Project and Fission Patterson Lake South Property [includes 100 m buffer]) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years - 33 years (i.e., start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 60 years to 80 years to establish mature ecosites ▪ Long-term (sensory disturbance): 48 years - 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change effects)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small changes to habitat connectivity caused by habitat loss and sensory disturbance (i.e., low magnitude due to high mobility)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Local ▪ Beyond regional (Highway 955)	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (Highway 955) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years - 33 years (i.e., start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 60 years to 80 years to establish mature ecosites ▪ Long-term (sensory disturbance): 48 years - 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Probable	▪ Probable (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Less than 0.1 ha of moderate suitability habitat represents less than one home range (i.e., negligible magnitude) ▪ Negligible change to abundance and distribution resulting from changes in habitat availability and distribution	▪ 27.1 ha of high and moderate suitability habitat represents 1 to 2 home ranges (i.e., low magnitude) ▪ Small measurable change in northern myotis abundance and distribution around Patterson Lake due to effects associated with development-related changes to habitat availability and distribution
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and wetland habitat ▪ Long-term (direct habitat loss): 93 to 113 years - 33 years (i.e., start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 60 years to 80 years to establish mature ecosites ▪ Long-term (sensory disturbance): 48 years - 43 years (i.e., start of Construction to end of Closure) plus 5 years beyond Closure	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 95 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property ▪ Long-term (sensory disturbance): maximum of 30 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible	▪ Reversible (habitat loss from Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Unlikely	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)

RFD = reasonably foreseeable development; < = less than; WRSA = waste rock storage area.

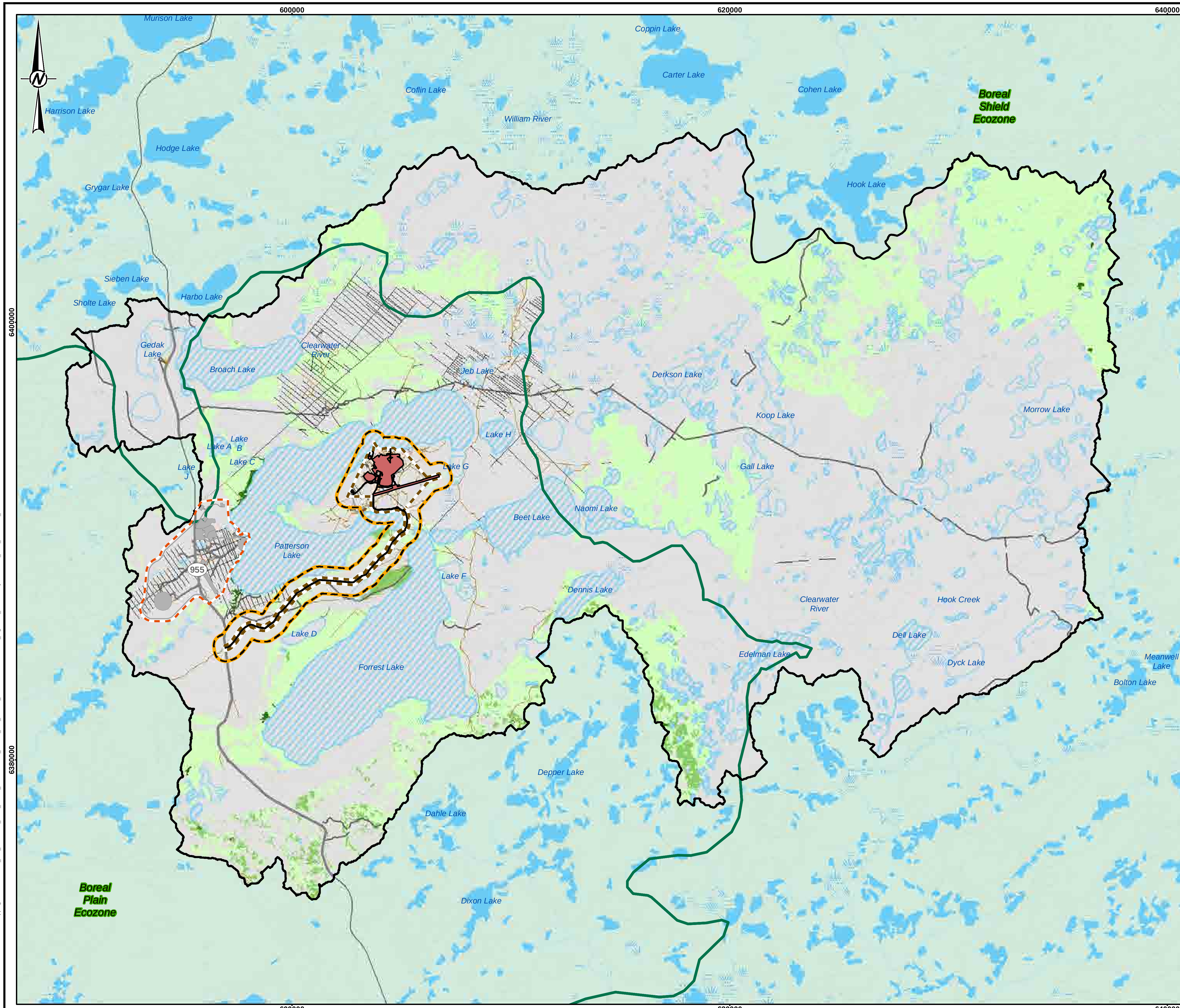
Bats are relatively resilient and adaptable, making use of anthropogenic features such as abandoned mines, buildings, and bridges as hibernacula and roosting sites. Further, they often forage near edge habitats (i.e., more open areas adjacent to forest), including areas next to human disturbance with low levels of activity. Existing disturbances in the RSA are predicted to have little influence on northern myotis movement and habitat connectivity, except Highway 955 and the existing access road during periods of high traffic volume. Although roosting habitat is limited in the RSA due to fire disturbance, foraging habitat is abundant and well connected and WNS is presently not detected. The northern myotis population(s) that overlaps the RSA is considered self-sustaining and ecologically effective at Base Case.

At Application Case, the Project is expected to result in a loss of 114.7 ha of low suitability roosting habitat, representing 0.5% of availability in the RSA and less than 0.1 ha of moderate suitability roosting habitat, representing less than 0.1% of availability in the RSA. The Project is not expected to remove high suitability roosting habitat. Most of the habitat loss would occur in low suitability roosting habitat, which is common and well distributed in the RSA (Figure 14A-6). The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and continuous from Construction through Closure (Table 14A-3).

Effects from losses to wetland habitat that could be used for foraging, and areas covered by permanent features (e.g., waste rock storage areas [WRSAs]) would be irreversible (Table 14A-3). However, there would be progressive reclamation of areas no longer required for Project activities and decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Roosting habitat for northern myotis would be established well beyond the Active Closure Stage (perhaps within 60 to 80 years based on the age of mature upland ELC units at existing conditions; EIS Section 13.3.1.3).

Sensory disturbance effects from the Project would most likely occur from Construction to the end of the Active Closure Stage when heavy equipment, blasting, and general mine activity would be highest. Noise levels are expected to decrease following the Active Closure Stage (EIS Section 7.3) but animals may remain sensitive to the presence of people and activities associated with the Project during the Transitional Monitoring Stage and beyond. Applying a conservative approach, the duration of effects from sensory disturbance were predicted to occur for the 43-year lifespan of the Project and be reversible five years after Closure (i.e., duration is 48 years).

Northern myotis are expected to be resilient to changes in habitat distribution because of their dispersal and movement ability. Small changes in movement patterns may occur in the LSA (i.e., around the Project footprint); however, individuals should still be able to move through the landscape to access habitat patches in the RSA. The Project is predicted to not affect seasonal migration movements between winter habitat and summer roosting habitat within or beyond the RSA. The Project is expected to increase the number of vehicles on Highway 955 by up to 13% relative to existing conditions (EIS Section 14.4.2), which could affect the movement of northern myotis that use habitat in and outside the western portion of the RSA (i.e., regional to beyond regional effect) (Table 14A-3).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- POOR

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. FISSION (FISSION URANIUM CORP.) OBTAINED FROM 2019 TECHNICAL REPORT ON THE PRE-FEASIBILITY STUDY OF THE PATTERSON LAKE SOUTH PROPERTY USING UNDERGROUND MINING METHODS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

NORTHERN MYOTIS ROOSTING HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		20144150	PHASE	3314 - 6
DESIGN	MT	2020-03-13	SCALE AS SHOWN	REV. 0
GIS	NO	2023-02-09		
CHECK	SM	2023-02-09	FIGURE 14A-6	
REVIEW	JV	2023-02-09		

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25mm

The average home range for northern myotis is unknown in northern Saskatchewan; however, Owen et al. (2003) recorded mean female northern myotis home ranges of 65 ha in a population in West Virginia. Henry et al. (2002) found that home range size in pregnant little brown myotis in Quebec was 30.1 ha and 17.6 ha for lactating females. The loss of less than 0.1 ha of moderate suitability habitat represents less than 1% of the estimated home range of northern myotis (17 ha to 65 ha). The loss of 114.7 ha of low suitability habitat represents 2 to 7 home ranges. A single home range can include several individuals. Applying a precautionary approach to address uncertainty, the Project has the potential to displace several individuals from the LSA, which could lead to a small decline in the local abundance of northern myotis. Habitat loss caused by the Project is not expected (i.e., unlikely) to have a measurable effect on northern myotis survival and reproduction; approximately 22,000 ha of suitable habitat would remain connected in the RSA.

The Project is not expected to have a measurable effect on northern myotis survival and reproduction after the effective implementation of environmental design features and mitigation (EIS Section 14.4, Table 14.4-1). Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of the species. Northern myotis is predicted to remain self-sustaining and ecologically effective at Application Case (i.e., there is no predicted change in the assessment endpoints). The residual effects from the Project are therefore considered not significant.

At the RFD Case, the Fission Patterson Lake South Property would reduce the amount of high suitability habitat by 27.1 ha, which represent 21.2% of available high suitability habitat in the RSA (the Project does not remove high quality roosting habitat). There is less than 0.1 ha of moderate suitability habitat lost at the RFD Case from the Project and Fission Patterson Lake South Property (0.1% of the total available in RSA). Low suitability roosting habitat and foraging habitat remain common and well connected in the RSA (Figure 14A-6). The primary driver of habitat disturbance in the region is wildfire and it is anticipated that the population(s) of northern myotis overlapping the RSA has the adaptive capacity and resilience to the effects from fire. The change in habitat suitability from the Project and Fission Patterson Lake South Property are also predicted to be within the adaptive capacity and resilience limits of northern myotis occupying the RSA. The change is expected to occur at a regional scale, continuously, and be reversible for reclaimed upland habitats. Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has recently entered the formal regulatory process (Table 14A-3). The combined loss of habitat from the Project and Fission Patterson Lake South Property may possibly influence survival and reproduction (i.e., effects may occur but are not likely) and any changes in abundance and distribution would be limited to the area around Patterson Lake. Habitat loss in the RFD Case is not expected to have a measurable demographic effect on the northern myotis population as almost 22,000 ha of suitable habitat would remain connected in the RSA.

The duration of effects from direct habitat loss from the two projects would be a function of the amount of temporal overlap between the start of construction to end of active closure or decommissioning and the time required to establish northern myotis roosting habitat. Incremental effects from direct habitat loss due to the Project was predicted to occur from Construction through the end of the Active Closure Stage (33 years) plus 60 to 80 years to establish mature forest. The duration of effects from direct habitat loss for the Fission Patterson Lake South Property was therefore assumed to be from construction to the end of active decommissioning (i.e., 15 years; see Section 14A2.2) plus 60 to 80 years to establish northern myotis roosting habitat. Assuming that habitat loss from the Fission Patterson Lake South Property completely overlaps habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 95 years (Table 14A-3). A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

The duration of cumulative effects from sensory disturbance for the RFD Case would also depend on the temporal overlap of related activities for the Project and the Fission Patterson Lake South Property. Sensory disturbance effects from the Project are conservatively predicted occur from Construction to 5 years after Closure. The duration of sensory disturbance effects for the Fission Patterson Lake South Property was therefore assumed to be from construction to 5 years after closure (i.e., 30 years; Section 14A3.2). If assumed sensory disturbance from the Fission Patterson Lake South Property completely overlapped sensory disturbance associated with the Project, the duration of cumulative effects for the RFD Case would be a maximum of 30 years. A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Future climate change could reduce wetland (forage) habitat availability in the RSA and increase the amount of suitable roosting habitat if weather and fire disturbance patterns change as expected (EIS Section 22). Wetland ecosystem availability could be reduced in the RSA due to an increase of 2.4°C and 9.1% in annual mean temperature and evapotranspiration rate, respectively (EIS Section 9.2.6), though the extent of wetlands reduction is not known (EIS Section 13.5.2.2.1). Reductions in the size and occurrence of wetlands may decrease forage habitat for northern myotis. Large stand-replacing fires are a driver of forest composition, structure, function, and therefore overall availability. However, forests within the RSA may be resilient to fire, particularly with respect to jack pine stands, as self-replacement is the most common post-fire trajectory (Hart et al. 2019), which may not change roosting habitat availability.

Alternatively, the composition of boreal forest is also expected to change under future climate change scenarios whereby as fire frequency increases, the availability of deciduous ELC units would increase as black spruce dominant stands become less common (Hart et al. 2019). The replacement of coniferous-dominated forest with mixed-wood or deciduous forest stands may benefit northern myotis because the species prefers mature forest stands dominated with deciduous species (Psyllakis and Brigham 2006; Willis et al. 2006; Park and Broders 2012; Environment Canada 2018). There is a large degree of uncertainty regarding the potential effects of climate change because predictions are based on simulations that can be highly variable. Changes in climate that affect disturbance regimes and forest resilience would have effects beyond the regional scale and be irreversible (Table 14A-3).

Cumulative effects from the previous and existing developments, and the Project and the Fission Patterson Lake South Property in the RFD Case, are be expected to remain within the species' resilience and adaptability limits. Northern myotis would remain self-sustaining and ecologically effective in the RFD Case assuming WNS did not spread to the RSA. Overall, the residual effects from the Project and the Fission Patterson Lake South Property are predicted to be not significant. Effects from climate change are uncertain and potentially adverse but are not expected to significantly influence the abundance and distribution of northern myotis and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

If the spread of WNS continues at its current rate, all hibernacula in Canada and the US are anticipated to be infected by 2025 to 2028 (Government of Canada 2018). Northern myotis is predicted to be functionally extirpated (i.e., less than 1% of existing population) in Canada and the US by 2030 (COSEWIC 2013), or possibly sooner based on the recent confirmation of WNS in Washington (USGS 2016). Despite the conclusion that cumulative effects from the Project and Fission Patterson Lake South Property are predicted to be not significant, should WNS spread to the RSA, northern myotis are not predicted to remain self-sustaining or ecologically effective. Effects on survival and population viability caused by WNS are expected to exceed the resilience and adaptability limits of the regional population. The arrival of WNS in the RSA would represent a significant adverse effect for northern myotis, independent of effects from either the Project or the Fission Patterson Lake South Property.

14A5 Ashton Cuckoo Bumble Bee and Yellow-Banded Bumble Bee

14A5.1 Existing Conditions

14A5.1.1 Habitat Availability

Two bumble bee SAR have the potential to occur in the LSA and RSA: Ashton cuckoo bumble bee and yellow-banded bumble bee. However, the occurrence of these two species has not been confirmed. Ashton cuckoo bumble bees are social parasites of several bumble bee species, including yellow-banded bumble bee. As a social parasite, Ashton cuckoo bumble bees invade the nests of other bumble bee species and displace the queen by either injuring or killing her (COSEWIC 2014). The worker bees of the invaded colony are then used by the Ashton cuckoo bumble bee to rear their own offspring. Yellow-banded bumble bees nest in underground cavities, such as abandoned rodent burrows, and in decomposing vegetation, such as rotten logs (COSEWIC 2014, 2015). Both Ashton cuckoo and yellow-banded bumble bees overwinter underground or in decomposing vegetation (e.g., leaf layer) (COSEWIC 2014, 2015).

Ashton cuckoo bumble bee and yellow-banded bumble bee are generalist pollen and nectar foragers that use a wide variety of plant species (COSEWIC 2014, 2015). These species can be found in many different habitat types including forests, meadows, road ditches, and urban areas (COSEWIC 2014, 2015). Ashton cuckoo bumble bees forage on flowering plants that are close to wooded areas (COSEWIC 2014). Yellow-banded bumble bee has shown preference for flowering herbs over ericaceous (i.e., in or related to the heather family [*Ericaceae*]) shrubs, but many different types of flowering shrubs and herbs are used for pollen and nectar collection (Gibson et al. 2019).

Suitable foraging habitat for Ashton cuckoo bumble bee and yellow-banded bumble bee was identified and mapped across the LSA and RSA in the Base Case through the development of a habitat suitability index (HSI) model (Attachment 14A-1). Using land cover mapping for the RSA, all habitat types were classified as either high, moderate, low, or nil based on the abundance of nectar or pollen-producing shrubs and herbs present in the ecosite (as detailed in McLaughlan et al. 2010). A full list of land cover types considered in the Ashton cuckoo bumble bee and yellow-banded bumble bee HSI model is provided in Attachment 14A-1, Table 4.

High-quality habitat for Ashton cuckoo bumble bee and yellow-banded bumble bee in the LSA and RSA is largely composed of recently burned land cover. According to the HSI model, the LSA has an estimated 479 ha (16.9% of total area) of high-quality bumble bee habitat (Figure 14A-7). There is 154 ha of moderate quality and 1,803 ha of low-quality habitat (5.4% and 16.7% of total area, respectively) for bumblebees in the LSA. In the RSA, high-quality bumble bee habitat is estimated at 24,900 ha (i.e., 23.2% of total area). There is 28,837 ha of moderate-quality and 34,879 ha of low-quality habitat (26.8% and 32.4% of total area, respectively) for bumblebees in the RSA.

Bumble bees are tolerant of most sensory disturbances, but recent studies indicate that artificial electromagnetic fields (EMF), such as power lines, may affect bumble bees. One study found that the abundance of ground-nesting wild bees increased near areas with artificial EMF (Lázaro et al. 2016), while another study found that bumble bees avoided pollinating flowers within 235 m of areas with artificial EMF (Molina-Montenegro et al. 2023).

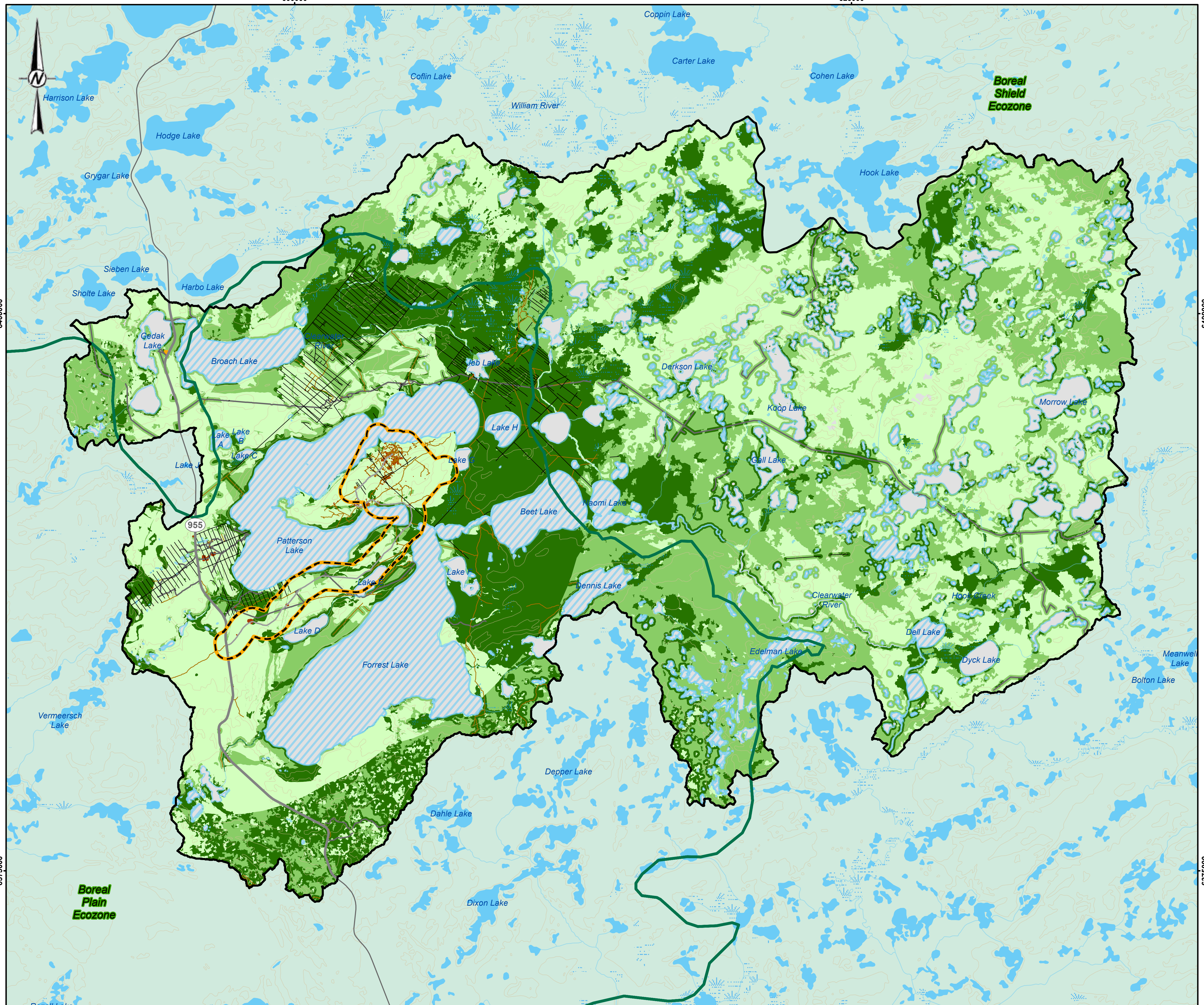
14A5.1.2 Habitat Distribution

Ashton cuckoo bumble bee and yellow-banded bumble bee have historically been detected in every Canadian province and territory, except Nunavut, and historical detections of both species have been recorded primarily in the central and southern portions of Saskatchewan (COSEWIC 2014, 2015). The northern distribution of these species' ranges is relatively unknown because of limited sampling effort (COSEWIC 2014, 2015). There have been recent detections of yellow-banded bumble bees in Saskatchewan (COSEWIC 2015), but no detections of Ashton cuckoo bumble bees have been noted in Saskatchewan since 1991 (COSEWIC 2014). Nonetheless, as a conservative approach for the assessment, it is assumed that both species occur in the LSA and RSA.

Bees use earth's magnetic fields for navigation to foraging resources via their "waggle dance". The waggle dance is a series of complex circles and waggle patterns that is used to communicate the distance and direction of food sources to other members of the hive using the orientation of the sun and earth's magnetic fields. Therefore, the creation of artificial EMF from infrastructure, such as electrical distribution lines, may have a negative influence on bumble bee foraging patterns (Levitt et al. 2021).

Patches of high-quality bumble bee foraging habitat in the LSA occur adjacent to Patterson Lake and Forrest Lake (Figure 14A-6). Large patches of recently burned upland habitat to the east of the LSA comprise most of the contiguous high-quality bumble bee habitat in the RSA in the Base Case (Figure 14A-7) Bumble bees could also use the ditches along Highway 955 and the existing access road for the Project for foraging and travel.

Bumble bees are capable of travelling long distances. Individuals can forage up to 10 km from their nest site (Kraus et al. 2008; Mola et al. 2020). Recent documentation of migration of bumble bees in Europe has shown that bees can move several hundreds of kilometres; these distances include crossing large expanses of open water (Fijen 2020). Habitat fragmentation from anthropogenic features, such as Highway 955, is not expected to have reduced bumble bee habitat distribution in the LSA or RSA because the region is relatively undisturbed and existing anthropogenic disturbances are not expected to have isolated bumble bee populations from each other.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- NIL

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

ASHTON CUCKOO BUMBLE BEE AND YELLOW-BANDED BUMBLE BEE HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		22522691	PHASE	3314 - 6
DESIGN	LD	2020-05-30	SCALE AS SHOWN	REV. 0
GIS	SP	2023-12-06		
CHECK	LD	2023-12-06	FIGURE 14A-7	
REVIEW	JV	2023-12-06		

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PATH: I:\CLIENTS\NexGen\22522691\Mapping\Products\Wildlife\IR_Response\22522691_Fig14A-7_BumbleBee_RSA_BaseCase_Rev0.aprx PRINTED ON: AT 8:20:30 AM

14A5.1.3 Survival and Reproduction

Ashton cuckoo bumble bee is listed as Endangered under Schedule 1 of the *Species at Risk Act* (Government of Canada 2023). Yellow-banded bumble bee is listed as Special Concern under Schedule 1 of the *Species at Risk Act* (Government of Canada 2023). Both species are provincially tracked; Ashton cuckoo bumble bee is considered Critically Imperiled / Extremely Rare (S1) in Saskatchewan, while yellow-banded bumble bee is considered Apparently Secure (S4) (SKCDC 2023).

Ashton cuckoo bumble bee and yellow-banded bumble bee populations have declined throughout their ranges (COSEWIC 2014, 2015). The Ashton cuckoo population in Canada declined by more than 50.0% over a 10-year period (COSEWIC 2014). The rate of yellow-banded bumble bee population decline across Canada is unknown, but there was an average decline of 66.5% in the total number of mature individuals over a 10-year period across southeastern and south-central Canada (COSEWIC 2015).

Bumble bees have four developmental stages: egg, larvae, pupa, and adult (COSEWIC 2014, 2015). Female Ashton cuckoo bumble bees invade the nests of other bumble bee species, such as yellow-banded bumble bee, and use the workers of other bee species to raise their own offspring (COSEWIC 2014). Yellow-banded bumble bees are part of one of three castes in the hive: the queen (i.e., reproductive female), workers (i.e., unmated daughters of the queen that usually do not reproduce), and males (COSEWIC 2015).

Ashton cuckoo bumble bee eggs hatch approximately four days after invading a host bumble bee nest and displacing the queen. Only mated queens overwinter; all males and female workers die in the fall (COSEWIC 2014). In the spring, queen Ashton cuckoo bumble bees emerge approximately one month after the host species (COSEWIC 2014). Development of Ashton cuckoo bumble bees takes approximately five weeks but can vary with temperature and food supply (COSEWIC 2014).

Yellow-banded bumble bee colonies are annual, with one generation per year (COSEWIC 2015). Yellow-banded bumble bee colonies generally contain approximately 200 individuals (COSEWIC 2015). Maximum worker production and production of males and potential queens occurs in the mid to later summer (COSEWIC 2015). The number of potential queens produced by yellow-banded bumble bee colonies has been found to range from 0 to 56 (COSEWIC 2015). The sex ratio for wild yellow-banded bumble bee colonies is estimated to be one queen to 6.1 males (Owen et al. 1980). Only the queens from yellow-banded bumble bee colonies overwinter; all other individuals die in the fall (COSEWIC 2015). Eggs typically hatch four days after being laid. Similar to Ashton cuckoo bumble bees, development of yellow-banded bumble bees takes approximately five weeks but can vary with temperature and food supply (COSEWIC 2015).

The largest threat to Ashton cuckoo bumble bee is the decline of host bumble bee populations, which is primarily caused by agricultural practices (COSEWIC 2014). Effects related to agriculture, such as the introduction of non-native bee species for crop pollination and associated pathogen spillover, and the use of pesticides, are considered the largest threats to yellow-banded bumble bee populations in Canada (COSEWIC 2015). These threats are not present in either the LSA or RSA.

Recent research suggests that artificial EMF can interfere with bumble bee navigation. Honey bee (*Apis mellifera*) homing ability was found to decrease by 14.0% to 17.0% when exposed to artificial EMF (Kimmel et al. 2007; Treder et al. 2023). Interference in navigation to food resources may be partly responsible for bumble bee colony collapse disorder (Ferrari 2014; Levitt et al. 2021). Exposure to artificial EMF was not found to affect bumble bee brood development or adult worker longevity (Treder et al. 2023).

Bumble bees are more susceptible to habitat fragmentation than many other animal species because of their complementary sex determination. That is, the sex of bumble bees is determined by a single genotype whereby hemizygotes (i.e., haploids) are reproductive males, heterozygotes are females, and homozygotes (i.e., diploids) are sterile or inviable males (COSEWIC 2015). The number of sex alleles in a population determines the number of sterile/inviable males in a population, and this single genotype makes bumble bee populations vulnerable to extinction when effective population sizes are small (COSEWIC 2015); that is, as the total number of bumble bees decline, the number of sterile/inviable males produced increases (COSEWIC 2015). This increase in sterile/inviable males with a decline in abundance can cause a “diploid male extinction vortex” (Zayed and Packer 2005).

Bumble bee survival and reproduction in the RSA is expected to be similar to pre-disturbance conditions because the region is relatively undisturbed and the primary threats to bumble bee populations (i.e., agricultural practices) are not present in either the LSA or RSA.

14A5.2 Residual Effects and Determination of Significance

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation measures (Table 14A-4). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence of the effect occurring following the methods described in EIS Section 14.2.9, Residual Effects Classification and Determination of Significance. Effective implementation of mitigation summarized in EIS Section 14.4, Project Interactions and Mitigation (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on Ashton cuckoo bumble bee and yellow-banded bumble bee. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in EIS Section 14.2.9.

Table 14A-4: Classification of Residual Effects on Yellow-Banded Bumble Bee and Ashton Cuckoo Bumble Bee Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size: Application Case	Rating / Effect Size: RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 169 ha of high-quality habitat loss in RSA (0.7% of total available in the Base Case) (i.e., low magnitude) ▪ No predicted change in habitat quality from sensory disturbance	▪ 390 ha of suitable habitat loss in RSA (1.6% of total available in the Base Case) (i.e., low magnitude) ▪ No predicted change in habitat quality from sensory disturbance
	Geographic extent	▪ Maximum disturbance area	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and for wetland habitat ▪ Long-term (direct habitat loss): 38 years to 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Patterson Lake South Property) ▪ Possible (climate change effects)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change in habitat connectivity caused by habitat loss (i.e., low magnitude due to high mobility of bumble bees) ▪ Negligible change in foraging movements due to artificial EMF from power distribution infrastructure	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude) ▪ Negligible change in foraging movements due to artificial EMF from power distribution infrastructure for the Project and the Fission Patterson Lake South Property
	Geographic extent	▪ Maximum disturbance area	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and for wetland habitat ▪ Long-term (direct habitat loss): 38 years to 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat). ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Possible	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Vegetation clearing and soil disturbance could result in the removal of colonies if present in the maximum disturbance area (i.e., high magnitude) ▪ Negligible change in survival and reproduction due to EMF from power distribution infrastructure	▪ Vegetation clearing and soil disturbance from the Project and the Fission Patterson Lake South Property could result in the removal of colonies if present in the maximum disturbance area (i.e., high magnitude) ▪ Negligible change in survival and reproduction due to EMF from power distribution infrastructure for the Project and the Fission Patterson Lake South Property
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for any colonies removed during construction of the Project	▪ Permanent: for any colonies removed during construction of the Project or Fission Patterson Lake South Property ▪ Permanent: climate change effects
	Reversibility	▪ Irreversible	▪ Irreversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous (Project and Fission Patterson Lake South Property) ▪ Continuous (climate change)
	Probability of occurrence	▪ Possible	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change effects)

EMF = electromagnetic fields; RSA = regional study area; RFD = reasonably foreseeable development; WRSA = waste rock storage area.

Populations of Ashton cuckoo and yellow-banded bumble bees have declined over the past few decades; declines are expected to be more pronounced in the southern portion of their range in Canada due to the large effects agriculture can have on these species (COSEWIC 2014, 2015). In the Base Case, high-quality habitat for Ashton cuckoo and yellow-banded bumble bees in the RSA is abundant (i.e., approximately 23.2% of the RSA) and well connected on the landscape with few barriers to movement. Additionally, both species are generalist foragers and nectar collectors and may be found in many habitat types. The available information suggests that Ashton cuckoo bumble bee and yellow-banded bumble bee populations in the RSA are self-sustaining and ecologically effective under existing conditions.

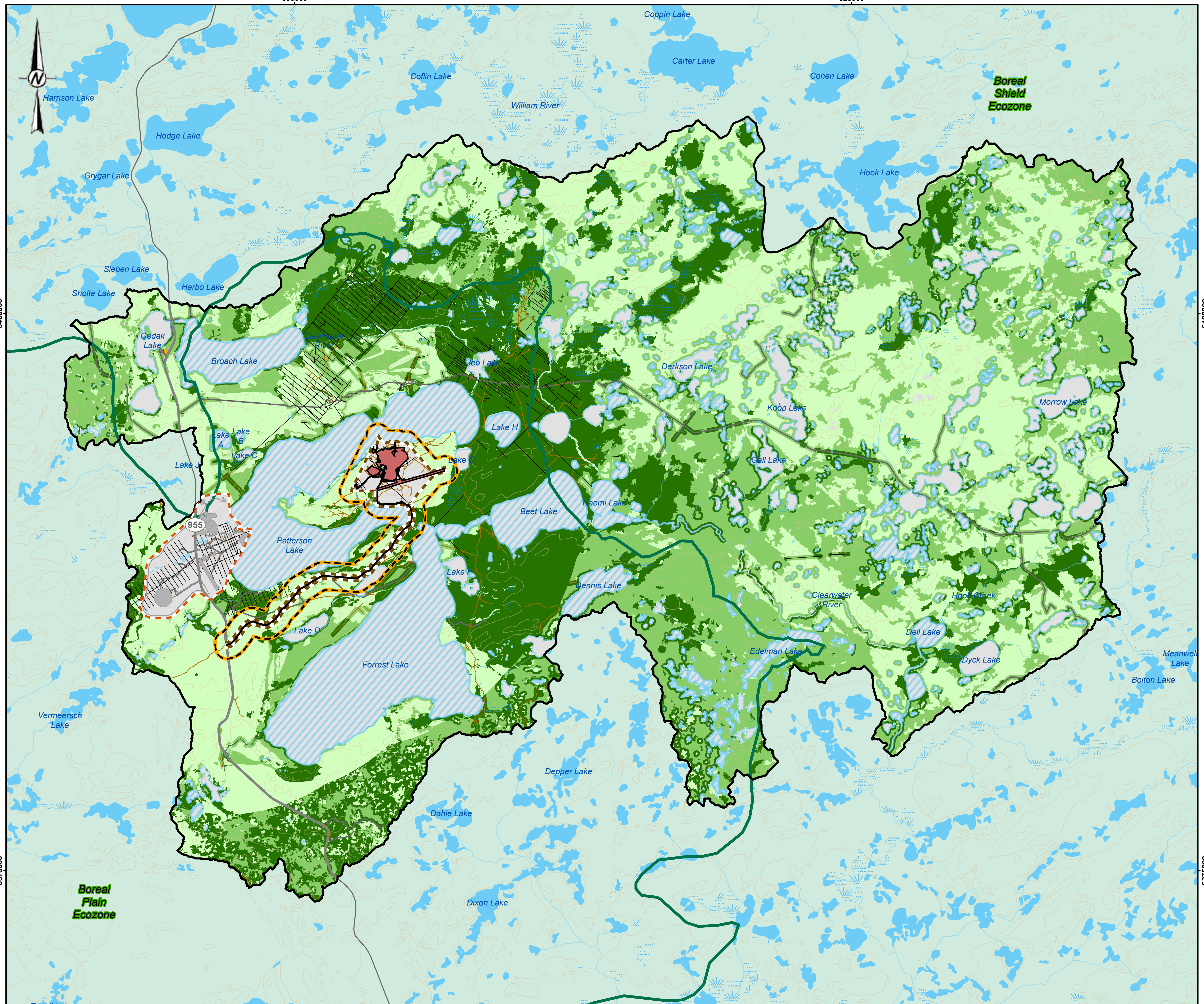
In the Application Case, the Project is predicted to result in a loss of 169 ha of high-quality bumble bee habitat, representing 0.7% of available high-quality habitat in the RSA in the Base Case. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and continuous from Construction through Decommissioning and Reclamation (i.e., Closure) (Table 14A-4). Additional habitat loss due to sensory disturbance is not expected (COSEWIC 2014, 2015).

Effects from losses to wetland habitat that could be used for foraging and areas covered by permanent features (e.g., waste rock storage areas [WRSAs]), would be irreversible (Table 14A-4). However, there would be progressive reclamation of areas no longer required for Project activities and decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclaimed areas would likely provide foraging habitat (i.e., flowering plants) for Ashton cuckoo bumble bee and yellow-banded bumble bee within five years following the Active Closure Stage (i.e., similar to recent burn upland Ecological Land Classification units; Attachment 14A-1).

Changes to habitat availability and distribution are likely to have limited effects on Ashton cuckoo bumble bee and yellow-banded bumble bee populations because remaining suitable habitat is abundant and widespread throughout the RSA (Figure 14A-8). Remaining patches of contiguous, undisturbed habitat would remain in areas surrounding the LSA and should continue to provide landscape connectivity (Figure 14A-8). Bumble bees have been reported to travel long distances and changes in habitat configuration from the proposed Project are not expected to create barriers to movement relative to existing conditions.

The Project could remove bumble bee colonies during vegetation clearing and soil disturbance in the summer, and queens/females could be killed during vegetation clearing and soil disturbance during the spring and winter. However, the probability of the presence of bumble bee colonies in habitats in the Project footprint is low as the abundance of bumble bees at the northern extent of their range is likely low and habitat is abundant in the RSA.

Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of Ashton cuckoo and yellow-banded bumble bee. Both species populations are predicted to remain self-sustaining and ecologically effective in the Application Case (i.e., there are no predicted changes in the assessment endpoints). The residual effects from the Project are considered not significant.



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- PROPOSED PROJECT FOOTPRINT
- MAXIMUM DISTURBANCE AREA
- FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
- PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY INDEX

- HIGH
- MODERATE
- LOW
- NIL

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

ASHTON CUCKOO BUMBLE BEE AND YELLOW-BANDED BUMBLE BEE HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT

wsp

PROJECT		22522691	PHASE	3314 - 6
DESIGN	LD	2020-05-30	SCALE AS SHOWN	REV. 0
GIS	SP	2023-12-06		
CHECK	LD	2023-12-06	**FIGURE 14A-8**	
REVIEW	JV	2023-12-06		

PATH: I:\CLIENTS\NexGen\22522691\Mapping\Products\Wildlife\IR_Response\22522691_Fig14A-8_BumbleBee_RSA_RFDCase_Rev0.aprx PRINTED ON: AT: 11:40:13 AM

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In the RFD Case, the Project and the Fission Patterson Lake South Property (Fission 2019, 2021) would combine to reduce the amount of high-quality bumble bee foraging habitat by 390 ha or 1.6% high-quality habitat available of the RSA in the Base Case. The change is expected to occur at a regional scale, continuously, and be reversible for reclaimed upland habitats (Table 14A-4). Cumulative effects from the two projects are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has not received regulatory approvals. The duration of effects from direct habitat loss from the two projects would be a function of the amount of temporal overlap between the start of construction to the end of active closure or decommissioning activities and the time required to establish bumble bee foraging habitat. Incremental effects from direct habitat loss due to the Project were predicted to occur from Construction through the end of the Active Closure Stage plus five years to regenerate foraging habitat. At a minimum, habitat loss from the Fission Patterson Lake South Property would occur during a hypothetical or projected three-year construction period, seven-year operating period, and active decommissioning (Fission 2019, 2021).

The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years). The duration of effects from direct habitat loss for the Fission Patterson Lake South Property was therefore assumed to be from the start of construction to the end of active decommissioning (i.e., 15 years) plus five years for functional bumble bee foraging habitat to be regenerated. If assumed habitat loss from the Fission Patterson Lake South Property completely overlapped habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 20 years (i.e., 15 years plus additional 5 years). A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Due to the wide variety of habitats potentially inhabited by Ashton cuckoo bumble bee and yellow-banded bumble bee, effects from climate change on habitat availability and distribution are anticipated to be small. Changes in habitat availability and distribution due to climate change are possible and expected to occur at a beyond-regional scale; however, the direction and magnitude of changes are uncertain given the variability in climate change models (Table 14A-4). Losses or gains in suitable foraging habitat due to climate change would be irreversible.

The relative effect of climate change on Ashton cuckoo bumble bee and yellow-banded bumble bee survival and reproduction is unknown; however, temperate invertebrates were found to be highly vulnerable to increased temperature variability from climate change (Vasseur et al. 2014). Bumble bee species in eastern Canada and northeastern United States are emerging 10 days earlier than they did 100 years ago due to climate change (Bartomeus et al. 2011). Although emergence appears to be keeping pace with shifts in plant flowering (Bartomeus et al. 2011), changes in the timing of bee emergence could lead to a mismatch of timing with early spring forage or increase the likelihood of queens emerging before the end of winter storms (COSEWIC 2015). Increased drought and/or flooding could also have negative effects on bumble bees, but the extent of this threat is unknown (COSEWIC 2015). Ashton cuckoo bumble bee and yellow-banded bumble bee are considered to be “somewhat sensitive/possibly very sensitive” to climate change but have “good to moderate-good” adaptative capacity (Singer and Lee 2021).

The anticipated loss of habitat attributed to the Project and Fission Patterson Lake South Property is unlikely to have a measurable influence on the abundance and distribution of bumble bees around the area of Patterson Lake. Habitat remains common and well connected in the RFD Case and should not limit Ashton cuckoo bumble bee and yellow-banded bumble bee populations overlapping the RSA (Figure 14A-8).

Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species' resilience and adaptability limits. Overall, the residual effects from the Project and the Fission Patterson Lake South Property are predicted to be not significant. Effects of climate change on bumble bees are unknown (COSEWIC 2014, 2015) but are mostly assumed to have an adverse influence on Ashton cuckoo and yellow-banded bumble bees. Effects from climate change are uncertain and potentially adverse but are not expected to significantly influence the abundance and distribution of Ashton cuckoo bumble bee and yellow-banded bumble bee and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

14A6 Transverse Lady Beetle and Nine-Spotted Lady Beetle

14A6.1 Existing Conditions

14A6.1.1 Habitat Availability

Two lady beetle SAR have the potential to occur in the LSA and RSA: transverse lady beetle and nine-spotted lady beetle. Habitat use by both species is primarily driven by prey availability rather than habitat type (COSEWIC 2016a,b). Both adults and larvae of transverse lady beetle and nine-spotted lady beetle primarily feed on aphids (Family Aphidoidea). Both lady beetle species have been detected in all types of forested and open habitats and on a wide variety of plants including birch (*Betula* spp.), pine (*Pinus* spp.), spruce (*Picea* spp.), poplar (*Populus* spp.), willow (*Salix* spp.), alder (*Alnus* spp.), pea species (Family Fabaceae), and grasses (Family Poaceae) (COSEWIC 2016a,b). Adults of both transverse lady beetle and nine-spotted lady beetle aggregate under stones, in rock crevices, in grass tussocks, in leaf litter, or in tree bark to overwinter (COSEWIC 2016a,b). Lady beetles are considered to be tolerant of sensory disturbance.

Suitable foraging habitat for transverse lady beetle and nine-spotted lady beetle was identified and mapped across the LSA and RSA in the Base Case through the development of a habitat suitability model (Attachment 14A-1). Using land cover mapping for the RSA, all habitat types were classified as either suitable or unsuitable. All vegetated ecosites in the RSA were considered suitable foraging habitat for transverse lady beetle and nine-spotted lady beetle. A full list of land cover types considered in the transverse lady beetle and nine-spotted lady beetle habitat model is provided in Attachment 14A-1, Table 7.

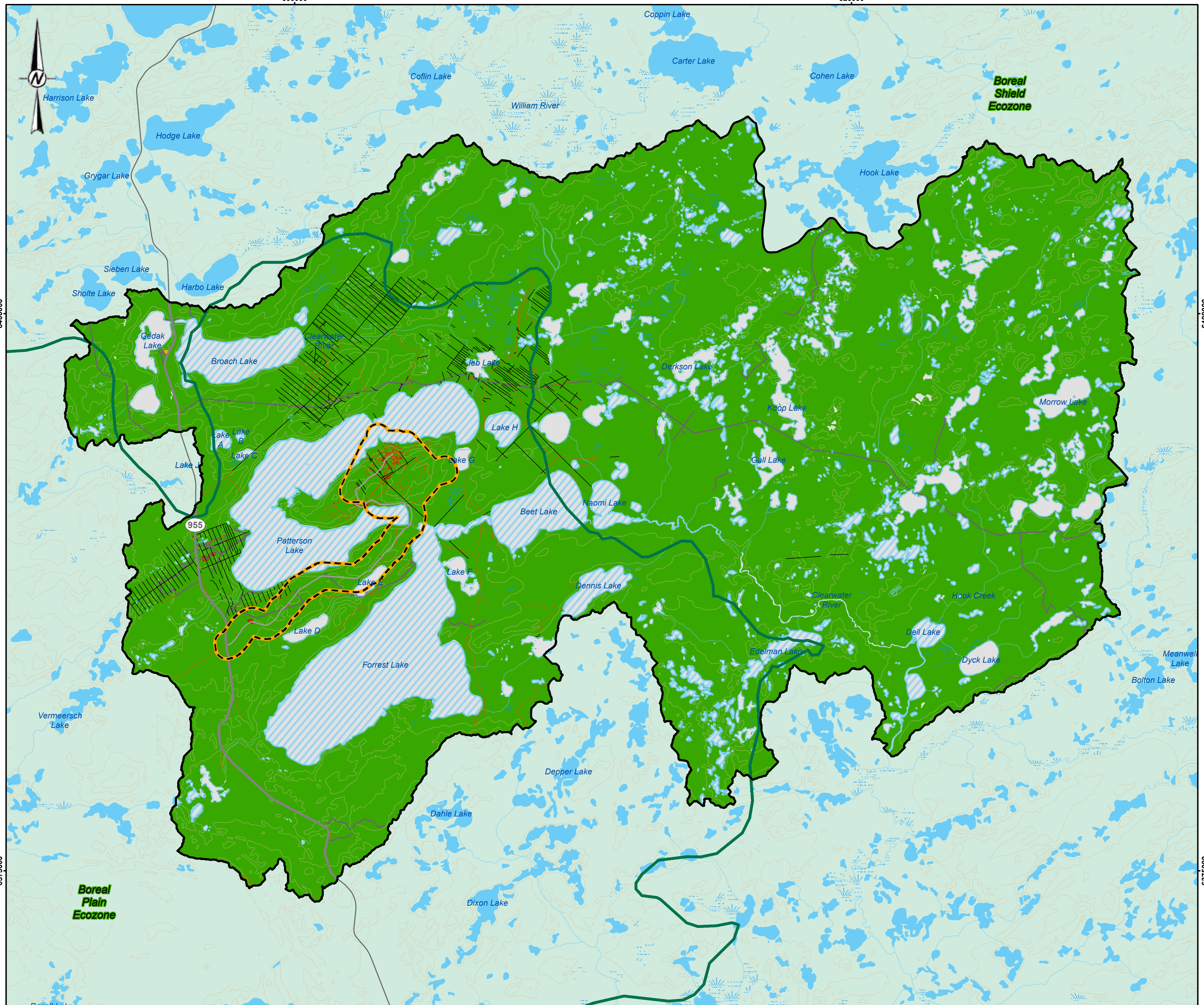
Most habitat types in the LSA and RSA provide suitable habitat for transverse lady beetle and nine-spotted lady beetle (Figure 14A-9). According to the habitat suitability model, the LSA has an estimated 2,436 ha of suitable lady beetle habitat (i.e., 86.0% of total area) and there is 88,616 ha of suitable lady beetle habitat in the RSA (i.e., 82.4% of total area). Unsuitable habitat covers 396 ha in the LSA and 18,874 ha in the RSA (14.0% and 17.6% of total area, respectively).

14A6.1.2 Habitat Distribution

Transverse lady beetle and nine-spotted lady beetle have historically been detected in every Canadian province and territory, except Nunavut, and historical detections of both species have been recorded primarily in the central and southern portions of Saskatchewan, though both species have been recorded on the shore of Lake Athabasca (COSEWIC 2016a,b). The northern distribution of these species' ranges is relatively unknown because of limited sampling effort (COSEWIC 2016a,b). Although historically a common species throughout Canada, no observations of transverse lady beetle or nine-spotted beetle have been reported in Saskatchewan since 2005 (COSEWIC 2016a,b). Nonetheless, as a conservative approach for the assessment, it is assumed that both species occur in the LSA and RSA.

Suitable habitat for lady beetles occurs throughout the LSA and RSA (Figure 14A-9). Lady beetles could also use the ditches along Highway 955 and the existing access road for the Project for foraging.

Habitat fragmentation from anthropogenic features, such as Highway 955, is not expected to have reduced lady beetle population distribution and connectivity in the LSA or RSA because habitat is well connected, and transverse lady beetle and nine-spotted lady beetle are capable of travelling long distances. Dispersal distances of 18 km to 120 km have been estimated for lady beetles during laboratory tests (Jeffries et al. 2013).



LEGEND

- ELEVATION CONTOUR (20 m INTERVAL)
- WATERCOURSE
- OPEN WATER (WITHIN THE RSA)
- WATERBODY (WITHIN THE RSA)
- WATERBODY (OUTSIDE OF RSA)
- WETLAND
- WOODED AREA
- ECOZONE BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA

DISTURBANCE CLASS

- ACCESS ROAD
- CUTLINE/SEISMIC
- SECONDARY HIGHWAY
- ROUGH ROAD
- TRAIL
- NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
- OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

- SUITABLE
- NOT SUITABLE

0 5 10

1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).

PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

NexGen Energy Ltd

ROOK I PROJECT

TITLE

TRANSVERSE LADY BEETLE AND NINE-SPOTTED LADY BEETLE HABITAT IN THE REGIONAL STUDY AREA, BASE CASE

CONSULTANT

wsp

PROJECT		22522691	PHASE	3314 - 6
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GIS	SP	2023-12-06	FIGURE 14A-9	
CHECK	LD	2023-12-06		
REVIEW	JV	2023-12-06		

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14A6.1.3 Survival and Reproduction

Transverse lady beetle is listed as Special Concern under Schedule 1 of the *Species at Risk Act* (Government of Canada 2023). Nine-spotted lady beetle is listed as Endangered under Schedule 1 of the *Species at Risk Act* (Government of Canada 2023). Both species are provincially tracked and considered Apparently Secure (S4) in Saskatchewan (SKCDC 2023).

Nine-spotted lady beetle and transverse lady beetle populations have declined throughout their ranges (COSEWIC 2016a,b). In Canada, nine-spotted lady beetle populations are estimated to have declined by 62.0% to 70.8% between 2005 and 2016 (COSEWIC 2016b). Population trends for transverse lady beetle in Canada are unknown, but this species population has likely declined substantially from historical numbers (COSEWIC 2016a).

Lady beetles have four developmental stages: egg, larvae, pupa, and adult (COSEWIC 2016a,b). Transverse lady beetles and nine-spotted lady beetles can have two generations per year, particularly in northern areas as adult lady beetles have been found to live longer in cooler conditions (COSEWIC 2016a,b). Transverse lady beetles can lay approximately 270 eggs (COSEWIC 2016a), and nine-spotted lady beetles have been observed to lay more than 690 eggs (COSEWIC 2016b). Generally, mortality of lady beetle eggs is low (i.e., approximately 7.0%) (Ugine and Losey 2014). The development time for transverse lady beetle is unknown but is expected to be similar to nine-spotted lady beetle at approximately 20 days to develop from egg to adult; timing can differ based on climatic and food resource variables (Ugine and Losey 2014). Information on transverse lady beetle sex ratio is not available but is expected to be one female: one male, as with most lady beetle species (COSEWIC 2016). The sex ratio for nine-spotted lady beetle is 56 females: 44 males, which is slightly different than the 1 female: 1 male ratio seen for most lady beetle species (COSEWIC 2016b).

The introduction of non-native lady beetle species for pest control in agricultural areas is the largest threat to transverse lady beetle and nine-spotted lady beetle populations in Canada (COSEWIC 2016a,b); this threat is not present in either the LSA or RSA and should not be influencing lady beetle survival and reproduction. Similarly, the RSA is relatively undisturbed by anthropogenic activity and development and should have little influence on lady beetle demography.

14A6.2 Residual Effects and Determination of Significance

Residual effects were classified for the Application Case and RFD Case after the implementation of effective mitigation measures (Table 14A-5). Residual effects were summarized according to direction, magnitude, geographic extent, duration, reversibility, frequency, and probability of occurrence of the effect occurring following the methods described in EIS Section 14.2.9. Effective implementation of mitigation summarized in EIS Section 14.4 (Table 14.4-1) and progressive reclamation and revegetation is expected to reduce the magnitude and duration of residual effects on transverse lady beetle and nine-spotted lady beetle. Following the summary of residual effects, significance of residual effects for the Application Case and RFD Case was determined according to the methods described in EIS Section 14.2.9.

Table 14A-5: Classification of Residual Effects on Transverse Lady Beetle and Nine-Spotted Lady Beetle Measurement Indicators

Measurement Indicator	Criterion	Rating / Effect Size	
		Application Case	RFD Case
Habitat availability	Direction	▪ Negative	▪ Negative
	Magnitude	▪ 978 ha of suitable habitat loss in RSA (1.1% of total available in the Base Case) (i.e., low magnitude) ▪ No predicted change in habitat quality from sensory disturbance	▪ 2,509 ha of suitable habitat loss in RSA (2.8% of total available in the Base Case) (i.e., low magnitude) ▪ No predicted change in habitat quality from sensory disturbance
	Geographic extent	▪ Maximum disturbance area	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and for wetland habitat ▪ Long-term (direct habitat loss): 38 years to 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Certain	▪ Probable (Project and Patterson Lake South Property) ▪ Possible (climate change effects)
Habitat distribution	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Small change in habitat connectivity caused by habitat loss (i.e., low magnitude due to high mobility of lady beetle species)	▪ Landscape disturbance created by human development would create small loss in habitat connectivity (i.e., low magnitude)
	Geographic extent	▪ Maximum disturbance area	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for habitat covered by permanent features (e.g., WRSAs) and for wetland habitat ▪ Long-term (direct habitat loss): 38 years to 33 years (start of Construction to end of Active Closure Stage), or earlier with progressive reclamation, plus 5 years to establish functional habitat	▪ Permanent: habitat covered by permanent features and loss of wetlands ▪ Permanent: climate change effects ▪ Long-term (direct habitat loss): maximum of 20 years, depending on extent of temporal overlap between the Project and the Fission Patterson Lake South Property
	Reversibility	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands)	▪ Reversible (reclaimed habitat) ▪ Irreversible (habitat covered by permanent features and wetlands) ▪ Irreversible (climate change effects)
	Frequency	▪ Continuous	▪ Continuous
	Probability of occurrence	▪ Possible	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change)
Survival and reproduction	Direction	▪ Negative	▪ Negative
	Magnitude	▪ Vegetation clearing and soil disturbance could result in the removal of aggregations of overwintering individuals if present in the maximum disturbance area (i.e., high magnitude)	▪ Vegetation clearing and soil disturbance for the Project and Fission Patterson Lake South Property could result in the removal of aggregations of overwintering individuals if present in the maximum disturbance area (i.e., high magnitude)
	Geographic extent	▪ Local	▪ Regional (Project and Fission Patterson Lake South Property) ▪ Beyond regional (climate change)
	Duration	▪ Permanent: for any aggregated, overwintering individuals removed during construction of the Project	▪ Permanent: for any aggregated, overwintering individuals removed during construction of the Project or Fission Patterson Lake South Property ▪ Permanent: climate change effects
	Reversibility	▪ Irreversible	▪ Irreversible (Project and Fission Patterson Lake South Property) ▪ Irreversible (climate change)
	Frequency	▪ Continuous	▪ Continuous (Project and Fission Patterson Lake South Property) ▪ Continuous (climate change)
	Probability of occurrence	▪ Possible	▪ Possible (Project and Fission Patterson Lake South Property) ▪ Possible (climate change effects)

RFD = reasonably foreseeable development; RSA = regional study area; WRSA = waste rock storage area.

The populations of transverse and nine-spotted lady beetles have declined over the past few decades; declines are expected to be more pronounced in the southern portion of their range in Canada due to the large effects agriculture can have on these species (COSEWIC 2016a,b). In the Base Case, suitable habitat for transverse lady beetle and nine-spotted lady beetle in the RSA is abundant (i.e., approximately 82.4% of RSA) and well connected on the landscape with few barriers to movement. The available information suggests that transverse lady beetle and nine-spotted lady beetle populations in the RSA are self-sustaining and ecologically effective under existing conditions.

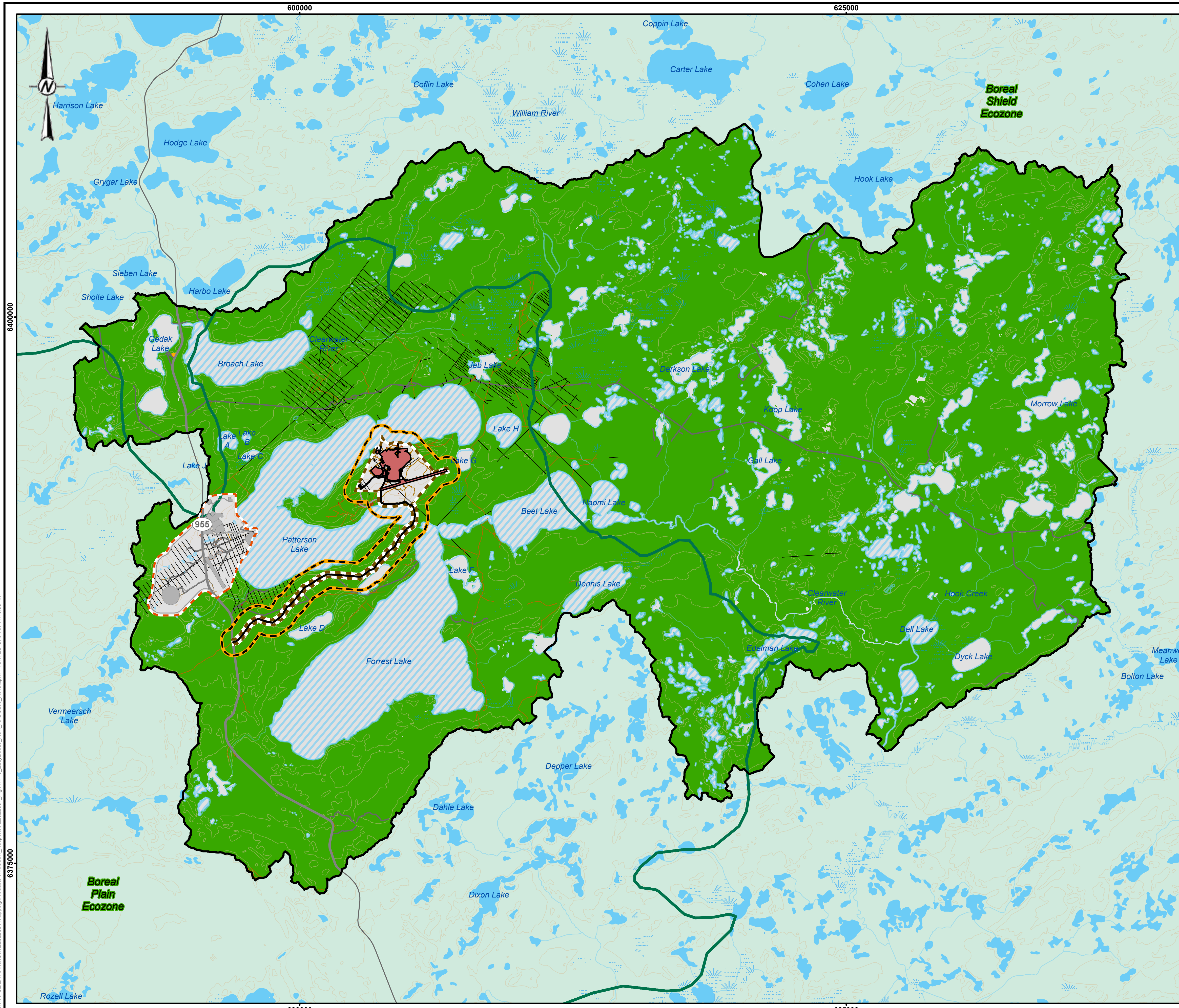
In the Application Case, the Project is predicted to result in a loss of 978 ha of suitable lady beetle habitat, representing 1.1% of available suitable habitat in the RSA in the Base Case. The effect from direct habitat loss is certain and expected to be confined to the maximum disturbance area and continuous from Construction through Decommissioning and Reclamation (i.e., Closure) (Table 14A-5). Additional habitat loss due to sensory disturbance is not expected.

Effects from losses to wetland habitat that could be used for foraging and areas covered by permanent features (e.g., WRSAs) would be irreversible (Table 14A-5). However, there would be progressive reclamation of areas no longer required for Project activities and decommissioning and reclamation of non-permanent facilities and infrastructure during the Active Closure Stage. Reclaimed areas would likely provide foraging habitat for transverse lady beetle and nine-spotted lady beetle within five years following the Active Closure Stage (i.e., similar to recent burn upland Ecological Land Classification units; Attachment 14A-1).

Changes to habitat availability and distribution are likely to have limited effects on transverse lady beetle and nine-spotted lady beetle populations because remaining suitable habitat is abundant and widespread throughout the RSA (Figure 14A-10). Patches of contiguous, undisturbed habitat would remain in areas surrounding the LSA and should continue to provide landscape connectivity (Figure 14A-10). Lady beetles can travel long distances, and changes in habitat configuration from the proposed Project are not expected to create barriers to movement relative to existing conditions.

The Project could remove individuals that are aggregated for overwintering during vegetation clearing and soil disturbance in the spring and winter. However, the probability of the presence of overwintering lady beetles in habitats in the Project footprint is low. The distribution and abundance of lady beetles in the boreal forest of Saskatchewan is likely small, and habitat is abundant in the RSA.

Incremental changes to habitat availability, habitat distribution, and survival and reproduction from the Project are expected to remain within the resilience and adaptability limits of transverse lady beetle and nine-spotted lady beetle. Both species populations are predicted to remain self-sustaining and ecologically effective in the Application Case (i.e., there are no predicted changes in the assessment endpoints). The residual effects from the Project are considered not significant.



LEGEND

ELEVATION CONTOUR (20 m INTERVAL)
WATERCOURSE
OPEN WATER (WITHIN THE RSA)
WATERBODY (WITHIN THE RSA)
WATERBODY (OUTSIDE OF RSA)
WETLAND
WOODED AREA
ECOZONE BOUNDARY
LOCAL STUDY AREA
REGIONAL STUDY AREA
PROPOSED PROJECT FOOTPRINT
MAXIMUM DISTURBANCE AREA
FISSION PATTERSON LAKE SOUTH PROPERTY FOOTPRINT
PATTERSON LAKE SOUTH PROPERTY HYPOTHETICAL MAXIMUM DISTURBANCE AREA

DISTURBANCE CLASS

ACCESS ROAD
CUTLINE/SEISMIC
SECONDARY HIGHWAY
ROUGH ROAD
TRAIL
NON-LINEAR DEVELOPMENT (E.G., CLEARING, EXISTING EXPLORATION)
OIL AND GAS DEVELOPMENT

HABITAT SUITABILITY

SUITABLE
NOT SUITABLE

0 5 10
1:175,000 KILOMETRES

REFERENCE(S)

1. PROJECT FEATURES OBTAINED FROM NEXGEN, APRIL 6, 2021. UPDATED JUNE 8, 2021.
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED. ECOZONES OBTAINED FROM AGRICULTURE AND AGRI-FOOD CANADA (AAFC).
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT
NexGen Energy Ltd
ROOK I PROJECT

TITLE
TRANSVERSE LADY BEETLE AND NINE-SPOTTED LADY BEETLE HABITAT IN THE REGIONAL STUDY AREA, REASONABLY FORESEEABLE DEVELOPMENT CASE

CONSULTANT
wsp

PROJECT		22522691	PHASE	3314 - 6
DESIGN	LD	2020-05-30	SCALE AS SHOWN	REV. 0
GIS	SP	2023-12-06		
CHECK	LD	2023-12-06	FIGURE 14A-10	
REVIEW	JV	2023-12-06		

In the RFD Case, the Project and the Fission Patterson Lake South Property (Fission 2019, 2021) would combine to reduce the amount of suitable lady beetle foraging habitat by 2,509 ha or 2.8% of suitable habitat that is available in the RSA in the Base Case. The change is expected to occur at a regional scale, continuously, and be reversible for reclaimed upland habitats (Table 14A-5). Cumulative effects in the RFD Case are likely but uncertain (i.e., probable) given that the Fission Patterson Lake South Property has not received regulatory approvals. The duration of effects from direct habitat loss from the two projects would be a function of the amount of temporal overlap between the start of construction to the end of active closure or decommissioning activities and the time required to establish lady beetle foraging habitat. Incremental effects from direct habitat loss due to the Project were predicted to occur from Construction through the end of the Active Closure Stage plus five years to regenerate foraging habitat. At a minimum, habitat loss from the Fission Patterson Lake South Property would occur during a hypothetical or projected three-year construction period, seven-year operating period, and active decommissioning (Fission 2019, 2021).

The anticipated start of construction and duration of active decommissioning at the Fission Patterson Lake South Property were not publicly available at the time this assessment was completed. For the assessment, it was assumed that the duration of active decommissioning for the Fission Patterson Lake South Property would be similar to the Active Closure Stage for the Project (i.e., five years). The duration of effects from direct habitat loss for the Fission Patterson Lake South Property was therefore assumed to be from the start of construction to the end of active decommissioning (i.e., 15 years) plus 5 years for functional lady beetle foraging habitat to be regenerated. If assumed habitat loss from the Fission Patterson Lake South Property completely overlapped habitat loss associated with the Project, the maximum duration of cumulative effects for the RFD Case would be 20 years (i.e., 15 years plus additional 5 years). A decrease in temporal overlap of the two projects would result in a shorter duration of cumulative effects.

Due to the wide variety of habitats potentially inhabited by transverse lady beetle and nine-spotted lady beetle, effects from climate change on habitat availability and distribution are anticipated to be small. Changes in habitat availability and distribution due to climate change are possible and expected to occur at a beyond-regional scale; however, the direction and magnitude of changes are uncertain given the variability in climate change models (Table 14A-5). Losses or gains in suitable foraging habitat due to climate change would be irreversible.

The relative effect of climate change on transverse lady beetle and nine-spotted lady beetle survival and reproduction is unknown; however, temperate invertebrates were found to be highly vulnerable to increased temperature variability from climate change (Vasseur et al. 2014). Lady beetles are considered to be “likely not sensitive” to climate change and have “good to moderate-good” adaptive capacity (Singer and Lee 2021).

The anticipated loss of habitat attributed to the Project and Fission Patterson Lake South Property is unlikely to have a measurable influence on the abundance and distribution of lady beetles around the area of Patterson Lake. Habitat remains common and well connected in the RFD Case and should not limit transverse lady beetle or nine-spotted lady beetle populations overlapping the RSA (Figure 14A-10).

Cumulative effects from the Project and the Fission Patterson Lake South Property are expected to remain within the species’ resilience and adaptability limits. Overall, the residual effects from the Project and the Fission Patterson Lake South Property are predicted to be not significant. Effects of climate change on lady beetles are unknown (COSEWIC 2016a,b) but are mostly assumed to have an adverse influence on transverse and nine-spotted lady beetles. Effects from climate change are uncertain and potentially adverse but are not expected to significantly influence the abundance and distribution of transverse lady beetle and nine-spotted lady beetle and do not alter the assessment of no significant cumulative effects from the Project and Fission Patterson Lake South Property.

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Attachment 14A-1 Habitat Suitability Determination for Barn Swallow, Common Nighthawk, and Northern Myotis, Ashton Cuckoo Bumble Bee, Yellow-banded Bumble Bee, Transverse Lady Beetle, and Nine-spotted Lady Beetle

Abbreviations and Units of Measure

Abbreviation	Definition
NexGen	NexGen Energy Ltd.
Project	Rook I Project
UGTMF	underground tailings management facility
uranium concentrate	triuranium octoxide (U_3O_8)

Unit	Definition
%	percent
°	degree
°C	degrees Celsius
>	more than
<	less than
µm	micron
kg	kilogram
mg	milligram

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1 Approach

An Ecological Land Classification (ELC) map was developed for the regional study area (RSA), which includes the local study area (LSA), to provide information on the abundance and distribution of landcover or vegetation types and associated ELC units. The ELC map provides a basis for understanding the existing ecosite conditions as well as interpreting wildlife habitat suitability. Appendix 14B, Wildlife Habitat Models, provides full details on the ELC mapping process and landcover classification system used for wildlife habitat suitability modelling. The ELC mapping process provides the foundation for mapping and quantifying the availability of different suitable (or quality) habitats in the maximum disturbance area, LSA, and RSA. For this assessment, landcover types and associated ELC units were assigned a habitat suitability index or habitat suitability value of ‘suitable’ or ‘unsuitable’ for four species: barn swallow (*Hirundo rustica*), common nighthawk (*Chordeiles minor*), transverse lady beetle (*Coccinella transversalis*), and nine-spotted lady beetle (*Coccinella novemnotata*). The habitat suitability index values assigned for northern myotis (*Myotis septentrionalis*) reflected those used for little brown myotis (*Myotis lucifugus*); all ELC units were assigned a suitability value of either poor (unsuitable), low, moderate, or high (Appendix 14B). The habitat suitability values assigned for Ashton (formerly gypsy) cuckoo bumble bee (*Bombus bohemicus*) and yellow-banded bumble bee (*Bombus terricola*) were nil, low, moderate, or high.

Wildlife species may avoid or reduce their use of habitat adjacent to areas of human development and activity. These changes in behaviour and distribution are typically related to sensory disturbance (e.g., dust, noise, lights, smells), which reduces the effectiveness or functionality of habitat to support wildlife populations. The distance and associated area and degree that sensory disturbance adversely affects habitat use and distribution of wildlife can be defined as the zone of influence (ZOI). The amount of habitat affected by sensory disturbance associated with anthropogenic disturbance was estimated by applying ZOIs to human development features with a particular level of activity. Appendix 14B provides full details on how ZOIs were calculated and applied to ELC mapping units in the LSA and RSA.

1.1 Barn Swallow

Barn swallow habitat suitability was determined for each landcover type present in the Project LSA and RSA after reviewing landcover preferences and ecological requirements in the species’ summer breeding grounds. Table 1 provides a summary of landcover types determined to be suitable for barn swallow breeding habitat in the Project LSA and RSA. The primary sources used to determine landcover suitability for barn swallow included:

- the species’ COSEWIC Status Report (COSEWIC 2011);
- Brown and Brown (2020); and
- experienced opinion.

No ZOI was applied to barn swallow as the species is largely tolerant of human activity and will nest on anthropogenic structures such as bridges, tunnels, culverts, and buildings (COSEWIC 2011).

Table 1: Suitability of Landcover Types and Ecosites for Barn Swallow Breeding Habitat

Landcover Type	Ecosite	Suitability
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)	Suitable
Young or immature forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Young or immature treed wetland	BP18 (BU/E); BP19 (BU/E); BP23 (BU/E); BS17 (BU/E); BS21(BU/E)	
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS18; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Existing disturbance	Cutlines/seismic lines; trail; rough road; clearing; NexGen non-linear development; unknown disturbance; outfitting (fishing) camp; existing access road; historical oil and gas development	
Open water	Water	
Mature birch-dominant mixed forest	BP11; BS13	Not Suitable
Mature deciduous forest	BP06; BP07; BP16; BS14; BS15	
Mature coniferous forest (with birch)	BS05; BS08; BS10	
Mature pine-dominant mixed forest	BP04; BS06	
Mature coniferous forest	BP02; BP03; BP12; BP14; BS03; BS04; BS07; BS09	
Young or immature forest	BP02 (BU/L); BP03 (BU/L); BP04 (BU/L); BP07 (BU/L); BP11 (BU/L); BP12 (BU/L); BP14 (BU/L); BP16 (BU/L); BS 03 (BU/L); BS04 (BU/L); BS05 (BU/L); BS06 (BU/L); BS07 (BU/L); BS08 (BU/L); BS09 (BU/L); BS13 (BU/L); BS14 (BU/L); BS15 (BU/L)	
Mature and immature treed wetland	BP18; BS16(BU/L); BS17(BU/L); BS21(BU/L); BP19; BP23; BS17; BS21; BP18 (BU/L); BP19 (BU/L); BP23 (BU/L)	
Shrubby wetland	BS22; BS23	
Existing disturbance	Highway 955	

Note: No zone of influence was applied to disturbances.

1.2 Common Nighthawk

Common nighthawk habitat suitability was determined for each landcover type present in the Project LSA and RSA after reviewing landcover preferences and ecological requirements in their summer breeding grounds. The primary sources used to determine landcover suitability for common nighthawk included:

- the species' COSEWIC Status Report (COSEWIC 2018);
- the species' Recovery Strategy (Environment Canada 2016);
- Knight and Bayne (2017); and
- experienced opinion.

A ZOI of 200 m was applied to all anthropogenic disturbance types deemed to be unsuitable for common nighthawk and associated with sensory disturbance, which could affect surrounding suitable habitat. Table 2 provides a summary of landcover types determined to be suitable for common nighthawk breeding and foraging in the Project LSA and RSA.

Table 2: Suitability of Landcover Types and Ecosites for Common Nighthawk Habitat

Landcover Type	Ecosite	Suitability
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)	Suitable
Young or immature forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Young or immature treed wetland	BP18 (BU/E); BP19 (BU/E); BP23 (BU/E); BS17 (BU/E); BS21(BU/E); BP19 (BU/L); BP23 (BU/L); BS17 (BU/L); BS21 (BU/L)	
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Mature treed wetland	BP19; BP23; BS17; BS21	
Existing disturbance	Cutlines/seismic lines; trail; rough road; clearing; NexGen non-linear development; unknown disturbance; outfitting (fishing) camp	
Young or immature forest habitat	BP02 (BU/L); BP03 (BU/L); BP04 (BU/L); BP07 (BU/L); BP11 (BU/L); BP12(BU/L); BP14 (BU/L); BP16 (BU/L); BP18 (BU/L); BS03 (BU/L); BS04 (BU/L); BS05 (BU/L); BS06 (BU/L); BS07 (BU/L); BS08 (BU/L); BS09 (BU/L); BS13 (BU/L); BS14 (BU/L); BS15 (BU/L); BS16 (BU/L)	Not Suitable
Mature birch-dominant mixed forest	BP11; BS13	
Mature deciduous forest	BP06; BP07; BP16; BS14; BS15	
Mature coniferous forest (with birch)	BS05; BS08; BS10	
Mature pine-dominant mixed forest	BP04; BS06	
Mature coniferous forest	BP02; BP03; BP12; BP14; BS03; BS04; BS07; BS09	
Mature and immature treed wetland	BP18; BP18(BU/L); BS16(BU/L)	
Open water	Water	
Existing disturbance[a]	Existing access road; Highway 955; historical oil and gas development	

a) A zone of influence of 200 m was placed around each of the existing disturbance categories identified. All land cover that occurred within this 200 m was deemed to be 'Not Suitable' for common nighthawk to account for sensory disturbance around these disturbances that could lead to loss of habitat quality.

1.3 Northern Myotis

Available landcover in the LSA and RSA were assigned suitability classes (High, Moderate, Low, Poor), and suitable roosting habitat in the LSA and RSA was determined for northern myotis based on their ecology and primary literature. Habitat suitability ranks assigned for northern myotis were the same as those assigned to the little brown myotis based on the similar requirements the two species have for roosting sites during the summer (COSEWIC 2013). Appendix 14A provides full details on how habitat suitability mapping in the Project LSA and RSA was completed for little brown myotis.

A ZOI of 100 m was applied to all anthropogenic disturbance types deemed to be unsuitable for northern myotis and associated with sensory disturbance, which could affect surrounding suitable habitat. Table 3 provides a summary of landcover types determined to be suitable for northern myotis roosting in the Project LSA and RSA.

Table 3: Suitability of Landcover Types and Ecosites for Northern Myotis Roosting Habitat

Landcover Type	Ecosite	Suitability
Mature birch-dominant mixed forest	BP11; BS13	High
Mature deciduous forest	BP06; BP07; BP16; BS14; BS15	
Mature coniferous forest (with birch)	BS05; BS08; BS10	Moderate
Mature pine-dominant mixed forest	BP04; BS06	
Mature coniferous forest	BP02; BP03; BP12; BP14; BS03; BS04; BS07; BS09	Low
Mature treed wetland	BP18; BP19; BP23; BS17; BS21	
Existing disturbance	Outfitting (fishing) camp	
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)	Poor
Young or immature forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	
Young or immature treed wetland	BP18(BU/E); BP19(BU/E); BP23(BU/E); BS17(BU/E); BS21(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BS16(BU/L); BS17(BU/L); BS21(BU/L)	
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Open water	Water	
Existing disturbance[a]	Cutlines/seismic lines; trail, existing access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas development; unknown disturbance	

a) A zone of influence of 100 m was placed around each of the existing disturbance categories identified. All land cover that occurred within this 100 m was deemed to be poor (unsuitable) for northern myotis to account for sensory disturbance around these disturbances that could lead to loss of habitat quality.

1.4 Ashton Cuckoo Bumble Bee and Yellow-Banded Bumble Bee

Habitat suitability for Ashton cuckoo bumble bee and yellow-banded bumble bee was determined for each landcover type present in the Project LSA and RSA after reviewing landcover preferences and ecological requirements for these species throughout the year. Table 4 provides a summary of landcover types determined to be suitable for Ashton cuckoo bumble bee and yellow-banded bumble bee SAR habitat in the LSA and RSA. The primary sources used to determine landcover suitability for SAR bumble bees are as follows:

- the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status report on Ashton cuckoo bumble bee (COSEWIC 2014);
- the COSEWIC status report on yellow-banded bumble bee (COSEWIC 2015); and
- experienced opinion.

Both bumble bee SAR that could be present in the LSA and RSA are habitat generalists that use a variety of open and forested habitats (COSEWIC 2014, 2015). The habitat suitability index model was based on the understanding that these two species are generalist pollen foragers and prefer habitats with flowering plants (COSEWIC 2014, 2015). Bumble bees can be found in disturbed areas with suitable vegetation such as roadside ditches and cutlines / seismic lines.

In the habitat suitability index model, high-quality foraging habitat for bumble bees was considered to have a high abundance of flowering plants. The abundance of flowering plants was determined by reviewing McLaughlan et al. (2010) and summing the percent cover values for flowering shrubs and herbs for each ecosite. Ecosites with flowering plant percent cover values of greater than 50% were considered high-quality habitats for bumble bees. Ecosites with flowering plant percent cover values of greater than 21% to less than or equal to 50% were considered moderate-quality habitats and percent cover values of more than 0% to less than or equal to 21% were considered low-quality habitats. Habitats with no flowering plants (e.g., non-vegetated bedrock and open water) were considered nil-quality habitats (Table 4).

Preferred foraging habitat for Ashton cuckoo bumble bee and yellow-banded bumble bee is located at the interface between open and forested/treed habitat because these areas have light conditions that are conducive to plant flower production and can support rapidly growing plant species (COSEWIC 2014, 2015). This consideration was incorporated into the habitat suitability index model by increasing habitat suitability rankings for all forested ecosites (Table 5) that were initially ranked as moderate- or low-quality habitat (Table 4) and were within 100 m of natural and anthropogenic forest openings (Table 6). Edge habitat around forested habitat initially ranked as high quality remained high-quality habitat.

Table 4: Suitability of Landcover Types and Ecosites for Ashton Cuckoo Bumble Bee Habitat and Yellow-Banded Bumble Bee

Landcover Type	Ecosite[(a)]	Suitability
Deciduous forest (dominant herbaceous cover)	BP06; BP06 (BU/E); BP07; BP07 (BU/E); BP07 (BU/L); BP16; BP16 (BU/L)	High
Shrubby (Labrador tea) wetland	BP20; BP20 (BU/E); BP20 (BU/L); BP24; BP24 (BU/L); BS18; BS18 (BU/E); BS18 (BU/L)	
Treed bog (dominant Labrador tea shrub layer)	BP19; BP19 (BU/E); BP19 (BU/L);BS17; BS17 (BU/E); BS17 (BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Existing disturbance	Cutlines / seismic lines; trail; access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	
Jack pine forest (abundant herbaceous layer)	BP03; BP03 (BU/E); BP03 (BU/L); BP04; BP04 (BU/E); BP04 (BU/L); BP11; BP11 (BU/L); BP12; BP12 (BU/L); BS04; BS04 (BU/E); BS04 (BU/L)	Moderate
Deciduous forest (dominant shrubby cover)	BS14; BS14 (BU/E); BS14 (BU/L); BS15; BS15 (BU/L)	
Treed bog (diverse herbaceous layer)	BP18; BP18 (BU/E); BP18 (BU/L); BS21; BS21 (BU/E); BS21 (BU/L)	
Mixedwood forest (black spruce – deciduous)	BS10; BS13; BS13 (BU/E); BS13 (BU/L); BS16 (BU/L)	
Shrubby (leatherleaf) wetland	BS22; BS22 (BU/E); BS22 (BU/L)	
Jack pine forest (lichen)	BP02; BP02 (BU/E); BP02 (BU/L); BS03; BS03 (BU/E); BS03 (BU/L)	Low
Jack pine forest (minimal herbaceous layer)	BS05; BS05 (BU/E); BS05 (BU/L); BS06; BS06 (BU/L)	
Treed bog (with jack pine)	BS07; BS07 (BU/E); BS07 (BU/L); BS08; BS08 (BU/L); BS09; BS09 (BU/E); BS09 (BU/L)	
Treed bog (feathermoss)	BP14; BP14 (BU/E); BP14 (BU/L)	
Graminoid wetland	BP21; BP21 (BU/L); BP26; BP26 (BU/E); BP26 (BU/L); BP28; BP28 (BU/E); BP28 (BU/L); BS24; BS24 (BU/E); BS24 (BU/L)	
Open wetland	BP22; BP27; BS19; BS19 (BU/L); BS20; BS20 (BU/E); BS20 (BU/L)	
Treed fen	BP23; BP23 (BU/E); BP23 (BU/L)	
Shrubby (willow) wetland	BP25; BP25 (BU/E); BP25 (BU/L); BS23; BS23 (BU/E); BS23 (BU/L); BS25; BS25 (BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	Nil
Rushy sandy shore	BS26; BS26 (BU/E); BS26 (BU/L)	
Open water	Water	

a) Refer to Appendix 14B, Attachment 14B-1 (Ecological Land Classification Units), Table 1 for ecosite descriptions.

Table 5: Habitat Suitability of Forested Landcover Types and Ecosites for Ashton Cuckoo Bumble Bee and Yellow-Banded Bumble Bee within 100 m of Ecosites Identified in Table 4

Landcover Type	Ecosite[a]	Suitability
Deciduous forest (dominant herbaceous cover)	BP06; BP06 (BU/E); BP07; BP07 (BU/E); BP07 (BU/L); BP16; BP16 (BU/L)	High
Treed bog (dominant Labrador tea shrub layer)	BP19; BP19 (BU/E); BP19 (BU/L); BS17; BS17 (BU/E); BS17 (BU/L)	
Jack pine forest (moderate herbaceous layer)	BP03; BP03 (BU/E); BP03 (BU/L); BP04; BP04 (BU/E); BP04 (BU/L); BP11; BP11 (BU/L); BP12; BP12 (BU/L); BS04; BS04 (BU/E); BS04 (BU/L)	
Deciduous forest (dominant shrubby cover)	BS14; BS14 (BU/E); BS14 (BU/L); BS15; BS15 (BU/L)	
Treed bog (with tamarack)	BP18; BP18 (BU/E); BP18 (BU/L); BS21; BS21 (BU/E); BS21 (BU/L)	
Mixedwood forest (black spruce – deciduous)	BS10; BS13; BS13 (BU/E); BS13 (BU/L); BS16 (BU/L)	
Jack pine forest (lichen)	BP02; BP02 (BU/E); BP02 (BU/L); BS03; BS03 (BU/E); BS03 (BU/L)	Moderate
Jack pine forest (minimal herbaceous layer)	BS05; BS05 (BU/E); BS05 (BU/L); BS06; BS06 (BU/L)	
Treed bog (with jack pine)	BS07; BS07 (BU/E); BS07 (BU/L); BS08; BS08 (BU/L); BS09; BS09 (BU/E); BS09 (BU/L)	
Treed bog (feathermoss)	BP14; BP14 (BU/E); BP14 (BU/L)	
Treed fen	BP23; BP23 (BU/E); BP23 (BU/L)	

a) Refer to Appendix 14B, Attachment 14B-1, Table 1 for ecosite descriptions.

Table 6: Ecosites from which a 100 m Buffer is Applied to Ecosites in Table 4

Landcover Type	Ecosite[a]
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)
Recent burn	Recent burn (upland); Recent burn (wetland)
Unvegetated	BS02; BS02(BU/L); BS26; BS26(BU/E); BS26(BU/L); Water
Existing disturbance	Cutlines / seismic lines; trail; rough road; clearing; NexGen non-linear development; outfitting (fishing) camp; unknown disturbance

a) Refer to Appendix 14B, Attachment 14B-1, Table 1 for ecosite descriptions.

1.5 Transverse Lady Beetle and Nine-Spotted Lady Beetle

Habitat suitability for transverse lady beetle and nine-spotted lady beetle was determined for each landcover type present in the LSA and RSA after reviewing landcover preferences and ecological requirements for these species throughout the year. Table 7 provides a summary of landcover types determined to be suitable for lady beetle SAR habitat in the LSA and RSA. The primary sources used to determine landcover suitability for SAR lady beetles are as follows:

- the COSEWIC status report on transverse lady beetle (COSEWIC 2016a);
- the COSEWIC status report on nine-spotted lady beetle (COSEWIC 2016b); and
- experienced opinion.

The habitat model was based on the understanding that these species are habitat generalists that can be found in a variety of habitats; habitat use is primarily driven by prey availability rather than habitat type (COSEWIC 2016a,b). Lady beetles can be found in disturbed vegetated areas, such as roadside ditches and cutlines / seismic lines.

Table 7: Suitability of Landcover Types and Ecosites for Transverse Lady Beetle and Nine-Spotted Lady Beetle Habitat

Landcover Type	Ecosite[(a)]	Suitability
Jack pine forest	BP02; BP02 (BU/E); BP02 (BU/L); BP03; BP03 (BU/E); BP03 (BU/L); BP04; BP04 (BU/E); BP04 (BU/L); BP11; BP11 (BU/L); BP12; BP12 (BU/L); BS03; BS03 (BU/E); BS03 (BU/L); BS04; BS04 (BU/E); BS04 (BU/L); BS05; BS05 (BU/E); BS05 (BU/L); BS06; BS06 (BU/L)	Suitable
Mixedwood forest	BS10; BS13; BS13 (BU/E); BS13 (BU/L); BS16 (BU/L)	
Deciduous forest	BP06; BP06 (BU/E); BP07; BP07 (BU/E); BP07 (BU/L); BP16; BP16 (BU/L); BS14; BS14 (BU/E); BS14 (BU/L); BS15; BS15 (BU/L)	
Treed wetland	BP14; BP14 (BU/E); BP14 (BU/L); BP18; BP18 (BU/E); BP18 (BU/L); BP19; BP19 (BU/E); BP19 (BU/L); BS07; BS07 (BU/E); BS07 (BU/L); BS08; BS08 (BU/L); BS09; BS09 (BU/E); BS09 (BU/L); BS17; BS17 (BU/E); BS17 (BU/L); BS21; BS21 (BU/E); BS21 (BU/L); BP23; BP23 (BU/E); BP23 (BU/L)	
Shrubby wetland	BP20; BP20 (BU/E); BP20 (BU/L); BP24; BP24 (BU/L); BP25; BP25 (BU/E); BP25 (BU/L); BS18; BS18 (BU/E); BS18 (BU/L); BS22; BS22 (BU/E); BS22 (BU/L); BS23; BS23 (BU/E); BS23 (BU/L); BS25; BS25 (BU/L)	
Open wetland	BP21; BP21 (BU/L); BP22; BP26; BP26 (BU/E); BP26 (BU/L); BP27; BP28; BP28 (BU/E); BP28 (BU/L); BS19; BS19 (BU/L); BS20; BS20 (BU/E); BS20 (BU/L); BS24; BS24 (BU/E); BS24 (BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Existing disturbance	Cutlines / seismic lines; trail; access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	
Unvegetated bedrock	BS02	Unsuitable
Open water	Water	

a) Refer to Appendix 14B, Attachment 14B-1, Table 1 for ecosite descriptions.

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Appendix 14B Wildlife Habitat Models

Abbreviations and Units of Measure

Abbreviation	Definition
ELC	ecological land classification
EIS	Environmental Impact Statement
HSI	habitat suitability index
IKTLU	Indigenous Knowledge and Traditional Land Use
LSA	local study area
NexGen	NexGen Energy Ltd.
Project	Rook I Project
RFD	reasonably foreseeable development
RSA	regional study area
RSF	resource selection function
TSD	technical support documents
VC	valued component
ZOI	zone of influence

Unit	Definition
%	percent
cm	centimetre
ha	hectare
km	kilometre
m	metre

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14B1 Introduction

Habitat suitability models quantify the predicted and measurable habitat preferences of wildlife and have been widely used to assess the potential effects of habitat alteration on wildlife populations (Marzluff et al. 2002). These models combine land cover data, species life history requirements and habitat selection, scientific studies, and experienced opinion to produce scientifically defensible estimates of habitat suitability in a specified area. The habitat suitability models can be used to quantify and display the distribution of changes in habitat quality across a landscape under different development scenarios (Kilgo et al. 2002; Beck and Suring 2009).

Habitat modelling was conducted for all wildlife valued components (VCs) in the Environmental Impact Statement (EIS) for the Rook I Project (Project); however, for two VCs (common goldeneye [*Bucephala clangula*] and Canadian toad [*Anaxyrus hemiophrys*]) the models were simplified (e.g., suitable or not suitable habitat) as these species are largely dependent on aquatic habitat (EIS Section 14.3.9.1 and EIS Section 14.3.11.1, Habitat Availability). The method for modelling woodland caribou (*Rangifer tarandus caribou*) habitat is provided in EIS Section 14.3.1.1, Woodland Caribou, and follows the approach used by Environment Canada (2011; ECCC 2019) and Saskatchewan Ministry of Environment (ENV 2014).

Valued components were selected using several criteria, including provincial and federal conservation status, and ecological, traditional, recreational, and economic importance. Details on the VCs and the rationale for their selection are provided in EIS Section 14.2.2, Valued Components, Measurement Indicators, and Assessment Endpoints. Briefly, VCs were identified using several factors such as:

- potential for interaction with the Project and degree of interaction, including presence, abundance, and amount of spatial overlap of a VC with the Project;
- sensitivity of a VC to potential Project effects and level of damage or harm that could be realized should an adverse effect occur;
- species conservation status or concern (e.g., rarity, sensitivity, uniqueness);
- ecological and socio-economic/cultural value to communities, government agencies, and the public;
- recent experience with similar projects in Saskatchewan and other jurisdictions in Canada; and
- avoidance of redundancy with other VCs; if two potential VCs represent the same issues, mitigation actions, and potential effects from the Project, only one was evaluated as part of the assessment.

Selection of wildlife VCs was informed by Indigenous and Local Knowledge obtained from feedback during previous and ongoing community engagement sessions and Joint Working Group meetings for the Project in La Loche, Turnor Lake, Buffalo River, and Buffalo Narrows (EIS Section 2, Indigenous, Regulatory, and Public Engagement, and EIS Section 3, Indigenous and Local Knowledge), and information provided by Indigenous Knowledge and Traditional Land Use (IKTLU) Studies. Indigenous Knowledge and Traditional Land Use Studies include all land use studies developed by the Project's affected Indigenous Groups, including Traditional Land Use and Occupancy studies, Traditional Knowledge and Use studies, and Indigenous Rights and Knowledge studies, henceforth referred collectively as IKTLU Studies. The IKTLU Studies are incorporated into the EIS as technical support documents (TSDs) and are listed below:

- TSD II (BNDN), Birch Narrows Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;

- TSD III (BRDN), Buffalo River Dene Nation Traditional Knowledge and Use Study Specific to NexGen Energy Limited's Proposed Rook I Project;
- TSD IV (MN-S), Métis Nation – Saskatchewan Northern Region 2 Traditional Land Use & Diet Study for the NexGen Rook I Project;
- TSD V.1 (CRDN), Preliminary Identification of Issues and Concerns Related to the Proposed NexGen Energy Ltd. Rook I Project in the Patterson Lake Area; A Review; Clearwater River Dene Nation; Traditional Land Use and Occupancy Mapping Interviews; 2010 – 2016;
- TSD V.2 (CRDN), Clearwater River Dene Nation Indigenous Rights and Knowledge Survey Related to the Proposed NexGen Energy Ltd. Rook 1 Project in the Patterson Lake Area. Prepared by Annette McCullough, Origins Consultants Inc., Calgary. AB;
- TSD V.3 (CRDN), Socio-economic and Harvest Study; Clearwater River Dene Nation; NexGen Rook 1 Project; and
- TSD VI (YNLR), Provision of Athabasca Denesųłiné Traditional Knowledge, Land Use and Occupancy Information for the NexGen Rook I Project Environmental Assessment.

Indigenous Knowledge from IKTLU Studies and local knowledge collected during community engagement were integrated as much as possible into the habitat suitability models. Available Indigenous and Local Knowledge information were applied during the description and characterization of habitat use by VCs, as applicable. For example, during Joint Working Group meetings, some Indigenous communities indicated that black bears (*Ursus americanus*) and grey wolves (*Canis lupus*) may be attracted to mine sites or roads (BRDN-JWG 2019; MN-S-JWG 2019). As a result, this information was considered when determining habitat suitability in the vicinity of certain anthropogenic activities.

14B2 Methods

14B2.1 Ecological Land Classification

An ecological land classification (ELC) map was developed for the regional study area (RSA), which includes the local study area (LSA), to provide information on the abundance and distribution of landcover or vegetation types and associated ELC units. The ELC map provides a basis for understanding the existing ecosite conditions as well as interpreting wildlife habitat suitability. Ecosite information classified according to the *Field Guide to the Ecosites of Saskatchewan's Provincial Forests* in McLaughlan et al. (2010) was compiled from several sources as described in EIS Section 13.2.6.1, Ecological Land Classification.

Fire disturbance data were applied based on a 40-year fire history period (1981 to 2020; EIS Section 13.2.6.1.4, Fire Mapping). Ecosites within fire disturbed areas were assigned an ecosite modifier (BU) to indicate previous wildfire disturbance. Burned areas less than five years old were grouped within a recent burn classification, as baseline conditions (Annex VI.2, Vegetation Baseline Report 2 [Inventory, Rare Plants, and Wetlands]) indicated post-fire conditions of ground-truthed recent burns were devoid of vegetation and did not lend themselves to ecosite classification. Fire disturbance between zero and five years was classified into upland and wetland categories (recent burn [upland]; recent burn [wetland]). Burned ecosites greater than five years old were assigned an additional burn modifier to indicate early-stage and late-stage regeneration classes based on the date of fire disturbance (Table 14B2-1).

Table 14B2-1: Fire Disturbance Ecological Land Classification Units within the Regional Study Area

Fire Disturbance ELC Units	Modifier
Early-Stage regeneration (6-20 years)	BU/E
Late-Stage regeneration (21-40 years)	BU/L

ELC = ecological land classification.

Habitat groupings used for descriptive purposes represent the average age of tree species typically found within each ecosite as per McLaughlan et al. (2010). Early-stage regeneration ELC units were described as young, late-stage regeneration ELC units were described as immature, and ELC units greater than 40 years old were described as mature (McLaughlan et al. 2010; ENV 2019).

The ELC units found within the LSA and RSA are listed in Attachment 14B-1, Ecological Land Classification Units, Table 1.

14B2.2 Modelling Approach and Limitations

Habitat suitability index (HSI) models are used to predict wildlife habitat quality based on the relationships between the species and its environment and life history requirements (Kilgo et al. 2002; Marzluff et al. 2002; Beck and Suring 2009). The models enable mapping and analysis of habitat for a species where habitat conditions or quality can be ranked on a scale of increasing suitability (e.g., unsuitable to highly suitable). This suitability scale describes the relative potential of an area to support individuals (or populations) of a wildlife species annually or for a particular season or time of year (e.g., winter, breeding period). The models evaluate the potential of an area to support a wildlife species based on a combination of literature review, field data, experienced opinion, and known or assumed relationships between attributes of habitat function and structure and their ability to support a species' biological needs (Kilgo et al. 2002; Beck and Suring 2009). Importantly, there is no direct correlation with population abundance or density, since some species require large areas of suitable habitat and may not use all suitable areas that are available. However, the models are ecologically appropriate for quantifying and displaying the distribution of habitat quality across a landscape in various land use or development scenarios, particularly when field data are limited (Marzluff et al. 2002). In the EIS, HSI models were used to compare the amount of different quality habitats for wildlife VCs during the Base Case, Application Case, and Reasonably Foreseeable Development (RFD) Case (EIS Section 14.2.5, Assessment Cases).

The ELC described above (Section 14B2.1, Ecological Land Classification) provides the foundation for mapping and quantifying the availability of different suitable (or quality) habitats in the maximum disturbance area, LSA, and RSA for each wildlife VC (EIS Section 14.2.3, Spatial Boundaries). Published and unpublished scientific studies were used to identify resource conditions that influence habitat use and to define the strength and direction of relationships between those resources and habitat quality for wildlife. Indigenous and Local Knowledge were also used to support and guide the habitat suitability models where information was available. A combination of baseline data and information from the scientific literature, Indigenous and Local Knowledge, and experienced opinion (i.e., Golder wildlife biologists) were used to model/predict the suitability of a particular landcover type (e.g., vegetation/ELC units, anthropogenic disturbance) for each VC. Several models are based on approaches and methods developed and applied in previous approved Environmental Assessments and recent research in the Saskatchewan boreal shield north of the Project. For this assessment, landcover types and associated ELC units were assigned an HSI or habitat suitability value of poor (unsuitable), low, moderate, or high (Kilgo et al. 2002), which represents an ordinal-scale measurement (the habitat suitability rankings or categories represent differences in direction and magnitude relative to each other).

Although poor or unsuitable habitats were assumed to not support reproduction of VCs, these habitats were not considered to be impermeable barriers to animal movement or necessarily result in immediate death and consequently never occupied by wildlife. Movement between patches is a function of the degree of hostility or risk of the landscape (i.e., matrix) between suitable habitat patches, distance between suitable patches, and the movement ability (i.e., mobility) of the VC (EIS Section 14.2.2.2). For example, animals may still travel across poor or unsuitable habitats, but a wolf or moose would likely be more successful than a Canadian toad or beaver due to differences in mobility (i.e., wolves have higher mobility than toads). Most bird and bat VCs have high mobility by flying over unsuitable or risky habitat patches. Low, moderate, and high suitability habitats were assumed to support reproduction and survival of VCs; however, these population vital (demographic) rates were predicted to increase from low suitability to high suitability habitats.

Time lag or carry over effects are included in the assessment through the evaluation of duration and reversibility of residual effects. For example, the Application Case included predictions on how far into the future effects from the Project would continue after Closure (e.g., how long until the regeneration of forest seral stages following reclamation, how long would a wildlife VC continue to avoid or reduce the area of use after Closure activities have ceased). The same duration or time lag would be applied to the RFD Case for future projects with effects identified as overlapping in time (and space) with the Project.

Ecological models, such as HSI models, represent a simplified approximation of reality that can be used as a tool for predicting how wildlife may respond to a changing landscape. It is recognized that reducing the complexity of natural ecosystems and animal behaviour results in predictions that contain uncertainty. As a result, the accuracy and precision of model predictions are limited by sources of uncertainty such as the ELC layer (applying ecosites to different aged burns; EIS Section 13.2.6.1.4) and the expected suitability for VCs. Model predictions also include biases related to using scientific studies conducted in other regions and applying habitat relationships and animal responses to disturbances to the RSA. The value of a habitat type assigned to a VC may under- or over-represent the actual use of habitat by individuals. Model validation was completed by external subject matter experts to reduce uncertainty in effects predictions (Section 14B2.4, Model Validation).

Habitat maps were also a static view between VCs and the environment and do not forecast changes over time with forest succession and natural disturbance such as future fire events and insect outbreaks, which limits their predictive power. For example, undisturbed early seral habitats assigned low suitability at present for some wildlife VCs would increase in quality through natural succession while mature or late seral habitats would degrade in quality. Such natural changes of forest succession would alter the availability of different suitability habitats in the RSA through the 43-year lifespan of the Project. However, the models are still useful for helping to evaluate effects from the Project and other human developments and activities on the availability of habitat to support the abundance and distribution of wildlife VC populations.

14B2.3 Sensory Disturbance and Avoidance of Anthropogenic Features

Wildlife species may avoid or reduce their use of habitat adjacent to areas of human development and activity. These changes in behaviour and distribution are typically related to sensory disturbance (e.g., dust, noise, lights, smells), which reduces the effectiveness or functionality of habitat to support wildlife populations. The distance and associated area and degree that sensory disturbance adversely affects habitat use and distribution of wildlife can be defined as the zone of influence (ZOI; Ficetola and Denoël 2009). In the assessment for wildlife VCs, the amount of habitat affected by sensory disturbance was estimated by applying ZOIs to human development features with a particular level of activity. Different ZOIs were applied for each VC and each type of human development feature (Table 14B2-2). For most wildlife species, data on the distance and degree of habitat avoidance due to sensory disturbance are limited. As a result, it was assumed that within the ZOI applied to a human development feature, habitat suitability was reduced to poor (unsuitable) so that effects were not underestimated. Habitats that are initially unsuitable with no human disturbance remain unsuitable within the applied ZOI. For inactive human disturbances, no ZOI was applied (Table 14B2-2). Inactive disturbances are given a habitat suitability value according to the VC. Unknown disturbances within the RSA appeared as unvegetated clearings adjacent to Highway 955. A precautionary approach was applied to unknown disturbances, which were assigned a predicted medium level of activity. Explanations for applying or not applying ZOIs to disturbance types and size of ZOIs are provided in each VC section below.

Zones of influence were applied to the Base Case, Application Case, and RFD Case, where applicable. Further details are provided in the methods for each wildlife VC in EIS Section 14, Wildlife and Wildlife Habitat.

Table 14B2-2: Existing Disturbance Types and Estimated Zones of Influence within the Local and Regional Study Areas

Type of Disturbance	Feature Type	Footprint Width (m)	Predicted Level of Activity	Area of Avoidance by Valued Component (m)							
				Moose	Grey Wolf	Black Bear	Beaver	Little Brown Myotis	Olive-sided Flycatcher	Rusty Blackbird	Mallard
Cutlines / seismic lines	Linear/Polygon[(a)]	2 / Actual	Medium	n/a	n/a	n/a	n/a	n/a	50	150	n/a
Trail	Linear/Polygon[(a)]	6 / Actual	Medium	n/a	n/a	n/a	n/a	n/a	50	150	n/a
Rough road	Linear	12	Medium	n/a	n/a	n/a	n/a	n/a	50	150	n/a
Existing access road	Polygon[(a)]	Actual	High	500	n/a	n/a	n/a	100	300	300	100
Highway 955	Linear	30	High	500	n/a	n/a	n/a	100	300	300	100
Clearing	Polygon	Actual	Inactive	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NexGen Energy Ltd. (NexGen) non-linear development	Polygon	Actual	Medium	n/a	n/a	n/a	n/a	n/a	150	150	n/a
Historical oil and gas / mineral exploration	Polygon	Actual	High	500	n/a	n/a	n/a	100	300	300	100
Outfitting (fishing) camp	Polygon	Actual	Medium	n/a	n/a	n/a	n/a	n/a	150	150	n/a
Unknown disturbance	Polygon	Actual	Medium	n/a	n/a	n/a	n/a	n/a	150	150	n/a

a) Includes data from ENV and ECCC (linear) as well as digitized disturbance data (polygon) from Axiom orthorectified aerial map.
n/a = not applicable; ENV = Saskatchewan Ministry of Environment; ECCC = Environment and Climate Change Canada.

The Project was incorporated into the assessment by applying the maximum disturbance area to the Application Case and RFD Case. The Patterson Lake South Property, which is planned by Fission Uranium Corp. (Fission 2019, 2021) was identified as an RFD and applied to the RFD Case (EIS Section 14.2.5). The ZOIs for high levels of activity were applied to the maximum disturbance area of the Project and the Fission Patterson Lake South Property hypothetical maximum disturbance area (Table 14B2-3). It was assumed that within the ZOIs, habitat suitability was reduced to poor (unsuitable) so that effects were not underestimated. The habitat suitability models were then run for the Application and RFD cases.

Table 14B2-3: Zones of Influence Applied to the Project and Reasonably Foreseeable Developments

Development	Feature Type	Predicted Level of Activity	Area of Avoidance by Valued Component (m)							
			Moose	Grey Wolf	Black Bear	Beaver	Little Brown Myotis	Olive-sided Flycatcher	Rusty Blackbird	Mallard
Rook I Project (maximum disturbance area)	Polygon	High	500	n/a	n/a	n/a	100	300	300	100
Fission Patterson Lake South Property (hypothetical maximum disturbance area)	Polygon	High	500	n/a	n/a	n/a	100	300	300	100

n/a = not applicable.

14B2.4 Model Validation

Models should be evaluated for reliability in a process generally referred to as model validation (Marcot et al. 1983). Model validation should be used to assess whether the habitat models used for the assessment reflect known animal use patterns in the RSA; however, data needed for validation are not always available or are limited. Model validation can also be accomplished through external or third-party review by qualified experts. Evaluating HSI models is often, by definition, difficult because this model type is most frequently used when data are insufficient to support empirical modelling approaches (e.g., resource selection functions or other statistical methods). Generally, the expectation is that the detection rate of individual animals increases from low to high habitat suitability classes.

14B3 Habitat Models

14B3.1 Moose

14B3.1.1 Habitat Requirements and Predicted Suitability

Moose (*Alces alces*) have typically been distributed across forested regions of Canada with more recent expansions into prairie and tundra ecosystems. Although considered a generalist species, moose have been shown to prefer deciduous aspen, shrubland, and wetlands interspersed with trees and shrubs. Optimal moose habitat consists of deciduous shrub and ground strata (i.e., layers) within deciduous, mixed, and coniferous forests that offer edge or disturbed areas of early successional vegetation (Courtois et al. 2002; Poole and Stuart-Smith 2004; Osko et al. 2004; Nelson et al. 2008). Forest fire disturbance increases the abundance of deciduous habitat by regenerating the landscape to an early successional stage where the forest canopy is reduced, allowing for regeneration of the deciduous understory shrubs and forbs (Street et al. 2015). In upland habitats, functional habitat for moose is expected to become available 6 to 10 years after fire disturbance (i.e., after the development of a shrub layer) and resulting optimal moose habitat occurs at 10 to 26 years post-fire, with subsequent declines in moose population density occurring as tree stands mature (Nelson et al. 2008). Indigenous Knowledge indicated that moose move away after fire but come back when vegetation grows back to a certain height, though a slow rate of regrowth of vegetation was noted (TSD II: BNDN). In northern environments (e.g., the taiga plains of British Columbia and boreal shield of Saskatchewan), the strong link between natural disturbance and moose densities may lessen (DeMars et al. 2019; Neufeld et al. 2021). Similar results have been shown for logging disturbance at higher latitudes. For example, Gagné et al. (2016) found that moose only selected for clear-cuts at low latitudes in their study area in Québec, where the availability of deciduous vegetation and net primary productivity was higher.

While aquatic habitat is used by moose in the warmer months, habitat containing deciduous foliage is more consistently linked to moose population abundance and species preference (Street et al. 2015). This preference is reduced when deep snow is present, as depths greater than 65 cm restrict moose movement; 90 cm is considered the critical snow depth for moose (Peek et al. 1982). In the presence of deep snow, moose will trade off forage availability for movement by avoiding areas of deep snow and preferring less snow cover such as in mature coniferous stands, which intercept snowfall (Courtois et al. 2002); however, there is higher risk of predation in coniferous stands (Dussault et al. 2005).

During spring, summer, and fall, moose prefer to browse on shrubs, primarily consuming fresh shoots and leaves from deciduous shrubs and young deciduous trees (e.g., birch species [*Betula* spp.]; Wam and Hjeljord 2010). Aquatic vegetation (e.g., yellow pond lily [*Nuphar variegata*]) is important in the moose diet during the spring and summer months as these plants contain sodium and other nutrients not found in other items in their diet (OMNR 1988). During the winter, moose feed almost exclusively on twigs and branches of woody plants such as trembling aspen (*Populus tremuloides*), willow species (*Salix* spp.), red-osier dogwood (*Cornus sericea*), balsam poplar (*Populus balsamifera)*, alder species (*Alnus* spp.), and beaked hazelnut (*Corylus cornuta*) (OMNR 1988; Romito et al. 1999). During winter back trailing baseline surveys for the Project, one moose was back trailed within regenerating coniferous tall shrub dominated forest; however, bedding and browsing was observed in patches of deciduous forest. Browsing was most frequently recorded on white birch and a smaller amount on alder and jack pine.

Habitat suitability rankings of landcover types and ecosites for moose in the RSA were assigned based on the habitat associations described in Table 14B3-1. The model implicitly incorporated seasonal requirements, movements, and use of habitats, such as the overall annual preference for deciduous and shrubby wetlands, periodic spring/summer use of more open aquatic habitats, and use of mature coniferous stands during deep snow conditions. For example, riparian areas (e.g., treed/willow areas adjacent to wetlands and streams) are important for calving and summer foraging habitat, because of the combination of forage availability and cover, with nearby water providing an escape from predators (Environment Yukon 2016). In winter, when snow depth may be limiting, moose prefer mature forest (Hauge and Keith 1981; Pierce and Peek 1984; Simpson et al. 1988), which moderates climatic extremes and intercepts snowfall (Bonar 1985; McNicol 1990).

Table 14B3-1: Habitat Suitability of Landcover Types and Ecosites for Moose

Landcover Type	Ecosites[a]	Suitability
Deciduous forest	BP06; BP07; BP16; BS14; BS15; BP06(BU/E); BP07(BU/E); BP07(BU/L); BP16(BU/L); BS15(BU/L)	High
Treed or shrubby (willow) wetland	BP18; BP19; BP23; BP25; BS17; BS21; BS23; BP18(BU/E); BP19(BU/E); BP23(BU/E); BP25(BU/E); BS17(BU/E); BS21(BU/E); BS23(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BP25(BU/L); BS16(BU/L); BS17(BU/L); BS21(BU/L); BS23(BU/L)	
Young mixed or coniferous forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Immature mixed or coniferous forest	BP02(BU/L); BP03(BU/L); BP04(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L)	Moderate
Mature mixed or coniferous forest	BP02; BP03; BP04; BP11; BP12; BP14; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13	

Table 14B3-1: Habitat Suitability of Landcover Types and Ecosites for Moose

<table>
<tr><th>Landcover Type</th><th>Ecosites[a]</th><th>Suitability</th></tr>
<tr><td>Graminoid wetland</td><td>BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)</td><td rowspan="5">Low</td></tr>
<tr><td>Open wetland</td><td>BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)</td></tr>
<tr><td>Shrubby (Labrador tea or leatherleaf) wetland</td><td>BP20; BP24; BS18; BS22; BP20(BU/E); BS18(BU/E); BS22(BU/E); BP20(BU/L); BP24(BU/L); BS18(BU/L); BS22(BU/L)</td></tr>
<tr><td>Recent burn</td><td>Recent burn (upland); recent burn (wetland)</td></tr>
<tr><td>Existing disturbance</td><td>Cutlines / seismic lines</td></tr>
<tr><td>Rush sandy shore</td><td>BS26; BS26(BU/E); BS26(BU/L)</td><td rowspan="4">Poor</td></tr>
<tr><td>Unvegetated bedrock</td><td>BS02; BS02(BU/L)</td></tr>
<tr><td>Open water</td><td>Water</td></tr>
<tr><td>Existing disturbance</td><td>Trail; rough road; access road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance</td></tr>
</table>

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Moose have been documented showing a preference for seismic lines and utility lines and logging roads, (Higgelke 1994; Serrouya and D'Eon 2002), and may be drawn to salt on and around highways in winter (Miller and Litvaitis 1992). During baseline winter track surveys for the Project, moose tracks were observed on the transect sampling road / anthropogenic disturbance (Annex VIII.1, Wildlife Baseline Report 1 [Mammals, Waterfowl, and Raptors]). Cameras deployed during baseline studies also detected moose more frequently along larger trails (cleared linear disturbance more 2 m wide) and smaller trails (cleared linear disturbance less 2 m wide) compared to roads that support truck traffic (Annex VIII.1). Laurian et al. (2008) found that moose showed avoidance of areas up to 500 m from highways, and that highway and forest road crossing frequencies were 16 and 10 times lower than expected by chance, respectively. In a subsequent study, moose avoidance of roads varied seasonally from 100 m to 250 m (Laurian et al. 2012). Moose have been shown to avoid human disturbance such as clearings caused by agricultural activity (e.g., Mytton and Keith 1981). However, moose also prefer logged areas 10 years to 30 years of age (Poole and Stuart-Smith 2004). There is growing evidence that moose differ from deer (*Odocoileus* spp.) in that they are not likely to use linear disturbances to the same extent when made available. Moose (McLoughlin et al. 2011) and caribou (DeMars and Boutin 2018) will avoid linear features in the presence of wolves. However, white-tailed deer (*Odocoileus virginianus*) adopt a galloping tactic to flee wolves that benefits from early detection and space to run. Deer show the opposite reaction to linear features in the presence of wolves, instead closing distance to features like secondary roads (Dellinger et al. 2019).

Indigenous communities indicated that moose are not smart about highways because they have not seen cars before and that at the Cluff Lake Mine, some animals moved into the mine site for protection (MN-S-JWG 2019; MN-S-JWG 2020). Other observations from a IKTLU Study indicated that moose move away from human disturbance due to too much activity in the area (TSD IV: MN-S). Suitable habitats that are within 500 m of human developments with high levels of activity (e.g., Highway 955, access road) were assigned a suitability rank of poor based on scientific and Indigenous Knowledge and as a precautionary approach (Table 14B2-2).

14B3.1.2 Model Validation

Baseline surveys recorded moose tracks and moose in the LSA and RSA but the quantity of data was not sufficient for statistical verification of the model. However, model structure and predictive outputs fit with the current state of knowledge regarding the ecology and habitat preferences of this species. To increase model confidence, a review and validation of the moose model was completed by Dr. Philip D. McLoughlin of MC^2 Consulting (McLoughlin 2021). The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on moose habitat.

14B3.2 Grey Wolf

14B3.2.1 Habitat Requirements and Predicted Suitability

While typically associated with forested uplands, wolves are considered habitat generalists that move around with prey availability (Walton et al. 2001; Arjo and Peltscher 2004; Boutin et al. 2015). Although wolves are generally not prey specialists, large ungulates such as deer, elk (*Cervus elaphus*), moose, and caribou make up most of their diet in Saskatchewan (Burton 2004). In addition, beaver (*Castor canadensis*) is an understated but likely important component of wolf diet (Latham et al. 2013; Moayeri 2013), including in Saskatchewan (Burton and Hobson 2005) and likely the RSA. Grey wolves (*Canis lupus*) are highly social animals that primarily occur in packs and have large home ranges.

Based on resource selection function (RSF) models, McLoughlin et al. (2019) found that in their study area, which is informed by wolf habitat selection in Saskatchewan's boreal shield and boreal plains, wolves selected for wetlands (i.e., open muskeg) at the home range (territory) scale during both the snow-free period and winter. Black spruce swamp (or bog) was also selected in the snow-free period and winter though the results were not significant. Wolves in the RSA can be expected to seek out lower elevations as linked with drainages (i.e., potential beaver habitat) across the landscape. The latter is likely to account for an expected HSI of open muskeg being high in both summer and winter. While caribou selection of wetlands to provide refuge from predators is expected (Rettie and Messier 2000), open muskegs may also provide preferable moose forage (Timmermann and McNicol 1988; Shipley 2010), which could attract wolves.

Mature black spruce and young/mid-successional jack pine were avoided during both snow-free period and winter. Mature jack pine was strongly avoided during the winter and slightly selected for during the snow-free period (McLoughlin et al. 2019). Mixed coniferous-deciduous forest was selected for during the winter because of their reliance on moose as prey (McLoughlin et al. 2019). Wolves are also expected to use mixed coniferous-deciduous forest in the snow-free period because of the higher abundance of moose, which is likely the primary prey species of large wolf packs in the RSA (McLoughlin 2021). The model developed by Serrouya et al. (2021) for the Cold Lake Air Weapons Range in northeast Alberta also suggests a strong moose-wolf link in the RSA. The top RSF model developed by Latham et al. (2014) for the non-mineable portion of the Athabasca Oil Sands Region indicated relatively strong selection for mixed and upland conifer forest, weak selection for cutblocks (6 to 30 years), fens and deciduous forest, and strong avoidance of water.

Conditions described in the study conducted by McLoughlin et al. (2019), which is in a transition zone likely to be informed by boreal plains and boreal shield wolf habitat selection, were assumed to be ecologically similar to those found within the RSA. Habitat suitability rankings of landcover types and ecosites for wolf in the RSA were assigned for the snow-free period (Table 14B3-2) and winter (Table 14B3-3) based on McLoughlin et al. (2019) RSF models at the home range scale. Habitats (ecosites) that were strongly (statistically significant) avoided in the RSF models were synonymous with poor (unsuitable) quality habitats in the HSI models. Low suitability habitats in the HSI models were associated with a negative trend for selection (significant or not significant), moderate suitability habitats were associated with a non-significant positive trend for selection, and high suitability habitats were significantly selected in the RSF models, respectively. Ecozonal synonyms (McLaughlan et al. 2010) were used to extrapolate habitat suitability rankings from boreal shield ecosites to boreal plain ecosites and the ELC for the RSA (Section 14B2.1).

Table 14B3-2: Habitat Suitability of Landcover Types and Ecosites for Wolf during the Snow-Free Period

Landcover Type	Ecosite[(a)]	Suitability
Mature jack pine	BP02; BP03; BP04; BP12; BS03; BS04; BS05; BS06	High
Open muskeg	BP20; BP21; BP22; BP23; BP24; BP25; BP26; BP27; BP28; BS18; BS19; BS20; BS21; BS22; BS23; BS24; BS25; BP18(BU/E); BP19(BU/E); BP20(BU/E); BP23(BU/E); BP25(BU/E); BP26(BU/E); BP28(BU/E); BS17(BU/E); BS18(BU/E); BS20(BU/E); BS21(BU/E); BS22(BU/E); BS23(BU/E); BS24(BU/E); BP18(BU/L); BP19(BU/L); BP20(BU/L); BP21(BU/L); BP23(BU/L); BP24(BU/L); BP25(BU/L); BP26(BU/L); BP28(BU/L); BS16(BU/L); BS17(BU/L); BS18(BU/L); BS19(BU/L); BS20(BU/L); BS21(BU/L); BS22(BU/L); BS23(BU/L); BS24(BU/L); BS25(BU/L)	
Young/mid-successional black spruce	BP14(BU/E); BS07(BU/E); BS09(BU/E); BP14(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L)	
Recent burn	Recent burn (upland); recent burn (wetland)	
Existing disturbance	Cutlines / seismic lines; trail	
Black spruce swamp or bog	BP18; BP19; BS17	Moderate
Mixed coniferous-deciduous forest	BP06; BP07; BP11; BP16; BS13; BS14; BS15; BP06(BU/E); BP07(BU/E); BS13(BU/E); BS14(BU/E); BP07(BU/L); BP11(BU/L); BP16(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	
Existing disturbance	Access road; rough road	
Mature black spruce	BP14; BS07; BS08; BS09; BS10	Low
Young/mid-successional jack pine	BP02(BU/E); BP03(BU/E); BP04(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP12(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	Poor
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Open water	Water	
Existing disturbance	Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Table 14B3-3: Habitat Suitability of Landcover Types and Ecosites for Wolf during Winter

Landcover Type	Ecosite[a]	Suitability
Mixed coniferous-deciduous forest	BP06; BP07; BP11; BP16; BS13; BS14; BS15; BP06(BU/E); BP07(BU/E); BS13(BU/E); BS14(BU/E); BP07(BU/L); BP11(BU/L); BP16(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	High
Open muskeg	BP20; BP21; BP22; BP23; BP24; BP25; BP26; BP27; BP28; BS18; BS19; BS20; BS21; BS22; BS23; BS24; BS25; BP18(BU/E); BP19(BU/E); BP20(BU/E); BP23(BU/E); BP25(BU/E); BP26(BU/E); BP28(BU/E); BS17(BU/E); BS18(BU/E); BS20(BU/E); BS21(BU/E); BS22(BU/E); BS23(BU/E); BS24(BU/E); BP18(BU/L); BP19(BU/L); BP20(BU/L); BP21(BU/L); BP23(BU/L); BP24(BU/L); BP25(BU/L); BP26(BU/L); BP28(BU/L); BS16(BU/L); BS17(BU/L); BS18(BU/L); BS19(BU/L); BS20(BU/L); BS21(BU/L); BS22(BU/L); BS23(BU/L); BS24(BU/L); BS25(BU/L)	
Recent burn	Recent burn (wetland)	
Existing disturbance	Cutlines/seismic lines; trail	
Black spruce swamp or bog	BP18; BP19; BS17	Moderate
Existing disturbance	Access road; rough road	
Mature black spruce	BP14; BS07; BS08; BS09; BS10	Low
Young/mid-successional black spruce	BP14(BU/E); BS07(BU/E); BS09(BU/E); BP14(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L)	
Young/mid-successional jack pine	BP02(BU/E); BP03(BU/E); BP04(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP12(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L)	
Recent burn	Recent burn (upland)	
Mature jack pine	BP02; BP03; BP04; BP12; BS03; BS04; BS05; BS06	Poor
Unvegetated bedrock	BS02; BS02(BU/L)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Open water	Water	
Existing disturbance	Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Most studies indicate wolves are relatively tolerant of human disturbance. Boutin et al. (2015) found weak evidence for wolf avoidance of mines and strong evidence for use of linear disturbances during travel. Cameras deployed during baseline studies for the Project also detected wolves more frequently along larger trails (cleared linear disturbance more than 2 m wide) and smaller trails (cleared linear disturbance less than 2 m wide) compared to roads that support truck traffic (Annex VIII.1). During winter back trailing surveys, two wolves were back trailed and recorded using linear features for 99% of the backtrail event (Annex VIII.1). Other studies found that roads with high traffic volumes may be a partial barrier to wolf movement, but linear developments such as roads with low traffic volumes or power line corridors may be preferred travel corridors for wolves, especially during winter in the presence of deep snow (Paquet and Callaghan 1996; Gurarie et al. 2011; Neilson 2017). A comprehensive study of wolf movement behaviour in northeast Alberta showed linear features such as pipelines, roads, railways, and transmission lines are preferentially selected by wolves and travel rates were observed to be significantly higher on linear features compared to the surrounding forest (Dickie et al. 2016). DeMars and Boutin (2018) found that wolves in northeastern British Columbia showed strong selection for linear features in peatlands while generally avoiding peatlands outside of linear features. Landscape disturbances as might be expected along established linear features like roads and geophysical cut lines can demonstrably lead to a change in animal behaviour for wolves (Hebblewhite and Merrill 2008; Dickie et al. 2016) and their prey including caribou (Frair et al. 2008; Laurian et al. 2008; review in Dabros et al. 2018).

Overall, wolves appear to be capable of adapting to the presence of humans and may select areas closer to human activity (Mech et al. 1995; Thiel et al. 1998; Boitani 2000; Hebblewhite and Merrill 2008). A study by Hebblewhite and Merrill (2008) showed that wolves displayed a functional response of selecting areas closer to anthropogenic features with higher human activity than areas of low human activity. This is supported by some Indigenous community observations that noted wolves coming around existing mining camps (BRDN-JWG 2019; MN-S-JWG 2019). Subsequently, no ZOI was applied to human disturbance types (Table 14B2-2). However, habitat suitability for wolf considered the type of human disturbance. For example, the existing trails and the access road were preferred relative to Highway 955, clearings, and outfitting camps (Table 14B3-2).

14B3.2.2 Model Validation

Baseline surveys recorded wolf tracks and wolf in the LSA and RSA but the quantity of data was not sufficient for statistical verification of the models. However, the structure of the models and predictive outputs fit with the current state of knowledge regarding the ecology and habitat preferences of this species. In addition, 69.7% of ELC units in the wolf models were correlated with the McLoughlin et al. (2019) RSF models directly or using ecozonal synonyms (McLaughlan et al. 2010) and burn modifiers. To increase model confidence, review and validation of the grey wolf models was completed by Dr. Philip D. McLoughlin of MC^2 Consulting (McLoughlin 2021); the snow-free period model was modified based on review comments. The models provide an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on grey wolf habitat.

14B3.3 Black Bear

14B3.3.1 Habitat Requirements and Predicted Suitability

Black bears are solitary animals that inhabit coniferous, deciduous, and mixed-wood forests that provide adequate cover for security and forage abundance (Lariviére 2001; McLoughlin et al. 2019). In the Saskatchewan boreal shield, which is assumed to be ecologically similar to the RSA, seasonal changes occur at the home range scale with black bears avoiding mature black spruce habitat in spring and summer but selecting this habitat type during fall (McLoughlin et al. 2019). Black bears selected for mixed coniferous-deciduous forests in the spring but strongly avoided it in the fall (McLouglin et al. 2019). Latham et al. (2011a,b) found that collared black bears in east-central Alberta avoided bogs and fens and selected upland habitats of mixed woods and various industrial features. Another study conducted by Bastille-Rousseau et al. (2011) found that black bears studied in the Laurentides Wildlife Reserve in Quebec displayed significantly stronger selection for habitats with forage-rich vegetation abundance and avoided wet, boggy habitat. Similarly, McLoughlin et al. (2019) found avoidance of black spruce swamp in spring and fall seasons at the home range scale. Black bears in the Saskatchewan boreal shield (McLoughlin et al. 2019) selected lower elevations in spring and summer but mid-high elevations in fall. Lower elevations were likely related to drainages and foraging in those areas early after den emergence. Wetlands, including open muskeg and mesic mixed coniferous-deciduous forest in the boreal shield, are often associated with drainages and forage associated with early green-up, and thus are expected to be of high suitability in spring.

During baseline pellet group surveys for the Project, black bear scat was detected most frequently in willow shrubby rich fen (BP25) and tamarack treed fen (BP23) (Annex VIII.1). Strong avoidance of young/mid-successional black spruce habitat was found during spring, though black bears selected for this habitat type during fall (McLoughlin et al. 2019). The shift in relative selection towards young coniferous stands in the fall was expected by McLoughlin et al. (2019) as bears rely heavily on berries to prepare for winter dormancy through much of North America (Nelson et al. 1983). In the Saskatchewan boreal shield, blueberry (*Vaccinium myrtilloides*) and lingonberry (*Vaccinium vitis-idaea*) were more commonly found and with equal or greater cover in young jack pine stands compared to mature stands, and generally, blueberry occurs more commonly in young jack pine stands than it does in any other stand (McLoughlin et al. 2019). In the RSA, blueberry was also common in late-stage regenerating stands of jack pine (EIS Section 13.3.1.3, Ecosystem Condition).

Black bears are opportunist omnivores; however, much of their diet consists of herbaceous vegetation. Black bears will consume a vast array of food types including roots, buds, fruit, nuts, insects, fish, mammals, and carrion (Garshelis et al. 2016). Bears will prey on moose and caribou calves although habitat selection of bears was not strongly associated with selection of habitat by caribou during the calving and post-calving seasons (Schwartz and Franzmann 1991; Bastille-Rousseau et al. 2011; McLoughlin et al. 2019). Indigenous and scientific knowledge indicates that black bears also consume food garbage and can be attracted to some human developments (Garshelis et al. 2016; MN-S-JWG 2019).

Little is known of the denning requirements of black bears in the LSA; however, Neufeld (2018) observed that for 14 black bears denning in the Saskatchewan boreal shield, microsites selected by bears showed avoidance of water within 100 m of dens and average denning of at least 14 km from a road. Investigated dens included southern-facing banks and under a tree, catching snow. Black bears require secluded areas for denning and will use a wide variety of den structures such as existing caves and tree cavities, excavated underground chambers, exposed root masses of overturned trees, brush piles, and above-ground nests (Garshelis et al. 2016). Denning sites are not expected to be limiting in the RSA (McLoughlin 2021) and are rarely considered limiting, except in areas that flood (White et al. 2001) or where bears prefer a specific den type (e.g., hollow tree), the abundance of which may be reduced through logging or other human activities (Davis et al. 2012). Variable denning behaviour is expected. Kolenosky (1987) found that 89% were excavations, of which 41% were under trees or stumps, 23% under logs, and 36% dug into the soil. The other 11% of the dens were in hollow logs and trees, in rock caves, or under piles of man-made debris.

Like wolves, conditions described in the boreal shield by McLoughlin et al. (2019) were assumed to be ecologically similar to those found within the RSA due to a similar natural disturbance (wildlife) regime and low amount of human disturbance (Section 14B3.2.1, Habitat Requirements and Predicted Suitability). Habitat suitability rankings of landcover types and ecosites for black bears in the RSA were assigned for the spring (Table 14B3-4) and fall (Table 14B3-5) seasons based on McLoughlin et al. (2019) RSF models at the home range scale. Spring and fall were selected because these seasons represent periods when energetic and nutritional requirements may be limiting for bears following emergence from the den and prior to entering hibernation (dormancy). Habitats (ecosites) that were strongly (statistically significant) avoided in the RSF models were synonymous with poor (unsuitable) quality habitats in the HSI models. Low suitability habitats in the HSI models were associated with a negative trend for selection (significant or not significant), moderate suitability habitats were associated with a non-significant positive trend for selection, and high suitability habitats were significantly selected in the RSF models, respectively. Ecozonal synonyms (McLaughlan et al. 2010) were used to extrapolate habitat suitability rankings from boreal shield ecosites to boreal plain ecosites and the ELC for the RSA (Section 14B2.1).

Table 14B3-4: Habitat Suitability of Landcover Types and Ecosites for Black Bear during Spring

Landcover Type	Ecosite[(a)]	Suitability
Mixed coniferous-deciduous forest	BP06; BP07; BP11; BP16; BS13; BS14; BS15; BP06(BU/E); BP07(BU/E); BS13(BU/E); BS14(BU/E); BP07(BU/L); BP11(BU/L); BP16(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	High
Existing disturbance	Cutlines / seismic lines; trail	
Open muskeg	BP20; BP21; BP22; BP23; BP24; BP25; BP26; BP27; BP28; BS18; BS19; BS20; BS21; BS22; BS23; BS24; BS25; BP18(BU/E); BP19(BU/E); BP20(BU/E); BP23(BU/E); BP25(BU/E); BP26(BU/E); BP28(BU/E); BS17(BU/E); BS18(BU/E); BS20(BU/E); BS21(BU/E); BS22(BU/E); BS23(BU/E); BS24(BU/E); BP18(BU/L); BP19(BU/L); BP20(BU/L); BP21(BU/L); BP23(BU/L); BP24(BU/L); BP25(BU/L); BP26(BU/L); BP28(BU/L); BS16(BU/L); BS17(BU/L); BS18(BU/L); BS19(BU/L); BS20(BU/L); BS21(BU/L); BS22(BU/L); BS23(BU/L); BS24(BU/L); BS25(BU/L)	Moderate
Recent burn	Recent burn (wetland)	
Existing disturbance	Access road; rough road	
Black spruce swamp or bog	BP18; BP19; BS17	Low
Mature black spruce	BP14; BS07; BS08; BS09; BS10	
Mature jack pine	BP02; BP03; BP04; BP12; BS03; BS04; BS05; BS06	
Young/mid-successional jack pine	BP02(BU/E); BP03(BU/E); BP04(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP12(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L)	
Recent burn	Recent burn (upland)	
Young/mid-successional black spruce	BP14(BU/E); BS07(BU/E); BS09(BU/E); BP14(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L)	Poor
Unvegetated bedrock	BS02; BS02(BU/L)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Open water	Water	
Existing disturbance	Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Table 14B3-5: Habitat Suitability of Landcover Types and Ecosites for Black Bear during Fall

Landcover Type	Ecosite[a]	Suitability
Mature black spruce	BP14; BS07; BS08; BS09; BS10	High
Young/mid-successional black spruce	BP14(BU/E); BS07(BU/E); BS09(BU/E); BP14(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L)	
Young/mid-successional jack pine	BP02(BU/E); BP03(BU/E); BP04(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP12(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L)	
Recent burn	Recent burn (upland)	
Existing disturbance	Cutlines / seismic lines; trail	
Existing disturbance	Access road; rough road	Moderate
Black spruce swamp or bog	BP18; BP19; BS17	Low
Mature jack pine	BP02; BP03; BP04; BP12; BS03; BS04; BS05; BS06	
Open muskeg	BP20; BP21; BP22; BP23; BP24; BP25; BP26; BP27; BP28; BS18; BS19; BS20; BS21; BS22; BS23; BS24; BS25; BP18(BU/E); BP19(BU/E); BP20(BU/E); BP23(BU/E); BP25(BU/E); BP26(BU/E); BP28(BU/E); BS17(BU/E); BS18(BU/E); BS20(BU/E); BS21(BU/E); BS22(BU/E); BS23(BU/E); BS24(BU/E); BP18(BU/L); BP19(BU/L); BP20(BU/L); BP21(BU/L); BP23(BU/L); BP24(BU/L); BP25(BU/L); BP26(BU/L); BP28(BU/L); BS16(BU/L); BS17(BU/L); BS18(BU/L); BS19(BU/L); BS20(BU/L); BS21(BU/L); BS22(BU/L); BS23(BU/L); BS24(BU/L); BS25(BU/L)	
Recent burn	Recent burn (wetland)	
Mixed coniferous-deciduous forest	BP06; BP07; BP11; BP16; BS13; BS14; BS15; BP06(BU/E); BP07(BU/E); BS13(BU/E); BS14(BU/E); BP07(BU/L); BP11(BU/L); BP16(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	Poor
Unvegetated bedrock	BS02; BS02(BU/L)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Open water	Water	
Existing disturbance	Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Some evidence suggests that black bears may avoid habitat adjacent to roads (Vander Heyden and Meslow 1999; Reynolds-Hoagland and Mitchell 2007; Simek et al. 2015). In contrast, McLoughlin et al. (2019) found that habitat use in black bears increased closer to linear features at the home range scale. Cameras deployed during baseline studies for the Project also detected black bears more frequently along larger trails (cleared linear disturbance more than 2 m wide) and roads that support truck traffic compared to smaller trails (cleared linear disturbance less than 2 m wide) (Annex VIII.1). Linear features were highly selected by bears in peatlands and other land covers in northeast British Columbia (DeMars and Boutin 2018).

In remote areas of northern Saskatchewan, it is expected that baiting for bears will occur along and adjacent to major highway routes. In the study area of McLoughlin et al. (2019), every bear was expected to have access to bait during the spring bear hunting season (mid-April to late June) and baits become a reliable food source at a time when resources are scarce leading to consistent use by bears throughout the active baiting season (McLoughlin 2021). During Joint Working Group Meetings, the Métis Nation – Saskatchewan indicated that bears may even come to roads expecting food when they hear vehicles (TSD IV: MN-S). While baiting is legal across the majority of black bear range in Canada (Hristienko and McDonald 2007), it is not usually considered a factor in habitat selection studies. Based on this information, no ZOI was applied to human disturbance types

(Table 14B2-2). However, habitat suitability for black bear considered the type of human disturbance (Table 14B3-4 and Table 14B3-5).

14B3.3.2 Model Validation

Baseline surveys recorded black bear and black bear sign in the LSA and RSA but the quantity of data was not sufficient for statistical verification of the models. However, the structure of the models and predictive outputs fit with the current state of knowledge regarding the ecology and habitat preferences of this species. In addition, 69.7% of ELC units in the black bear models were correlated with the McLoughlin et al. (2019) RSF models directly or using ecozonal synonyms (McLaughlan et al. 2010) and burn modifiers. To increase model confidence, review and validation of the black bear models was completed by Dr. Philip D. McLoughlin of MC^2 Consulting (McLoughlin 2021). The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on black bear habitat.

14B3.4 Beaver

14B3.4.1 Habitat Requirements and Predicted Suitability

The beaver is a semi-aquatic mammal that is found throughout forested regions of Canada. Beavers select habitat based on a variety of characteristics including stream gradient, stream size and depth, watershed size, valley or floodplain width, substrate type, and riparian slope (Touihri et al. 2018). Beavers inhabit a variety of aquatic habitats such as lakes, ponds, and slow-flowing streams (Cassola 2016). Beavers build lodges out of mud, sticks, logs, and debris in areas that are near abundant food supplies, lodge construction material, and in waterbodies that are deep enough so that the underwater lodge entrance does not freeze during winter. Beavers are herbivores and prefer to consume trembling aspen and willows but will consume the leaves, twigs, and bark of many woody plant species that grow near waterbodies including coniferous trees and shrubs (less preferred) (Jenkins and Busher 1979; Allen 1983). In the mixed boreal forest of central Alberta, studies suggest that aspen, balsam poplar (*Populus balsamifera*), and beaked hazelnut (*Corylus cornuta*) are preferred forage, while white birch (*Betula papyrifera*) was less preferred (Skinner 1984; Hood and Bayley 2008).

Beavers have been observed to forage at distances of up to 200 m from the lodge and associated waterbody; however, the majority of foraging occurred within 100 m of the shoreline (Allen 1983). Foraging up to 78 m from a waterbody was found during studies completed in the mixed boreal forest of central Alberta (Skinner 1984; Hood and Bayley 2008). According to Allen (1983), small lakes (less than 8 ha in surface area) provide suitable habitat for beaver. Larger lakes may provide suitable habitat if irregular shorelines are available (e.g., bays, coves, inlets). During baseline semi-aquatic mammal surveys for the Project, active beaver lodges were observed more often along creeks than lake shorelines (Annex VIII.1). A recent study in northwestern Alberta showed extensive use of inundated borrow pits by beavers for foraging and overwintering (Scrafford et al. 2020). Scrafford et al. (2020) found that borrow pits associated with active beaver lodges were closer to streams, marshes, and swamps, and had more vegetation concealment from adjacent roads. Beaver habitat use in human-altered landscapes is likely influenced by the presence of suitable habitat in proximity to disturbance.

The beaver habitat model was used to predict suitable lodge locations, food, and cover in the RSA. It was assumed that beaver distribution was similar across seasons because these animals are central-place foragers moving out from the lodge to select food that may be consumed or transported back to the dwelling (Basey and Jenkins 1995). The model incorporated the suitability of open water and wetlands for establishing a lodge and the suitability of adjacent terrestrial habitat containing food and cover and material for lodge construction. While open water provides little value with respect to forage for beaver, it is suitable in terms of cover, breeding and social behaviours, and lodge habitat (Novak et al. 1987). The model assumed that large lakes (less than 8 ha in surface area) provided negligible shelter from wind and wave action and provided poor quality beaver habitat.

Habitat suitability rankings of landcover types and ecosites for beaver lodge location in the RSA were assigned based on the information above (Table 14B3-6). Habitat suitability rankings for upland ecosites predicted to provide cover and food for beaver within 100 m of open water (less than 8 ha in surface area) and wetlands (with more than 1% water cover) are provided in Table 14B3-7.

Table 14B3-6: Habitat Suitability of Landcover Types and Ecosites for Beaver Lodge Location

Landcover Type	Ecosite[a]	Suitability
Open water (<8 ha in surface area)	Water	High
Wetland (average cover is >21% water)	BP25; BP26; BS23; BS24; BS25; BP25(BU/E); BP26(BU/E); BS23(BU/E); BS24(BU/E); BP25(BU/L); BP26(BU/L); BS23(BU/L); BS24(BU/L); BS25(BU/L)	
Wetland (average cover is 6%-20% water)	BP18; BP23; BP24; BS22; BP18(BU/E); BP23(BU/E); BS22(BU/E); BP18(BU/L); BP23(BU/L); BP24(BU/L); BS22(BU/L)	Moderate
Wetland (average cover is 1%-5% water)	BP27; BP28; BP28(BU/E); BP28(BU/L)	Low
Wetland (Average cover is <1% water)	BP19; BP20; BP21: BP22; BS17; BS18; BS19; BS20; BS21; BS26; BP19(BU/E); BP20(BU/E); BS17(BU/E); BS18(BU/E); BS20(BU/E); BS21(BU/E); BS26(BU/E); BP19(BU/L); BP20(BU/L); BP21(BU/L); BS16(BU/L); BS17(BU/L); BS18(BU/L); BS19(BU/L); BS20(BU/L); BS21(BU/L); BS26(BU/L)	Poor
Recent burn	Recent burn (upland); Recent burn (wetland)	
Upland habitat	BP02; BP03; BP04; BP06; BP07; BP11; BP12; BP14; BP16; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13; BS14; BS15; BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Existing disturbance	Cutlines/seismic lines; trail; access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	
Open water (>8 ha in surface area)	Water	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.
< = less than; > = greater than.

Table 14B3-7: Habitat Suitability of Landcover Types and Ecosites for Beaver within 100 m of Open Water and Wetlands

Landcover Type	Ecosite[(a)]	Suitability
Deciduous forest (aspen dominant	BP06; BP07; BP16; BS15; BP06(BU/E); BP07(BU/E); BP07(BU/L); BP16(BU/L); BS15(BU/L)	High
Shrubby (willow) wetland	BP25; BS23; BP25(BU/E); BS23(BU/E); BP25(BU/L); BS23(BU/L)	
Birch-dominant mixed forest (with aspen)	BS13; BS13(BU/E); BS13(BU/L)	Moderate
Pine-dominant mixed forest	BP04; BS06; BP04(BU/E); BP04(BU/L); BS06(BU/L)	
Birch-dominant mixed forest	BP11; BS14(BU/E); BP11(BU/L); BS14(BU/L)	Low
Coniferous forest	BP02; BP03; BP12; BP14; BS03; BS04; BS05; BS07; BS08; BS09; BS10; BP02(BU/E); BP03(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BP02(BU/L); BP03(BU/L); BP12(BU/L; BP14(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L)	
Deciduous forest (birch dominant)	BS14	

Note: Open water with less than 8 ha in surface area; wetlands with more than 1% water cover.
a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Beavers were assumed to be unaffected by human-related activities. For example, dams are often created at man-made structures (e.g., culverts; Boyles and Savitzky 2008). A study completed in northeastern British Columbia found no evidence that anthropogenic linear features decreased the likelihood of occurrence or distribution of beaver (Mumma et al. 2018). Based on this information, no ZOI was applied to human disturbance types (Table 14B2-2). However, habitat suitability for beaver considered human disturbance (Table 14B3-6).

14B3.4.2 Model Validation

Baseline surveys recorded active beaver lodges along waterbodies in the RSA, which provided support for the model, but the quantity of data was not sufficient for statistical verification. However, model structure and predictive outputs fit with the current state of knowledge regarding the ecology and suitability of lodge location for beavers, which is strongly tied to more open wetlands and adjacent deciduous upland. The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on beaver lodge habitat.

14B3.5 Little Brown Myotis

14B3.5.1 Habitat Requirements and Predicted Suitability

Habitat requirements for the little brown myotis (*Myotis lucifugus*) differ between winter and summer (COSEWIC 2013). In winter, little brown myotis hibernate in caves or abandoned mines where the open and accessible space extends below the frost line, and above zero temperatures and high humidity are relatively constant. In summer, maternity colonies are formed and roost in trees, rock crevices, buildings, bat houses, and under bridges. The trees that this species uses are often large and sometimes partly dead (called snags or wildlife trees); these trees are generally more abundant in late successional forest (i.e., mature, or old growth). Although there is considerable variation in the species of trees used for roosting, Lacki et al. (2007) and Olson and Barclay (2013) found that little brown myotis most often roost in large trembling aspen, balsam poplar, and white spruce (*Picea glauca*).

Myotis species are typically closed-canopy specialists (Kalcounis and Brigham 1995; Jung et al. 1999; Morris et al. 2010); however, little brown myotis is considered a more generalist species than other *Myotis* species. Little brown myotis is tolerant of anthropogenic disturbance, often favouring man-made structures for roosting, and prefer to forage in open areas including ponds, rivers, forest gaps, forest edges, or along trails and roads (Segers and Broders 2014). During baseline bat surveys for the Project, the high frequency bat species group and *Myotis* species group were detected most frequently in creek and bog habitat (Annex VII.2, Vegetation Baseline Report 2 [Inventory, Rare Plants, and Wetlands]). These high frequency echolocation signals were expected to be primarily little brown myotis based on known species ranges, abundance, call characteristics, and habitat preferences. No bat detectors recorded a spike indicative of the swarming period prior to hibernation (COSEWIC 2013).

White-nose syndrome is currently the key limiting factor affecting little brown myotis populations across North America (Environment Canada 2018). As white-nose syndrome has not yet spread to Saskatchewan, the availability of caves and other hibernacula are likely the factors currently limiting populations of this species in the province. No hibernacula are known to occur in the LSA and RSA.

Foraging (i.e., edge) habitat for little brown myotis is common in the boreal forest and not considered limiting. Conversely, roosting habitat was expected to be the most limiting factor for bats in the RSA during the non-hibernation period. As a result, habitat suitability for little brown myotis focused on defining roosting habitat. The model predicted that little brown myotis prefer deciduous forest stands over mixed wood stands, mixed wood stands are preferred over coniferous stands, and non-forested habitats are not used for roosting. Habitat suitability rankings of landcover types and ecosites for little brown myotis in the RSA are provided in Table 14B3-8.

Table 14B3-8: Suitability of Landcover Types and Ecosites for Little Brown Myotis Roosting Habitat

Landcover Type	Ecosite[a]	Suitability
Mature deciduous forest	BP06; BP07; BP16; BS14; BS15	High
Mature birch-dominant mixed forest	BP11; BS13	
Mature coniferous forest (with birch)	BS05; BS08; BS10	Moderate
Mature pine-dominant mixed forest	BP04; BS06	
Mature coniferous forest	BP02; BP03; BP12; BP14; BS03; BS04; BS07; BS09	Low
Mature treed wetland	BP18; BP19; BP23; BS17; BS21	
Existing disturbance	Outfitting (fishing) camp	
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)	Poor
Young or immature forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	
Young or immature treed wetland	BP18(BU/E); BP19(BU/E); BP23(BU/E); BS17(BU/E); BS21(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BS16(BU/L); BS17(BU/L); BS21(BU/L)	
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Open water	Water	
Existing disturbance	Cutlines / seismic lines; trail, access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Literature on ZOIs for little brown myotis is limited; however, Siemers and Schaub (2011) estimated that traffic noise affects prey detection ability of the greater mouse-eared bat (*Myotis myotis*) up to about 60 m from highways. In a similar study, Schaub et al. (2008) found that although greater mouse-eared bats responded to highway noise to a lesser degree than noise from vegetation movement and broadband sounds, the authors indicated that bats foraging 50 m from highways could still be affected by anthropogenic noise. Greater mouse-eared bats have a slightly wider echolocation range than little brown myotis and northern myotis (Fenton and Bell 1979; Faure et al. 1993; Schaub et al. 2008), so little brown myotis may show weaker responses to anthropogenic noise than greater mouse-eared bats. Luo et al. (2013) found that greater mouse-eared bats in a simulated roosting environment did not come out of torpor when subjected to five minutes of sustained highway noise at distances of 25 m, 50 m, and 100 m. The study did not test bat responses farther than 100 m from a highway, but the effects on bats were minimal and bats became habituated to repeated noise (Luo et al. 2013). Studies have found that vegetation noise and bat vocalizations have greater effects on bat activity than anthropogenic noises (Schaub et al. 2008; Luo et al. 2013).

As a precautionary approach to modelling the effects of anthropogenic noise on little brown myotis, a 100 m buffer (Luo et al. 2013) was applied as a ZOI to high-level activity disturbance types (Table 14B2-2). Suitable habitats that are within 100 m of human developments with high levels of activity (e.g., Highway 955, access road) were assigned a suitability rank of poor.

14B3.5.2 Model Validation

Baseline surveys detected little brown myotis in the LSA, but the quantity of data was not sufficient for statistical verification of the model. However, model structure and predictive outputs fit with the current state of knowledge regarding the ecology and roosting habitat preferences of little brown myotis, which is strongly tied to mature deciduous and mature mixed forest stands. The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on little brown myotis roosting habitat.

14B3.6 Olive-sided Flycatcher

14B3.6.1 Habitat Requirements and Predicted Suitability

Olive-sided flycatchers (*Contopus cooperi*) breed in forested areas in Canada and parts of the United States and overwinter in Central and South America. Olive-sided flycatchers prefer tall trees and snags (wildlife trees) adjacent to open areas, which provide individuals with perches to forage for flying insects. In Saskatchewan, nesting habitat is found in many forest types; however, the species shows a preference for mixed aged forest stands with openings and tall snags relative to more homogeneous forests (Smith 1996). As a result of their nesting and foraging requirements, olive-sided flycatcher abundance is correlated with landscapes containing fragmented late-seral forest with high-contrast edges (McGarigal and McComb 1995; Altman and Sallabanks 2012).

In the boreal forest of the species northern breeding range, olive-sided flycatcher is mostly found in open habitat of muskegs, bogs, and swamps dominated by tamarack (*Larix laricina*) and spruce (*Picea* spp.) (Errington 1933; Altman and Sallabanks 2012). Deciduous forests have been found to have lower reported rates of occurrence and abundance of olive-sided flycatchers than in coniferous leading stands (Altman and Sallabanks 2012).

In western Canada, olive-sided flycatchers are often associated with early to mid-successional post-disturbance coniferous forest with tall snags and residual live trees, mixed forests with canopy openings, and old growth forests (Schieck and Song 2006; COSEWIC 2018). A study of olive-sided flycatcher in the Peace River region of British Columbia found that small forest clearings of less than 10 ha within mature forest were preferred; however, the species was found to occur in clearings up to 284 ha in size where tall, standing snags were available (Norris et al. 2021). A sharp decline in olive-sided flycatcher occurrence in regenerating cuts older than 20 years was recorded (Norris et al. 2021). In Saskatchewan, olive-sided flycatcher was found to be more abundant in burned forests than in unburned forests (Morissette et al. 2002). During baseline wildlife surveys for the Project, olive-sided flycatchers were observed most frequently near large waterbodies (Patterson Lake and Forrest Lake) or along creeks and bogs with sparse vegetation in the adjacent uplands (Annex VII.2).

Olive-sided flycatchers are migratory and overwinter outside of Canada. As a result, habitat suitability for olive-sided flycatcher was focused on defining nesting habitat during the breeding period. The model was based on the understanding that this species is an edge specialist and aerial insectivore, preferring the interface between closed and open habitat types to meet both nesting and foraging needs.

Habitat suitability rankings of landcover types and ecosites for olive-sided flycatcher nesting habitat in the RSA are provided in Table 14B3-9. Olive-sided flycatcher also prefer high-contrast forest edges, which was incorporated into the model. Habitat suitability rankings were applied to dense and mature forested ecosites (Table 14B3-10) within 100 m of natural and anthropogenic forest openings (Table 14B3-11). As a result, for equivalent ecosites presented in Tables 14B3-9 and 14A3-10, habitat suitability is predicted to increase within 100 m of forest openings (e.g., BP12, BP18, BS06, BS08).

Table 14B3-9: Suitability of Landcover Types and Ecosites for Olive-sided Flycatcher Nesting Habitat

Landcover Type	Ecosite(a)	Suitability
Young coniferous forest(b)	BP02(BU/E); BP03(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E)	High
Young pine-dominant mixed forest(b)	BP04(BU/E)	
Young or immature treed wetland	BP18(BU/E); BP19(BU/E); BP23(BU/E); BS17(BU/E); BS21(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BS16(BU/L); BS17(BU/L); BS21(BU/L)	
Mature coniferous forest	BP02; BP03; BP12; BP14; BS03; BS04; BS05; BS07; BS08; BS09; BS10	Moderate
Mature pine-dominant forest	BP04; BS06	
Mature treed wetland	BP18; BP19; BP23; BS17; BS21	
Immature coniferous forest	BP02(BU/L); BP03(BU/L); BP12(BU/L); BP14(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L)	Low
Immature pine-dominant mixed forest	BP04(BU/L); BS06(BU/L)	
Young coniferous forest(c)	BP02(BU/E); BP03(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E)	
Young pine-dominant mixed forest(c)	BP04(BU/E)	
Young or immature birch-dominant forest	BS13(BU/E); BS14(BU/E); BP11(BU/L); BS13(BU/L); BS14(BU/L)	
Young or immature deciduous forest	BP06(BU/E); BP07(BU/E); BP07(BU/L); BP16(BU/L); BS15(BU/L)	
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)	Poor
Mature birch-dominant mixed forest	BP11; BS13	
Mature deciduous forest	BP06; BP07; BP16; BS14; BS15	
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Recent burn	Recent burn (upland); Recent burn (wetland)	
Open water	Water	
Existing disturbance	Cutlines / seismic lines; trail; access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.
b) Habitat patch of young forest less than or equal to 284 ha.
c) Habitat patch of young forest greater than 284 ha.

Table 14B3-10: Habitat Suitability of Landcover Types and Ecosites for Olive-sided Flycatcher within 100 m of Ecosites Identified in Table 14B3-11

Landcover Type	Ecosite[(a)]	Suitability
Dense mature coniferous forest	BP12; BS08	High
Dense pine-dominant mixed forest	BS06	
Dense treed wetland	BP18	
Mature pine-dominant mixed forest	BP04	Moderate
Dense birch-dominant mixed forest	BP11; BS13	
Dense mature deciduous forest	BP06; BP07; BP16	
Mature deciduous forest	BS14; BS15	Low

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Table 14B3-11: Ecosites from which a 100 m Buffer is Applied to Ecosites in Table 14B3-10

Landcover Type	Ecosite[(a)]
Graminoid wetland	BP21; BP26; BP28; BS19; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS19(BU/L); BS24(BU/L)
Open wetland	BP22; BP27; BS20; BS25; BS20(BU/E); BS20(BU/L); BS25(BU/L)
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)
Shrubby wetland	BP20; BP24; BP25; BS18; BS22; BS23; BP20(BU/E); BP25(BU/E); BS18(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS18(BU/L); BS22(BU/L); BS23(BU/L)
Unvegetated bedrock	BS02; BS02(BU/L)
Recent burn	Recent burn (upland); Recent burn (wetland)
Open water	Water
Existing disturbance	Cutlines / seismic lines; trail; rough road; clearing; NexGen non-linear development; outfitting (fishing) camp; unknown disturbance

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Literature on ZOIs for olive-sided flycatcher is limited; however, Bayne et al. (2008) found that noise from compressor stations had negative effects on boreal songbird abundance within 300 m of the noise source. The Saskatchewan Ministry of Environment Activity Restriction Guidelines for Sensitive Species (ENV 2017) recommend minimum setback distances from various levels of disturbance for olive-sided flycatcher. The guidelines recommend a 300 m setback from high disturbance activities and 150 m setback from medium disturbance activities and these distances were applied as ZOI buffers in the model. However, Norris et al. (2021) did not find a relationship between the presence of paved or unpaved roads and olive-sided flycatcher occurrence within 50 m of roads. As such, suitable olive-sided flycatcher habitats within 300 m of human developments with high levels of activity (e.g., Highway 955, airstrips), 150 m of non-linear human developments with medium levels of activity (e.g., NexGen Energy Ltd. [NexGen] non-linear development, outfitting camps), and 50 m of linear human developments with medium levels of activity (i.e., cutlines/seismic lines, trail, rough road) were assigned a suitability rank of poor (Table 14B2-2).

14B3.6.2 Model Validation

Olive-sided flycatchers were observed infrequently during baseline wildlife surveys for the Project (i.e., 15 locations) and the quantity of data were not sufficient for statistical verification of the model. However, model structure and predictive outputs fit with the current state of knowledge regarding the ecology and habitat preferences of this species. To increase model confidence, review and validation of the olive-sided flycatcher model was completed by Dr. Karen Wiebe of the University of Saskatchewan (Wiebe 2021); the model was modified based on review comments. The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on olive-sided flycatcher habitat.

14B3.7 Rusty Blackbird

14B3.7.1 Habitat Requirements and Predicted Suitability

Rusty blackbirds (*Euphagus carolinus*) are mid-distance migrants that primarily winter in the swamp forests of the southeastern United States and breed throughout the North American boreal forest (Avery 2020). In Saskatchewan, rusty blackbirds are a common summer resident in bogs and fens (Smith 1996).

Breeding habitat requirements of rusty blackbird are consistent across its range in western North America (COSEWIC 2017; Avery 2020). Rusty blackbirds breed in isolated, low-elevation wetlands in coniferous and mixed forest habitats across the boreal region to the northern edge of the tundra. Various wetlands and wet forests are used, including bogs, fens, muskegs, swamps, wet meadows, wet forest openings, and floodplain forests (Greenberg and Droege 1999; COSEWIC 2017; Avery 2020). Rusty blackbirds will also use shrubby riparian areas along the edges of lakes, beaver impoundments, rivers, and other watercourses in coniferous and mixed forests as well as early successional habitats created by natural disturbances such as fire (COSEWIC 2017; Avery 2020). In one study conducted in Maine, of 43 nests recorded, all nests were within 75 m of standing water and an average of 12 m from water (Powell et al. 2010). In British Columbia, nearly all breeding sites were associated with water in coniferous habitats (Campbell et al. 2001). Open water may be important for foraging, and nests are typically built near or over water in the branches of living or dead trees or among emergent vegetation (Shaw 2006; Deming 2009; Avery 2020).

During baseline surveys for the Project, four rusty blackbirds were detected among three locations (Annex VIII.2). One location was in a mixture of young and mature upland coniferous forest within 150 m of a wetland (shrubby bog) (one observation); poor to low suitability habitats. Another location was at the intersection of mature coniferous forest and a late-stage regenerating wetland (treed bog) adjacent to Patterson Lake (two observations); low suitability habitat. The third location was in mature upland coniferous forest adjacent to Forrest Lake (one observation); poor suitability habitat. Small forest disturbances (e.g., cut blocks, fires, windthrow) near water have also been used as breeding sites (Avery 2020). Upland forested habitats not adjacent to water/wetlands are rarely used by rusty blackbirds (COSEWIC 2017; Avery 2020).

Rusty blackbirds are migratory and overwinter outside of Canada. As a result, habitat suitability for rusty blackbird was focused on defining nesting habitat during the breeding period in the RSA. The model predicted that nesting habitat suitability increases in wetlands and riparian areas containing high shrub cover and in wetlands containing open water (Table 14B3-12). Well-drained upland habitats were not considered suitable nesting habitat; however, previously burned upland habitats (young and immature forests) within 75 m of open water were assigned a suitability ranking (Table 14B3-13).

Table 14B3-12: Suitability of Landcover Types and Ecosites for Rusty Blackbird Nesting Habitat

Landcover Type	Ecosite[a]	Suitability
Shrubby (willow) wetland[b]	BP25; BS23; BP25(BU/E); BS23(BU/E); BP25(BU/L); BS23(BU/L)	High
Treed wetland[b]	BP18; BP23; BP18(BU/E); BP23(BU/E); BP18(BU/L); BP23(BU/L)	Moderate
Graminoid wetland[b]	BP26; BS24; BP26(BU/E); BS24(BU/E); BP26(BU/L); BS24(BU/L)	Low
Treed wetland[c]	BP19; BS17; BS21; BP19(BU/E); BS17(BU/E); BS21(BU/E); BP19(BU/L); BS16(BU/L); BS17(BU/L); BS21(BU/L)	
Open wetland[b]	BS25; BS25(BU/L)	
Shrubby (Labrador tea or leatherleaf) wetland[b]	BP20; BP24; BS22; BP20(BU/E); BS22(BU/E); BP20(BU/L); BP24(BU/L); BS22(BU/L)	
Recent burn wetland	Recent burn (wetland)	
Graminoid wetland[c]	BP21; BP28; BS19; BP28(BU/E); BP21(BU/L); BP28(BU/L); BS19(BU/L)	Poor
Upland forest	BP02; BP03; BP04; BP06; BP07; BP11; BP12; BP14; BP16; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13; BS14; BS15; BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E); BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	
Open wetland[c]	BP22; BP27; BS20; BS20(BU/E); BS20(BU/L)	
Recent burn upland	Recent burn (upland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Shrubby (Labrador tea) wetland[c]	BS18; BS18(BU/E); BS18(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Open water	Water	
Existing disturbance	Cutlines / seismic lines; trail; access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.
b) Average cover is greater than 5% water.
c) Average cover is less than 5% water.

Table 14B3-13: Habitat Suitability of Landcover Types and Ecosites for Rusty Blackbird within 75 m of Open Water

Landcover Type	Ecosite[a]	Suitability
Young upland forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	Moderate
Immature upland forest	BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	Low

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Literature on disturbance ZOIs for rusty blackbird is limited. However, the Saskatchewan Ministry of Environment Activity Restriction Guidelines for Sensitive Species recommend minimum setback distances from various levels of disturbance for rusty blackbird and these distances were applied as ZOI buffers in the model. The guidelines recommend a 300 m setback from high disturbance activities and 150 m from medium disturbance activities (ENV 2017). As such, suitable rusty blackbird habitats within 300 m of human developments with high levels of activity (e.g., Highway 955, airstrips) and 150 m of human developments with medium levels of activity (e.g., trails, outfitting camps) were assigned a suitability rank of poor (Table 14B2-2).

14B3.7.2 Model Validation

Rusty blackbirds were observed infrequently during baseline wildlife surveys for the Project (i.e., three locations), and the quantity of data were not sufficient for statistical verification of the model. However, model structure and predictive outputs fit with the current state of knowledge regarding the ecology and habitat preferences of this species. To increase model confidence, review and validation of the rusty blackbird model was completed by Dr. Karen Wiebe of the University of Saskatchewan (Wiebe 2021); no revisions were recommended. The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on rusty blackbird habitat.

14B3.8 Mallard

14B3.8.1 Habitat Requirements and Predicted Suitability

Mallards (*Anas platyrhynchos*) are the most abundant duck species in North America and can be found in almost any wetland or waterbody habitat varying from lakes to ephemeral wetlands (Drilling et al. 2018). Although mallards prefer shallow and calm waterbodies and will generally avoid fast-flowing, nutrient-poor waters and unvegetated areas such as rocky ground and sand dunes, the species' only requirement is a readily available food supply and small area of open water for roosting and nesting (Drilling et al. 2018). Breeding mallards in the boreal forest prefer wetlands with some open water that are more vegetated such as shorelines with emergent vegetation, bog mats, or seasonal wetlands and bogs (Merendino and Ankney 1994). While the relationship between waterbody size and waterfowl density has been largely unstudied in forested regions, upland habitat greater than 100 m from shoreline are largely unused by waterfowl species (Lemelin et al. 2010). Baseline waterfowl aerial surveys for the Project recorded 61 pairs of mallards on watercourses and waterbodies of various sizes (Annex VIII.1).

Mallards typically construct their nests over water in densely vegetated wetlands or in upland habitat close to water including marshes, bogs, shrubland, and forests with the largest proportion of upland nests being within 150 m of water (Sowls 1955; Arnold et al. 1993; Dzus and Clark 1997; Clark and Shutler 1999; Drilling et al. 2018). During the breeding season, mallards mainly eat invertebrate species such as aquatic insect larvae, worms, snails, fresh water shrimp, and native wetland plants (del Hoyo et al. 1992; Drilling et al. 2018). In Saskatchewan, habitat selection and breeding distribution is widespread and, although this species is less numerous in the boreal forest than in the parkland regions, it is still considered a common species in northern Saskatchewan (Smith 1996).

Mallards are migratory birds that overwinter outside of Canada. As a result, habitat suitability for mallard was focused on defining nesting habitat during the breeding period in the RSA. The model assumed that upland habitats greater than 150 m from open water and wetlands are not used by mallards for nesting (i.e., habitat suitability is poor). Habitat suitability rankings of landcover types and ecosites for mallard nesting on wetlands and open water in the LSA and RSA are provided in Table 14B3-14. Habitat suitability was also predicted for upland habitats within 150 m of suitable open water and wetlands containing water (Table 14B3-15).

Table 14B3-14: Suitability of Landcover Types and Ecosites for Mallard Wetland Nesting Habitat

Landcover Type	Ecosite[a]	Suitability
Graminoid wetland[b]	BP21; BP26; BP28; BS24; BP26(BU/E); BP28(BU/E); BS24(BU/E); BP21(BU/L); BP26(BU/L); BP28(BU/L); BS24(BU/L)	High
Immature or young treed wetland[b]	BP18(BU/E); BP19(BU/E); BP23(BU/E); BP18(BU/L); BP19(BU/L); BP23(BU/L); BS16(BU/L)	
Mature treed wetland[b]	BP18; BP19; BP23	
Open wetland[b]	BP22; BP27; BS25; BS25(BU/L)	
Shrubby wetland[b]	BP20; BP24; BP25; BS22; BS23; BP20(BU/E); BP25(BU/E); BS22(BU/E); BS23(BU/E); BP20(BU/L); BP24(BU/L); BP25(BU/L); BS22(BU/L); BS23(BU/L)	
Recent burn wetland	Recent burn (wetland)	Moderate
Graminoid wetland[c]	BS19; BS19(BU/L)	Low
Immature or young treed wetland[c]	BS17(BU/E); BS21(BU/E); BS17(BU/L); BS21(BU/L)	
Mature treed wetland[c]	BS17; BS21	
Open wetland[c]	BS20; BS20(BU/E); BS20(BU/L)	
Shrubby wetland[c]	BS18; BS18(BU/E); BS18(BU/L)	
Open water	Water	
Immature upland forest	BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	Poor
Young upland forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Mature upland forest	BP02; BP03; BP04; BP06; BP07; BP11; BP12; BP14; BP16; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13; BS14; BS15	
Recent burn upland	Recent burn (upland)	
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	
Unvegetated bedrock	BS02; BS02(BU/L)	
Existing disturbance	Cutlines/seismic lines; trail; access road; rough road; Highway 955; clearing; NexGen non-linear development; historical oil and gas / mineral exploration; outfitting (fishing) camp; unknown disturbance	

a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.
b) Average cover is greater than or equal to 1% water.
c) Average cover does not contain water.

Table 14B3-15: Suitability of Landcover Types and Ecosites for Mallard Upland Nesting Habitat within 150 m of Open Water and Wetlands

Landcover Type	Ecosite[(a)]	Suitability
Immature upland forest	BP02(BU/L); BP03(BU/L); BP04(BU/L); BP07(BU/L); BP11(BU/L); BP12(BU/L); BP14(BU/L); BP16(BU/L); BS03(BU/L); BS04(BU/L); BS05(BU/L); BS06(BU/L); BS07(BU/L); BS08(BU/L); BS09(BU/L); BS13(BU/L); BS14(BU/L); BS15(BU/L)	High
Young upland forest	BP02(BU/E); BP03(BU/E); BP04(BU/E); BP06(BU/E); BP07(BU/E); BP14(BU/E); BS03(BU/E); BS04(BU/E); BS05(BU/E); BS07(BU/E); BS09(BU/E); BS13(BU/E); BS14(BU/E)	
Mature upland forest	BP02; BP03; BP04; BP06; BP07; BP11; BP12; BP14; BP16; BS03; BS04; BS05; BS06; BS07; BS08; BS09; BS10; BS13; BS14; BS15	
Recent burn upland	Recent burn (upland)	Moderate
Rush sandy shore	BS26; BS26(BU/E); BS26(BU/L)	Low

Note: Wetlands with more than 1% water cover.
a) Refer to Attachment 14B-1, Table 1 for ecosite descriptions.

Literature on ZOIs for mallards is lacking and there are no federal or provincial minimum setback distance guidelines for this species. However, waterbirds have been observed to be sensitive to disturbance and react negatively to anthropogenic noise or motion (Rodgers and Burger 1981; Bélanger and Bédard 1990; Dahlgren and Korschgren 1992). Although Environment and Climate Change Canada has removed reference to the buffer sizes for particular nesting birds, waterfowl and shorebirds previously had a recommended minimum 100 m setback. As a precautionary approach to modelling the effects of anthropogenic noise on mallards, suitable nesting habitats within 100 m buffer of human developments with high levels of activity (e.g., Highway 955, access road, historical oil and gas / mineral exploration) were assigned a suitability rank of poor (Table 14B2-2).

14B3.8.2 Model Validation

Baseline waterfowl aerial surveys recorded 61 pairs of mallards on watercourses and waterbodies of various sizes, which provided support for the model, but the quantity of data was not sufficient for statistical verification. However, model structure and predictive outputs fit with the current state of knowledge regarding the ecology and habitat preferences of mallards, particularly during the nesting period, which is strongly tied to wetlands. The model provides an ecologically relevant and confident assessment of the effects of the Project and previous, existing, and other future developments on mallard breeding habitat.

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Attachment 14B-1 Ecological Land Classification Units

Rook I Project

Environmental Impact Statement

Attachment 14B-1 Ecological Land Classification Units

Submitted to:
Canadian Nuclear Safety Commission
Saskatchewan Ministry of Environment

Submitted by:
NexGen Energy Ltd.
3150-1021 W Hastings St
Vancouver, BC
V6E 0C3

November 2024

Table 1: Ecological Land Classification Units within the Local and Regional Study Areas

Ecosite Code[a] (Modifier)[b]	Description[a]
BP02	Jack pine – lichen
BP03	Jack pine / feathermoss
BP04	Jack pine - trembling aspen / feathermoss
BP06	Trembling aspen / beaked hazel / sarsaparilla
BP07	Trembling aspen - white birch / sarsaparilla
BP11	White birch - white spruce - balsam fir
BP12	Jack pine - spruce / feathermoss
BP14	Black spruce / Labrador tea / feathermoss
BP16	Balsam poplar – trembling aspen / prickly rose
BP18	Black spruce – tamarack treed swamp
BP19	Black spruce treed bog
BP20	Labrador tea shrubby bog
BP21	Graminoid bog
BP22	Open bog
BP23	Tamarack treed fen
BP24	Leatherleaf shrubby poor fen
BP25	Willow shrubby rich fen
BP26	Graminoid fen
BP27	Open fen
BP28	Seaside arrow-grass marsh
BS02	Lichen / felsenmeer - bedrock
BS03	Jack pine / blueberry / lichen
BS04	Jack pine – black spruce / feathermoss
BS05	Jack pine – white birch / feathermoss
BS06	Jack pine – trembling aspen / green alder
BS07	Black spruce / blueberry / lichen
BS08	Black spruce – white birch / lichen
BS09	Black spruce – Jack pine / feathermoss
BS10	Black spruce – white birch / feathermoss
BS13	White birch – black spruce – trembling aspen
BS14	White birch / lingonberry – Labrador tea
BS15	Trembling aspen - white birch / green alder
BS17	Black spruce treed bog
BS18	Labrador tea shrubby bog
BS19	Graminoid bog
BS20	Open bog
BS21	Tamarack treed fen
BS22	Leatherleaf shrubby poor fen
BS23	Willow shrubby rich fen
BS24	Graminoid fen
BS25	Open fen
BS26	Rush sandy shore
BP02 (BU/E)	Jack pine – lichen (Burned early stage regeneration [6-20 years])
BP03 (BU/E)	Jack pine / feathermoss (Burned early stage regeneration [6-20 years])

Table 1: Ecological Land Classification Units within the Local and Regional Study Areas

Ecosite Code[a] (Modifier)[b]	Description[a]
BP04 (BU/E)	Jack pine – trembling aspen / feathermoss (Burned early stage regeneration [6-20 years])
BP06 (BU/E)	Trembling aspen / beaked hazel / sarsaparilla (Burned early stage regeneration [6-20 years])
BP07 (BU/E)	Trembling aspen – white birch / sarsaparilla (Burned early stage regeneration [6-20 years])
BP14 (BU/E)	Black spruce / Labrador tea / feathermoss (Burned early stage regeneration [6-20 years])
BP18 (BU/E)	Black spruce – tamarack treed swamp (Burned early stage regeneration [6-20 years])
BP19 (BU/E)	Black spruce treed bog (Burned early stage regeneration [6-20 years])
BP20 (BU/E)	Labrador tea shrubby bog (Burned early stage regeneration [6-20 years])
BP23 (BU/E)	Tamarack treed fen (Burned early stage regeneration [6-20 years])
BP25 (BU/E)	Willow shrubby rich fen (Burned early stage regeneration [6-20 years])
BP26 (BU/E)	Graminoid fen (Burned early stage regeneration [6-20 years])
BP28 (BU/E)	Seaside arrow-grass marsh (Burned early stage regeneration [6-20 years])
BS03 (BU/E)	Jack pine / blueberry / lichen (Burned early stage regeneration [6-20 years])
BS04 (BU/E)	Jack pine – black spruce / feathermoss (Burned early stage regeneration [6-20 years])
BS05 (BU/E)	Jack pine – white birch / feathermoss (Burned early stage regeneration [6-20 years])
BS07 (BU/E)	Black spruce / blueberry / lichen (Burned early stage regeneration [6-20 years])
BS09 (BU/E)	Black spruce – Jack pine / feathermoss (Burned early stage regeneration [6-20 years])
BS13 (BU/E)	White birch – black spruce – trembling aspen (Burned early stage regeneration [6-20 years])
BS14 (BU/E)	White birch / lingonberry – Labrador tea (Burned early stage regeneration [6-20 years])
BS17 (BU/E)	Black spruce treed bog (Burned early stage regeneration [6-20 years])
BS18 (BU/E)	Labrador tea shrubby bog (Burned early stage regeneration [6-20 years])
BS20 (BU/E)	Open bog (Burned early stage regeneration [6-20 years])
BS21 (BU/E)	Tamarack treed fen (Burned early stage regeneration [6-20 years])
BS22 (BU/E)	Leatherleaf shrubby poor fen (Burned early stage regeneration [6-20 years])
BS23 (BU/E)	Willow shrubby rich fen (Burned early stage regeneration [6-20 years])
BS24 (BU/E)	Graminoid fen (Burned early stage regeneration [6-20 years])
BS26(BU/E)	Rush sandy shore (Burned early stage regeneration [6-20 years])
BP02 (BU/L)	Jack pine – lichen (Burned late stage regeneration [21-40 years])
BP03 (BU/L)	Jack pine / feathermoss (Burned late stage regeneration [21-40 years])
BP04 (BU/L)	Jack pine – trembling aspen / feathermoss (Burned late stage regeneration [21-40 years])
BP07 (BU/L)	Trembling aspen – white birch / sarsaparilla (Burned late stage regeneration [21-40 years])
BP11 (BU/L)	White birch – white spruce – balsam fir (Burned late stage regeneration [21-40 years])
BP12 (BU/L)	Jack pine – spruce / feathermoss (Burned late stage regeneration [21-40 years])
BP14 (BU/L)	Black spruce / Labrador tea / feathermoss (Burned late stage regeneration [21-40 years])
BP16 (BU/L)	Balsam poplar – trembling aspen / prickly rose (Burned late stage regeneration [21-40 years])
BP18 (BU/L)	Black spruce – tamarack treed swamp (Burned late stage regeneration [21-40 years])
BP19 (BU/L)	Black spruce treed bog (Burned late stage regeneration [21-40 years])
BP20 (BU/L)	Labrador tea shrubby bog (Burned late stage regeneration [21-40 years])
BP21 (BU/L)	Graminoid bog (Burned late stage regeneration [21-40 years])
BP23 (BU/L)	Tamarack treed fen (Burned late stage regeneration [21-40 years])
BP24 (BU/L)	Leatherleaf shrubby poor fen (Burned late stage regeneration [21-40 years])
BP25 (BU/L)	Willow shrubby rich fen (Burned late stage regeneration [21-40 years])
BP26 (BU/L)	Graminoid fen (Burned late stage regeneration [21-40 years])
BP28 (BU/L)	Seaside arrow-grass marsh (Burned late stage regeneration [21-40 years])
BS02 (BU/L)	Lichen / felsenmeer – bedrock (Burned late stage regeneration [21-40 years])

Table 1: Ecological Land Classification Units within the Local and Regional Study Areas

Ecosite Code[(a)] (Modifier)[(b)]	Description[(a)]
BS03 (BU/L)	Jack pine / blueberry / lichen (Burned late stage regeneration [21-40 years])
BS04 (BU/L)	Jack pine – black spruce / feathermoss (Burned late stage regeneration [21-40 years])
BS05 (BU/L)	Jack pine – white birch / feathermoss (Burned late stage regeneration [21-40 years])
BS06 (BU/L)	Jack pine – trembling aspen / green alder (Burned late stage regeneration [21-40 years])
BS07 (BU/L)	Black spruce / blueberry / lichen (Burned late stage regeneration [21-40 years])
BS08 (BU/L)	Black spruce – white birch / lichen (Burned late stage regeneration [21-40 years])
BS09 (BU/L)	Black spruce – Jack pine / feathermoss (Burned late stage regeneration [21-40 years])
BS13 (BU/L)	White birch – black spruce – trembling aspen (Burned late stage regeneration [21-40 years])
BS14 (BU/L)	White birch / lingonberry – Labrador tea (Burned late stage regeneration [21-40 years])
BS15 (BU/L)	Trembling aspen – white birch / green alder (Burned late stage regeneration [21-40 years])
BS16 (BU/L)	Black spruce / balsam poplar / river alder swamp (Burned late stage regeneration [21-40 years])
BS17 (BU/L)	Black spruce treed bog (Burned late stage regeneration [21-40 years])
BS18 (BU/L)	Labrador tea shrubby bog (Burned late stage regeneration [21-40 years])
BS19 (BU/L)	Graminoid bog (Burned late stage regeneration [21-40 years])
BS20 (BU/L)	Open bog (Burned late stage regeneration [21-40 years])
BS21 (BU/L)	Tamarack treed fen (Burned late stage regeneration [21-40 years])
BS22 (BU/L)	Leatherleaf shrubby poor fen (Burned late stage regeneration [21-40 years])
BS23 (BU/L)	Willow shrubby rich fen (Burned late stage regeneration [21-40 years])
BS24 (BU/L)	Graminoid fen (Burned late stage regeneration [21-40 years])
BS25 (BU/L)	Open fen (Burned late stage regeneration [21-40 years])
BS26 (BU/L)	Rush sandy shore (Burned late stage regeneration [21-40 years])
Recent burn (upland)	Upland (Recent burn [0-5 years])
Recent burn (wetland)	Wetland (Recent burn [0-5 years])
Water	Water

a) All Boreal Plain (BP) and Boreal Shield (BS) ecosite codes and descriptions from McLaughlan et al. (2010).
b) BU/E and BU/L modifiers represent early-stage burn (6 to 20 years) and late-stage burn (21 to 40 years) habitat, respectively.

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