Potential Habitat for Avian SAR

Canada Warbler (*Wilsonia canadensis*) is listed as threatened (SARA), special concern (COSEWIC), endangered (NSESA) and ranked by the AC CDC as S3B for vulnerable in Nova Scotia for the breeding population. Canada Warblers typically breed throughout Maritimes and southeastern Canada. This species prefers wet mixed forests with well-developed shrub layers, as well as regenerating areas. Canada Warblers were detected within the Project site and suitable nesting habitat does exist within the PDA. Most observations of Canada Warblers were reported during the spring and summer.

Bobolink (*Dolichonyx oryzivorus*) is listed as threatened (SARA and COSEWIC), vulnerable (NSESA) and ranked by the AC CDC within Nova Scotia as S3S4B for apparently secure to vulnerable for the breeding population. Bobolinks typically occur in grassland habitats. This species was detected within 10 km of the Project site according to AC CDC records; however no observances were reported during the 2021 surveys. Suitable habitat for Bobolink was limited and they are not expected to occur frequently within the LAA.

Chimney Swift (*Chaetura pelagica*) is listed as threatened (SARA and COSEWIC), endangered (NSESA), and ranked by the AC CDC within Nova Scotia as S2S3B for vulnerable to imperiled for the breeding population and S1M as critically imperiled for the migratory population. Chimney Swifts are aerial foragers and tend to concentrated near water where insects are abundant (ECCC 2022c). Historically, the Chimney Swift used mainly large hollow trees for nesting sites but have adopted chimneys as preferred nesting sites. They are generally associated with urban and rural areas where chimneys are available for nesting and roosting. Chimney Swifts are aerial foragers and tend to concentrate near water where insects are abundant. Chimney Swifts were detected within the Project site, however suitable nesting habitat was not observed In the Study Area.

Common Nighthawk (*Chordeiles minor*) is listed as Threatened (SARA and NSESA), Special Concern (COSEWIC) and ranked by the AC CDC as S3B for vulnerable in Nova Scotia for the breeding population. They typically nest on the ground in open or sparsely vegetated habitats. This species was detected within the Project site and suitable nesting habitat does exist. Almost all detections of this species occurred during the Breeding Bird Survey Programs.

Eastern Wood-Pewee (*Contopus virens*) is listed as Special Concern (COSEWIC/SARA) and Vulnerable (NSESA) and ranked by the AC CDC as S3S4B for vulnerable to apparently secure in Nova Scotia for the breeding population. Eastern Wood-pewee breed throughout Nova Scotia during the summer months before migrating to northern South America for wintering. This species breeds in open woodland of all types in Nova Scotia, but shows a preference for forests with a dominance of deciduous trees. The Eastern wood-pewee forages on flying insects in the middle canopy. Between both years, this species was detected once within the Project site, during the spring, and is likely to use the site for foraging and nesting purposes.

Evening Grosbeak (*Coccothraustes vespertinus*) is listed as Special Concern (SARA and COSEWIC), Vulnerable (NSESA) and ranked by the AC CDC as S3B/N/M in Nova Scotia for vulnerable for the breeding, non-breeding, and migratory populations. Evening grosbeaks

4.2.8 Forest Connectivity and Associated Measurements

Cunningham et al. (2020) assessed forest connectivity in Nova Scotia using the Patch Analyst extension for ArcGIS and circuit theory, with results being divided by ecodistricts. While ecodistricts encompass a broader area than the PDA, they provide a good overview of the landscape status around the Project. The following three parameters from the study by Cunningham et al. (2020) are discussed in this section:

- Median patch size: Indicates the middle patch size. If patches are larger, there tends to be more connectivity and vice versa.
- Edge density: Measures the length of a patch edge over a particular area (m/ha). The more edges in an area, the more fragmented a landscape is.
- Effective mesh size: Measures connectivity within patches based on the probability that two random chosen points will fall within the same patch. The higher the value, the more interconnected a patch is.

Cunningham et al. (2020) assessed connectivity under different scenarios of road influence by using various Road Effect Zones. The Road Effect Zone is the effects of roads and linear infrastructure on ecosystems (Road Ecology Center 2022). The Project's analysis used the results from the 1 km buffer around roads, as on average, forests in the province are 1.8 km away from a road (Cunningham et al. 2020). A larger buffer would provide highly restrictive results in the context of Nova Scotia, given that 90% of the province is within 5 km of a road. When using a 5 km buffer province-wide, Cunningham et al. (2020) found that only 8.6% of Nova Scotia was unaffected.

Patch Analysis results from the ecodistrict where the Project is located (i.e., South Mountain) and the adjacent ecodistrict (i.e., LaHave Drumlins) are included in **Table 43.** The median patch sizes for South Mountain and LaHave Drumlins are far less than the median for the province, with the LaHave Drumlins being the second lowest of all ecodistricts. The patches around the Project are therefore relatively small compared to the rest of the province, suggesting they are already heavily fragmented ecodistricts with little connectivity. South Mountain has one of the highest edge densities of any ecodistrict and the LaHave Drumlins is also well above the provincial median. These results further support the conclusion that the landscape is already heavily fragmented by resource roads and the transmission line and would therefore not be significantly impacted by the Project.

In terms of interpatch connectivity, the effective mesh sizes are highly variable across Nova Scotia and it is therefore challenging to make meaningful comparisons. It is notable that the South Mountain ecodistrict is much great than the median, but is not considered an outlier. The large effective mesh size suggests that the patches within this ecodistrict are more interconnected.

Table 43: Patch Analysis Results for Ecodistricts of to the Project

Ecodistrict	Median patch size (ha)	Edge density (m/ha)	Effective mesh size (km^2)
South Mountain (720)	0.60	3.54	114.94

Ecodistrict	Median patch size (ha)	Edge density (m/ha)	Effective mesh size (km²)
LaHave Drumlins (740)	0.36	1.05	18.17
Median for all ecodistricts in province (n=38)	2.36	0.70	10

Cunningham et al. (2020) also used electric current theory to identify areas where connectivity is restricted and to model potential wildlife movement within the province. Circuitscape is a software that can be used to predict patterns of connectivity and key pinch points across heterogeneous landscapes. Areas in the landscape were assigned different resistance values depending on their current state. Forested areas were assigned low resistance (i.e., movement is easier) and non-forested areas had a higher resistance (i.e., movement is harder). Results are represented in the following colour scheme:

- White: areas with no flow, indicating no connectivity;
- Blue: areas with connectivity, a darker color indicates more movement;
- Red: areas where connectivity gets more constricted; and
- Yellow: the most constricted areas, also referred to as pinch points.

In terms of conservation, preserving pinch points is the most crucial and reactive approach, as they represent the last areas of flow within already disturbed areas. A more protective approach is to conserve areas that still have more connectivity (in dark blue).

Circuitscape results from Cunningham et al. (2020) were used as a basis to assess forest connectivity in the region surrounding the Project. The PDA is mostly located in areas with a mix of connectivity. Areas within the 1 km buffer from roads and highways outside the Project, primarily access roads, have no connectivity. One pinch point was identified within the Project area (**Figure 25**). However, it is comparatively very small and over 600 m from the PDA, and would therefore not be impacted by the Project. In general, the PDA is spread over a mixture of areas with little to no connectivity (white and light blue areas).

There are groupings of pinch points surrounding the Project site in each cardinal direction, including a very large pinch point north of the Project. However, each of these areas are all over 4 km from the PDA and would not likely be impacted by the Project. These larger pinch points are crucial for conservation as whole landscapes would be disconnected if they were impacted. Through careful design and planning, these sensitive areas were avoided when siting the Project.

There is a series of pinch points south of the Project surrounding the existing transmission line between the Project and the Portapique River Wilderness Area. The Project will not interact with this zone, as it will be connecting to the transmission line through an area showing no flow. Of note, all of the pinch points previously mentioned are considerably small when looking at the whole region. The largest pinch point in the Project is 200 m wide, while the most significant pinch points in the region are between 2 and 5 km wide (**Figure 26**).

Proposed Benjamins Mill Wind Project
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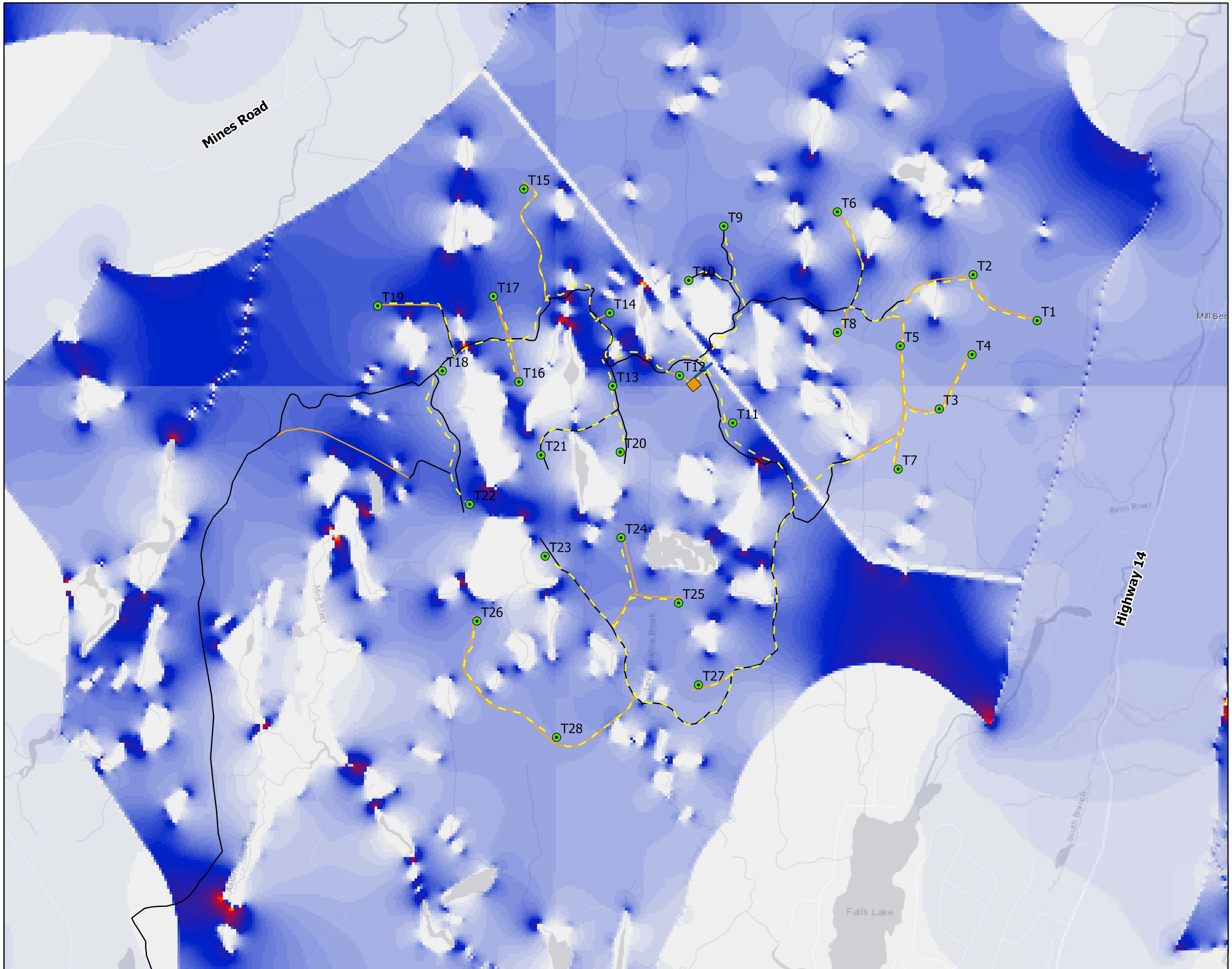
Figure 25
Circuitscape Analysis within the Project Area



Legend

- Proposed Turbine Locations
- Proposed Substation
- New Collector Lines
- Transmission Interconnection
- Existing Access Road
- Proposed New Road

Circuitscape Analysis

- High Connectivity
- Low Connectivity

Notes

Turbine markers are not to scale

Sources

- Basedata provided by the Province of Nova Scotia
- Basemap: ESRI World Topo Map

N

Kilometers

0 0.25 0.5 1

Scale: 1:35,000

Spatial Reference: NAD 1983 UTM Zone 20N

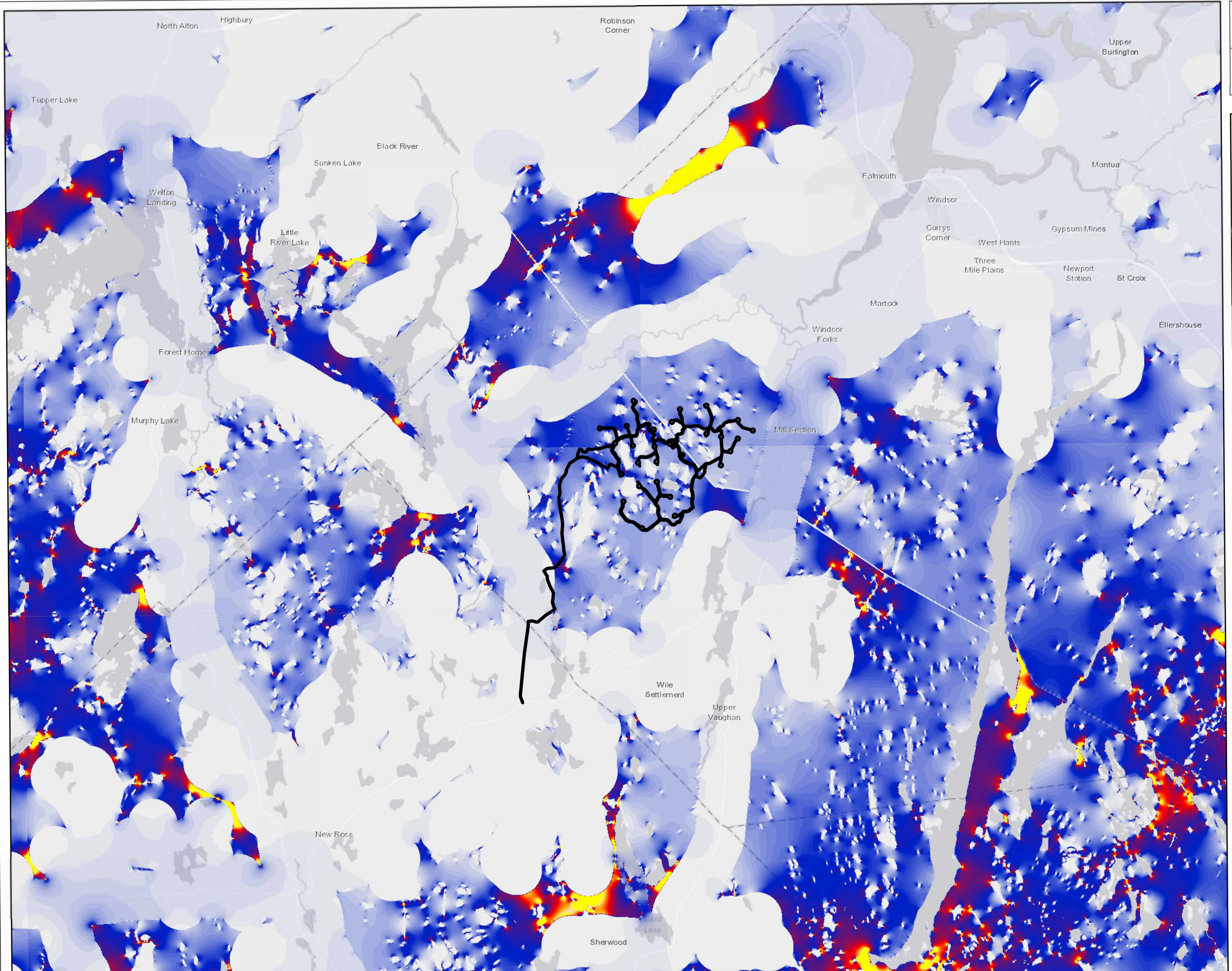
Page Size: 11" x 17"

Production Date: Dec 13, 2022

Natural Forces

Proposed Benjamins Mill Wind Project Addendum

Figure 26
Circuitscape Analysis within the Region



Legend

Project PDA

Circuitscape Analysis

High Connectivity

Low Connectivity

Notes

Sources
- Basedata provided by the Province of Nova Scotia
- Basemap: ESRI World Topo Map

N

Kilometers

0 1.25 2.5 5

Scale: 1:150,000

Spatial Reference: NAD 1983 UTM Zone 20N

Page Size: 11" x 17"

Production Date: Dec 13, 2022

Natural Forces

4.2.9 Analysis of Project Footprint

The Project will interact with the landscape to different extents depending on the Project phase. A larger Project footprint is expected during construction and decommissioning; however, these phases are short-term and reversible. The footprint of the 28-turbine layout for the Project is estimated to cover approximately 182 ha* during the construction phase. Once the Project is constructed, all temporary works will be removed and the lands specifically for construction activities will be restored, which will reduce the Project footprint to approximately 121 ha* for the operational life of the Project. These estimates are based on the full 28 turbine layout and are not inclusive of the area of the currently existing roads. **Table 2** is a summary of the Project footprint estimates by phase. **Table 44** is a summary of the Project footprint estimates by phase.

TABLE 44: PROJECT FOOTPRINT ACROSS PROJECT STAGES

Infrastructure	Construction Footprint (ha)*	Operational Footprint (ha)*	Infrastructure Length (km)
New roads without collector lines (12 m)	5.4	2.0	1.8
Existing roads without collector lines (6 m)	24.3	8.1	13.5
New roads with collector lines (12 m)	56.8	35.5	14.2
Existing roads with collector lines (12 m)	65.1	45.2	18.1
Turbine foundations	28.0	28.0	-
Substation	1.0	1.0	-
Collector Line (not along roads)	0.93	0.93	0.47
Transmission Line and cleared right of way	0.37	0.19	0.12
Total	**181.9**	**120.7**	

Notes:
*These calculations are a conservative estimate accounting for maximum possible clearing width required during construction, necessary ditching and clearing for danger trees during operations.

Potential effects of the Project to landscape-scale ecological connectivity were identified at the main access road. This road crosses through potential habitats for wildlife. The road's presence may act as a barrier to movement, as it is possible that wildlife would either be less likely to cross the road or be more vulnerable when doing so. However, this is an already existing road that the Project will be upgrading for construction. Therefore, there is already an impact on the connectivity of the landscape by the road. Revegetation and natural processes following construction will allow the road to return to its current state, making the additional impact temporary (road width during construction is approximately 30 m, going down to 12 m during operation).

The footprint does serve to fragment some other, smaller areas (eg., the area between T8 and T11). However, most of these areas are primarily harvested, and would therefore not be desirable or suitable habitat for wildlife. No potential significant corridors between important habitats were identified within or around the Project site. The only potential corridor identified is the movement from the Wolfville Watershed Nature Reserve to the South Panuke Wilderness Area. It would be unlikely for terrestrial wildlife to use this path however, because it is a long route across a great deal of highly disturbed areas.

Species sensitivity is also a factor that should be taken into account. It is found that species with an interpatch dispersal distance threshold of 50 to 100 m are less likely to be affected by agricultural fragmentation in an area (Tiang et al. 2021). Scattered trees on an area classified as converted could still influence connectivity in a landscape. Scattered trees and small patches in a disturbed site can provide momentary shelter to species while searching for habitat (Conradt et al. 2001). Fine-scale features within a converted site have proven to be important elements to include when looking at ecological connectivity, as they showed several other potential paths and reflected movement patterns typically observed in field studies (Tiang et al. 2021).

4.2.10 Road Density

Existing road density and the expected increase from the Project was calculated in order to determine if the potential impact on connectivity would be substantive. A road density value of 0.6 km/km^2 has been identified as the threshold value above where certain large species populations start to decline (Beazley et al. 2004). As many areas of the province already exceed that threshold, the Proponent aimed to site the Project in a location with higher road density so as to not add road stress to other less disturbed areas, while aiming to not substantially increase the existing road density.

A cross-province assessment area was selected for road density to explore landscape effects of the Project (**Figure 27**). Among other factors, the spatial boundaries took into consideration the large home range required by moose, which is estimated to be 30-55 km^2 (Snaith and Beazley 2004) and that moose, depending on the season, age, and sex, travel an average of 0.5 km to 1.4 km daily (AAM 2022). As such, the assessment area for road density was determined to be a 30 km-radius buffer around the PDA.

To calculate road density within the region, various sources for linear infrastructure data in the province were selected (i.e., Nova Scotia Road Network and Nova Scotia Topographic Database - Utilities). The total linear infrastructure was divided by the assessment area (a 30 km-radius buffer around the PDA) to determine the current road density (**Table 45**). The total Project infrastructure was then added to the current linear infrastructure to determine if the Project would have any substantive impacts on road density in the region. It is relevant to note that the Nova Scotia Road Network does not include all existing resource roads, particularly forestry roads. The Project has been sited on existing resource roads as much as feasible to minimize further landscape fragmentation.

Table 45: Current and Expected Road Density within the Region

Current road density	
Gridlines within assessment area	557.83 km
Roads within assessment area	2376.76 km

Total linear infrastructure	2934.59 km
Assessment area	3876.61 km^2
Current road density	**0.76 km/km^2**
Road density with Project infrastructure	
Collector and Interconnection	0.21 km
New roads	15.56 km
Existing roads	33.92 km
Total roads	49.48 km
Project infrastructure total	49.48 km
Estimated road density with Project	**0.77 km/km^2**

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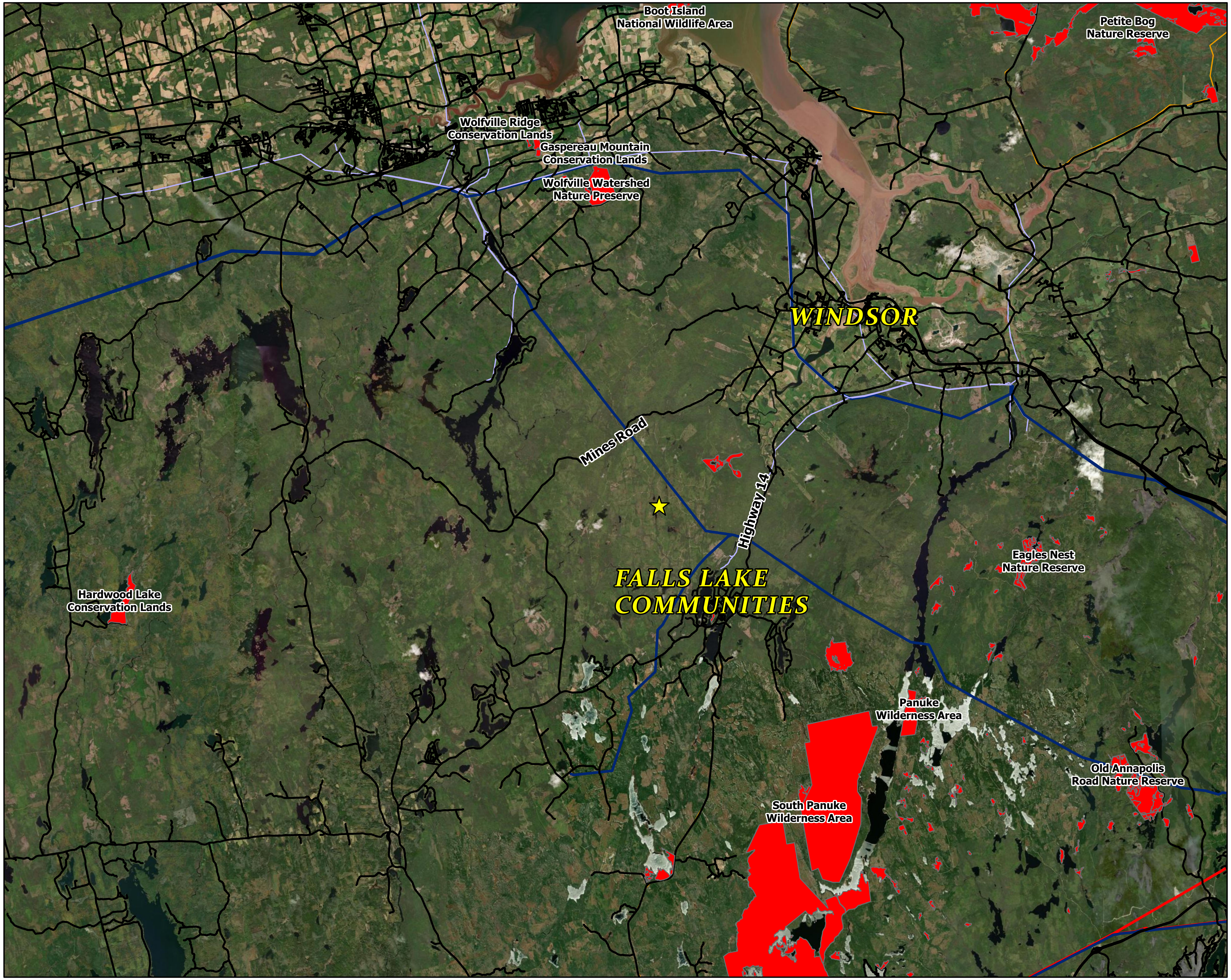
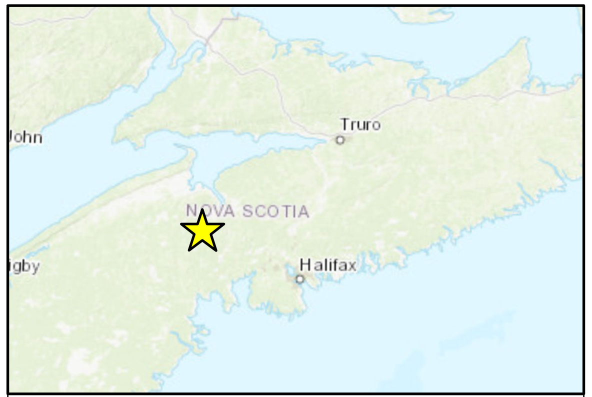
Figure 27
Nova Scotia Road Network and Power Grid





Legend

- Project Location
- Protected Areas and Old Growth Forest
- Nova Scotia Road Network

Nova Scotia Power Grid

- 138 kV
- 230 kV
- 345 kV
- 69 kV
- Dx

Notes

Sources
- Basedata provided by the Province of Nova Scotia
- Basemap: ESRI World Topo Map

N

Kilometers
0 1.75 3.5 7

Scale: 1:200,000

Spatial Reference: NAD 1983 UTM Zone 20N

Page Size: 11" x 17"

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Natural Forces

The existing road density in the assessment area already exceeds the 0.6 km/km^2 threshold (0.665). Most of the infrastructure in the area is existing highways and roads, with 23% of the linear infrastructure being existing gridlines. The total Project infrastructure for 28 turbines is approximately 49 km, including collector lines, interconnection, existing roads with upgrades, and new roads. The addition of the Project represents a 1% increase in the linear infrastructure of the region. This is further reflected in the road density, which would only increase 0.01 km/km^2 with the Project.

4.3 Potential Interactions and Mitigation

Approximately 34% of the PDA is located within areas that have been previously disturbed by forestry, agriculture, recreational trails, and access roads. Habitat fragmentation has been minimized during the planning phase and Project siting. To understand and mitigate the environmental effects of the Project, a variety of studies have been conducted that included two years of field work and analysis. These studies ensure a thorough understanding of the ecological conditions within the area of the Project and allow the Proponent to minimize the impact to local habitats, which influences the availability of connectivity within the landscape.

4.3.1 Potential Environmental Effects

Without mitigation, the potential environmental effects of the Project to biodiversity values and ecological connectivity include the following:

- Loss and fragmentation of potential habitat and corridors during construction and decommissioning due to linear infrastructure, crane pads, and construction disturbance, deterring wildlife.
- Loss and fragmentation of potential habitat and corridors during operation due to linear infrastructure and operation disturbance, deterring wildlife.

4.3.2 Mitigation

To further reduce the likelihood of interactions between any phase of the Project and ecological connectivity, the mitigation measures, summarized below in **Table 46** will be followed.

Table 46: Potential Interactions and Proposed Mitigation for Ecological Connectivity

Potential Interactions with Ecological Connectivity	Proposed Mitigation Measures
Short-term, reversible loss and fragmentation of potential habitat during <u>construction</u> and <u>decommissioning</u> due to linear infrastructure, crane pads and construction disturbance, deterring	1) The Project has been sited in an area with previous anthropogenic activities to minimize impacts to non disturbed areas. 2) The Project has been sited in an area with high road density and adjacent to existing roads to minimize fragmentation and the creation of new roads. 3) The area to be disturbed by the Project will be minimized to the extent possible (i.e., limited to the area that is

Potential Interactions with Ecological Connectivity	Proposed Mitigation Measures
wildlife. Long-term, reversible loss and fragmentation of potential habitat during operation due to linear infrastructure and operation disturbance, deterring wildlife.	required to accomplish the Project objectives only); 4) Existing roads and trails will be utilized to reduce road density, limit disturbance outside the Project footprint, and minimize the interactions with wildlife and wildlife habitat. 5) Road and access points will be laid out in a manner to minimize fragmentation of habitat and/or isolation of habitat where feasible. 6) Natural forest patches will be retained and restored where possible to maintain habitat. 7) Control measures to manage and prevent the spread of invasive plant species will be applied to each phase of the Project. 8) Erosion and sediment control measures will be installed and checked regularly during the construction phase and prior to, and after, storm events to confirm they are continuing to operate properly to minimize potential effects to adjacent habitat. 9) Should fencing be required, it will be built in such a way that it would not cut off access to viable habitat for wildlife. 10) Following the construction and decommissioning phases of the Project, natural revegetation of the site will be promoted. 11) Decommissioning/reclamation activities following the Project will be undertaken to improve interconnections between landscapes in the Project. 12) To minimize disruptions of fauna activity at night, Project construction activities will be limited to daylight hours when feasible. 13) To minimize disruptions of fauna activity at night, Project construction activities will be limited to daylight hours when feasible.

4.3.3 Residual Environmental Effects

In consideration of the above including proposed mitigation to avoid or minimize environmental effects, the residual environmental effects of the Project on ecological connectivity during all phases of the Project are rated not significant. The effects of the Project activities on ecological connectivity are expected to be limited to the PDA, as required to meet Project objectives during the construction, operation, and decommissioning phases.

The Project is to be constructed within existing anthropologically disturbed areas where possible, which reduces effects to wildlife habitat, and their ability to traverse between habitats. Disturbance of mature forest habitat as a result of this Project will be minimized through site selection and by employing the proposed mitigation measures.

Noise associated with the construction phase of the Project may deter some species, but the potential effects are considered to be short term and reversible. With the proposed mitigation, the residual interactions of the Project with habitat are not anticipated to be substantive as they are occurring already in highly fragmented habitat with ongoing forestry, agriculture, and recreation activities.

Further fragmentation of habitat, which is presently fragmented by forestry activities, agricultural operations and access roads, as well as snowmobile and all-terrain vehicles (ATV) trails, is minimized through careful site selection and the re-purposing of existing roads and trails. Following the construction and decommissioning phases of the Project, natural revegetation of the site will be promoted. Roads will be decommissioned following the life of the Project, if possible, to reconnect landscapes and improve habitat connectivity.

The broader threat of climate change will have many negative impacts overall ecological function. Although the Project may not necessarily have measurable climate effects with local impacts on an ecological level, the societal transition to renewable energy is a positive action which may support long term population growth through a reduction in climate change.

It is worth noting that a regional approach to minimizing habitat fragmentation is needed to achieve net neutral or net positive impacts. While the Proponent commits to implementing mitigation measures to minimize habitat fragmentation to the extent possible, other activities outside of the PDA may modify the landscape status. Other new and existing projects in the region should also implement measures to promote ecological connectivity and preserve biodiversity values across the region.

5 Physical Environment

5.1 Geology

This section serves to fulfill the following request from the Minister's AIR:

1. *In consultation with Natural Resources and Renewables (NRR) Geological Survey Division Mineral and Management Division, provide a comprehensive review and presentation of all historical geoscience data for the project footprint. This includes but is not limited to:*
    a. *Detailed geological map(s) of the development footprint and project area.*
    b. *Uranium distribution map layer(s) based on geological, geophysical and geochemical data.*
    c. *A technical summary that:*
        i. *Identifies and describes known occurrences of uranium;*
        ii. *Describes geological controls related to primary occurrences, and potential secondary distribution of uranium;*
        iii. *Identifies and describes common benchmark standards for naturally occurring uranium mineralization and human health and safety considerations; and*
        iv. *Identifies and describes the local health and safety risk to known and potential occurrences of uranium mineralization.*
    d. *Provide an avoidance and mitigation plan which includes:*
        i. *A general exposure assessment related to geoscience site characterization.*
        ii. *An exposure assessment for planned activities including infrastructure development and all primary or secondary ground disturbance activities.*

Scope of VEC

The geological environment has been identified as a VEC because its relationship with other biological and physical components addressed as VECs, as well as the potential interactions with the Project during all phases of the Project. Specifically, a review of uranium distribution throughout the local area was assessed. As such, in order to reach a comprehensive understanding of the geological, geophysical and geochemical conditions, as well as the potential interactions with the Project, the following studies were conducted in consultation with NSDNRR Geological Survey Division:

- A preliminary desktop review of geological data focusing on historical geoscience;
- An interpreted Uranium distribution analysis;
- A review of drill core and soil samples from a geotechnical investigation program;
- A series of site visits to measure radiation in the Project site;
- The identification of benchmarks standards for human health with respect to uranium;
- The identification of local health and safety risks from uranium; and
- An avoidance and mitigation plan for uranium in the Project site.

The data compilation area of study covered a 10.5 x 11 km area extending over the PDA. The LAA for geology was defined as a 1 km radius around the PDA, as potable water screenings for industrial activities are generally conducted for potable wells within 1 km of a site, as typically provided in an industrial approval. More detailed methodology is described in **Appendices K** and **L**.

5.1.1 Surficial Geology

The Project is located in the South Mountain Betholith, an expansive intrusive complex comprised predominantly of granodioritic to granitic lithologies. Surficial geology in the South Mountain ecodistrict is dominated by a thin stony till cover with bedrock very close and often exposed at the surface (Nova Scotia DNR 2015). Almost the entire ecodistrict is characterized by Gibraltar/Bayswater soils which are derived from the parent material and are typically shallow and acidic. These soils are often well-drained, coarse sandy loams. Surface stoniness in these soils is usually high and sometimes excessive. The landscape is often dotted with large, granite boulders which can restrict forest operations and travel.

The surficial geology of the Project area generally consists mostly of a thin and discontinuous till veneer dominated by granitic bedrock of various types and ages that occurs across glacially scoured basins and knobs (Stea, Conley and Brown, 1992). South of the Project area, there is a stony till plain with a stony, sandy matrix with material (i.e., pebbles and boulders) derived from local bedrock sources. Shallow till thicknesses, predominance of boulder till and glacial striations on bedrock surfaces were verified at numerous locations during the Mercator site visits.

5.1.2 Bedrock and Mineralization

The bedrock geology of the Project area consists of three intrusive phases of the SMB. These phases consist of granodiorite of the New Ross Pluton, the Salmontail Lake Monzogranite (SLM) and a single small zone of mafic porphyry. Most bedrock uranium occurrences in the area, including the Millet Brook Deposit occur along the geological contact between the SLM and the New Ross Pluton units in the south-central portion of the Project area. Mineralization occurs in both major intrusive units, but the deposit is hosted primarily by altered, sheared and fractured granodiorite of the New Ross Pluton.

The Millet Brook Deposit consists of mineralized veins in steeply-dipping, northeast-trending, en-echelon fracture zones (**Figure 28** and **Figure 29**). Although the main mineralized zones that define the deposit occur south of the Project area, there are several lesser mineralized zones and exploration work areas (i.e., exploration drill core shed facility) located within the Project area that have associated historical exploration datasets (**Figure 28**). Pitchblende is the dominant uranium-bearing mineral in drilling-defined mineralized zones below 50 m depth, whereas the U-phosphate minerals torbernite and autunite are dominant above that depth. This zonation is attributed to surface weathering processes.

5.1.2.1 Interpreted Uranium Distribution Layer

Approach and Methodology

Mercator conducted a thorough compilation of geoscience data was using data from government assessment reports, government and industry technical reports, digital government data, published maps, soil sample survey data, water sample survey data, ground geophysical survey data and airborne geophysical data. The data compilation covered a 10.5 x 11 km area extending over the PDA and includes the area of the well documented Millet Brook Deposit. The historical data compilations and LiDAR interpretation are shown on **Figure 28** and **Figure 29.** Detailed methodologies of data compilation and analysis are described in **Appendix L**.

A uranium distribution layer was then developed for the Project through the integration of historical and modern geoscience data. Geological, geochemical, and geophysical data sets were considered for this interpreted layer, but emphasis was placed on geological and geochemical data (i.e., samples with assay or scintillometer data) to develop an interpretation of areas in which uranium mineralization was either historically documented or considered to have a high probability of occurring. The uranium distribution interpretation completed for the PDA is found in **Figure 28** and **Figure 29.**

The following data sets were considered for the interpreted uranium distribution layer and are listed in sequence below from highest weighting (top) to lowest weighting (bottom).

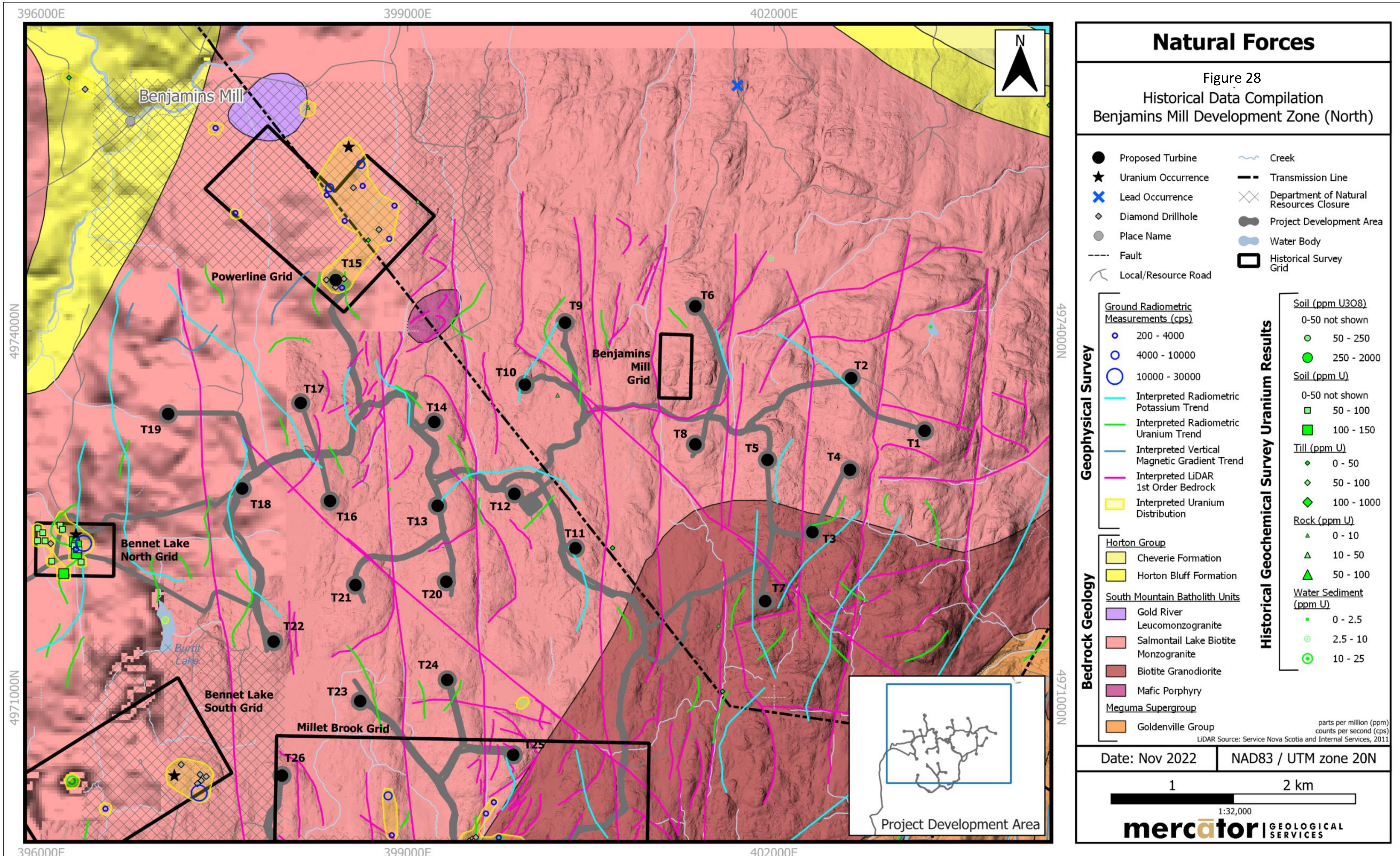
- Documented uranium deposits (i.e., Millet Brook Deposit).
- Documented uranium occurrences (from government databases and historical reports).
- Historical drill holes within and adjacent to the PDA containing uranium mineralization or elevated radiometric readings observed from the core logging process.
- Ground radiometric anomalies (those above 180 counts per second (cps) that are often indicative of bedrock uranium mineralization or of bedrock alteration in close proximity to a uranium mineralization system. For reference, the surface area over the C2 Zone at the Millet Brook Deposit generally has a radiation level between 3,000 to 5,000 counts per second as measured on a scintillation counter, with sporadic patches up to 26,500 cps (O'Reilly and Mills, 2009).
- Geochemical data (i.e., rock, soil, till, lake sediment data) containing above detection limit concentrations of uranium (U or ^{U308}). Trends were interpreted within soil datasets that displayed greater than 50 ppm U or U_3O_8. (50 ppm U equals approximately 60 ppm U_3O_8)
- Geophysical (magnetic, electromagnetic, radiometric) trends and directions.
- LIDAR interpretation for bedrock lineament structures and directions.

Results

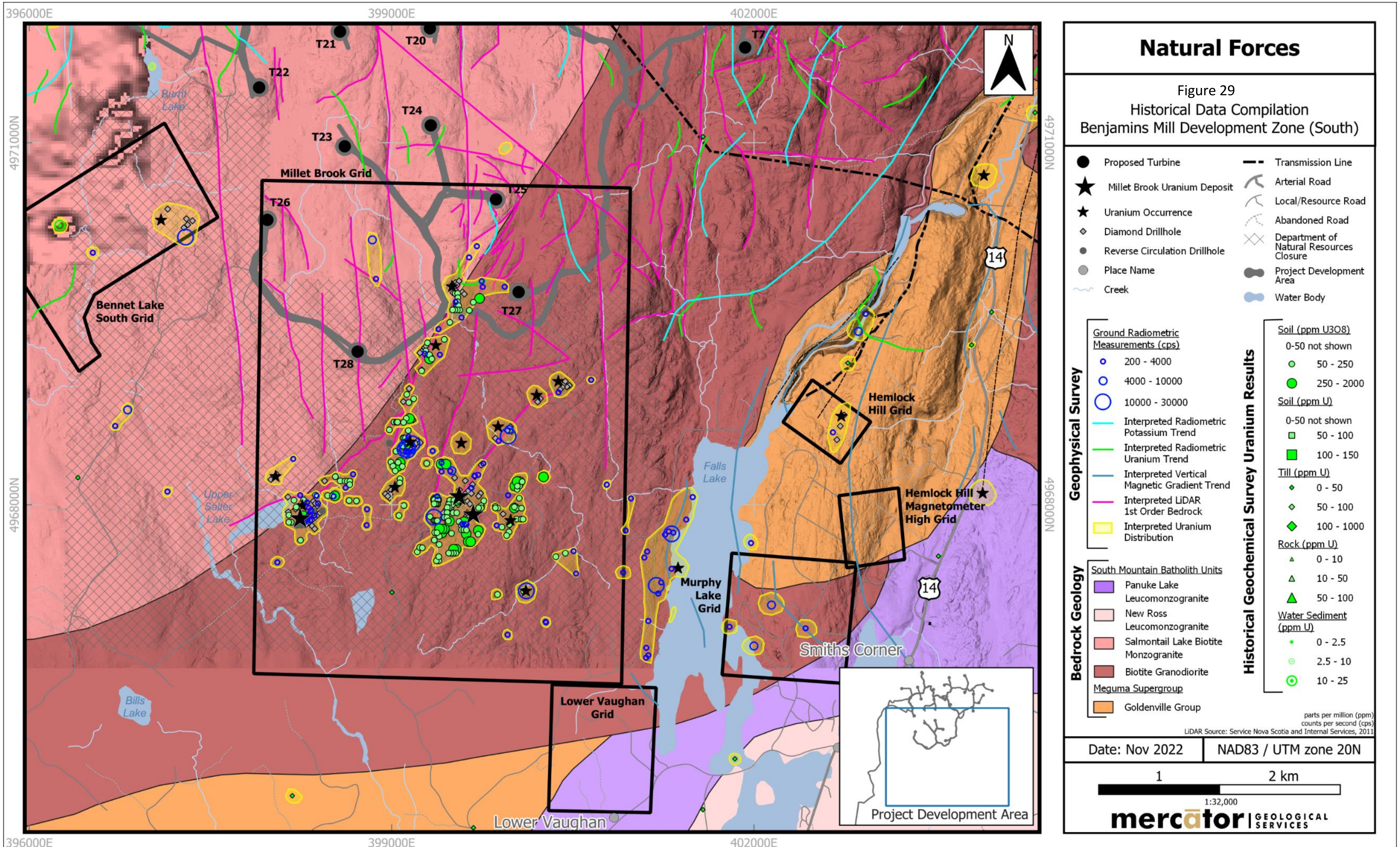
The geoscience compilation and interpretation at the project area identified both geological structures and historical geoscience information associated with discovery and delineation of the Millet Brook U-Cu-Ag deposit (Millet Brook Deposit) that consists of vein and fracture-hosted uranium mineralization located within the south-central Project Area. In addition, other bedrock uranium occurrences and areas of historical exploration work (i.e., Powerline and Bennet Lake North grid areas) were identified in the western portion of the Project area during the compilation exercise. Specifically, the T15, T25 and T27 proposed wind turbine sites are located within a radius of approximately 500 to 800 m of the Millet Brook uranium deposit F1 occurrence (T25, T27) and in the vicinity of the historical Powerline grid area (T15), respectively, with this radius also including various associated exploratory trenches, drill holes and radiometric anomalies, plus several less significant occurrences of bedrock uranium mineralization.

LiDAR interpretation identified numerous north-south and northeast-southwest trending bedrock lineaments within the mapped limits of two intrusive phases of the SMB. The northeast lineament trends are important because the main sites of bedrock uranium mineralization identified in the area, including the Millet Brook Deposit and its associated mineral occurrences, tend to be concentrated along similar north to northeast trending bedrock structural zones within either the granodiorite or monzogranite. This is especially true along the interpreted contact between these units in the Millet Brook Deposit area.

The results of the uranium distribution interpretation identified uranium in several areas either within or adjacent to the PDA. The largest of such interpreted areas corresponds with the main Millet Brook Deposit trend that is located approximately 600 m south of the PDA's southeast boundary, of which some associated historical bedrock uranium occurrences are mapped on the PDA. Substantially less significant zones are located in the north and northwest sectors of the PDA and adjoining the PDA to the southeast. These are associated with the 1970-80s era Bennet Lake North, Murphy Lake, Hemlock Hill, Bennet Lake South, and Powerline exploration grid areas that are identified on **Figure 28** and **Figure 29**. However, except for very anomalous scintillometer readings taken by Mercator staff along the access roads through the main Millet Brook Deposit area and along the access road to proposed turbine site T27, most readings taken during the 2022 site visits were only slightly elevated above background levels.



Natural Forces
Figure 28
Historical Data Compilation
Benjamins Mill Development Zone (North)
Proposed Turbine
Uranium Occurrence
Lead Occurrence
Diamond Drillhole
Place Name
Fault
Local/Resource Road
Creek
Transmission Line
Department of Natural Resources Closure
Project Development Area
Water Body
Historical Survey Grid
Geophysical Survey
Ground Radiometric Measurements (cps)
200 - 4000
4000 - 10000
10000 - 30000
Interpreted Radiometric Potassium Trend
Interpreted Radiometric Uranium Trend
Interpreted Vertical Magnetic Gradient Trend
Interpreted LiDAR 1st Order Bedrock
Interpreted Uranium Distribution
Bedrock Geology
Horton Group
Cheverie Formation
Horton Bluff Formation
South Mountain Batholith Units
Gold River Leucomonzogranite
Salmontail Lake Biotite Monzogranite
Biotite Granodiorite
Mafic Porphyry
Meguma Supergroup
Goldenville Group
Historical Geochemical Survey Uranium Results
Soil (ppm U3O8)
0-50 not shown
50 - 250
250 - 2000
Soil (ppm U)
0-50 not shown
50 - 100
100 - 150
Till (ppm U)
0 - 50
50 - 100
100 - 1000
Rock (ppm U)
0 - 10
10 - 50
50 - 100
Water Sediment (ppm U)
0 - 2.5
2.5 - 10
10 - 25
parts per million (ppm)
counts per second (cps)
LiDAR Source: Service Nova Scotia and Internal Services, 2011
Date: Nov 2022
NAD83 / UTM zone 20N
1
2 km
1:32,000
mercator GEOLOGICAL SERVICES
396000E
399000E
402000E
4974000N
4971000N
N
Benjamins Mill
Powerline Grid
Benjamins Mill Grid
Bennet Lake North Grid
Bennet Lake South Grid
Millet Brook Grid
Burnt Lake
Project Development Area
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
T19
T20
T21
T22
T23
T24
T25
T26



Natural Forces
Figure 29
Historical Data Compilation
Benjamins Mill Development Zone (South)
Proposed Turbine
Millet Brook Uranium Deposit
Uranium Occurrence
Diamond Drillhole
Reverse Circulation Drillhole
Place Name
Creek
Transmission Line
Arterial Road
Local/Resource Road
Abandoned Road
Department of Natural Resources Closure
Project Development Area
Water Body
Geophysical Survey
Ground Radiometric Measurements (cps)
200 - 4000
4000 - 10000
10000 - 30000
Interpreted Radiometric Potassium Trend
Interpreted Radiometric Uranium Trend
Interpreted Vertical Magnetic Gradient Trend
Interpreted LiDAR 1st Order Bedrock
Interpreted Uranium Distribution
Historical Geochemical Survey Uranium Results
Soil (ppm U3O8)
0-50 not shown
50 - 250
250 - 2000
Soil (ppm U)
0-50 not shown
50 - 100
100 - 150
Till (ppm U)
0 - 50
50 - 100
100 - 1000
Rock (ppm U)
0 - 10
10 - 50
50 - 100
Water Sediment (ppm U)
0 - 2.5
2.5 - 10
10 - 25
Bedrock Geology
South Mountain Batholith Units
Panuke Lake Leucomonzogranite
New Ross Leucomonzogranite
Salmontail Lake Biotite Monzogranite
Biotite Granodiorite
Meguma Supergroup
Goldenville Group
parts per million (ppm)
counts per second (cps)
LiDAR Source: Service Nova Scotia and Internal Services, 2011
Date: Nov 2022
NAD83 / UTM zone 20N
1
2 km
1:32,000
mercator GEOLOGICAL SERVICES
396000E
399000E
402000E
4971000N
4968000N
T20
T21
T22
T23
T24
T25
T26
T27
T28
T7
Burnt Lake
Millet Brook Grid
Bennet Lake South Grid
Upper Salter Lake
Falls Lake
Murphy Lake Grid
Hemlock Hill Grid
Hemlock Hill Magnetometer High Grid
Lower Vaughan Grid
Bills Lake
Smiths Corner
Lower Vaughan
14
Project Development Area
N

5.1.2.2 Site Visits

Approach and Methodology

Two initial site visits were completed by Mercator staff to the PDA to ground-truth geological information at proposed turbine sites T15, T25 and T27. The visits were carried out on July 7th and August 10th, 2022, and two Natural Forces staff accompanied Mercator staff on the July 7th site visit. The three turbine sites were selected because they are most proximal to areas of historical mineral exploration interest such as drill holes, uranium showings, geochemical data anomalies and radiometric anomalies. Historical showings and remains of the storage facilities associated with the Millet Brook Deposit uranium exploration drilling in the late 1970's to early 1980's were also visited, since they are located adjacent to, but outside, the southern PDA limit.

A Super-Scint RS-120 gamma-ray scintillometer was used in the field to measure the amount of occurring gamma ray radiation present. This is a "total count" instrument that measures gamma radiation in counts per second units (cps) and cannot discriminate between the main potential sources of radioactivity in this setting, these being uranium, thorium and potassium. At each of the proposed turbine locations and at various other geological sites of interest in the Project area, scintillometer readings were taken, geological observations were made, and photos taken, including observations of any observed alteration or mineralization of the local bedrock and boulders at each site. Observation notes and associated scintillometer readings are included in **Table 3** in **Appendix L**, selected site photos appear in **Figures 5** to **11** in **Appendix L** and the locations of fieldwork scintillometer readings can be found in **Figure 30**.

Comparison of field measurements to average background values has been shown in Nova Scotia and elsewhere to be an effective method of identifying areas of potential uranium mineralization in either bedrock or overburden. A typical SMB granite, when measured by most gamma-ray scintillometers would have background radiation levels in the order of 100 to 180 counts per second (O'Reilly et al., 2009). A background alarm threshold on the scintillometer used during the site visits was set to 160 cps, which is within the upper portion of this range.

On July 7th, 2022, the site visit team, consisting of three Mercator staff and two Natural Forces staff, carried out vehicle-based scintillometer surveying while traversing the area's access roads. They also surveyed with this instrument while carrying out geological ground-truthing traverses at the T15 proposed turbine site and it's associated proposed access road. The existing forestry access roads to the T25 and T27 sites were surveyed in the same manner. On August 10, 2022, two Mercator staff geologists visited the PDA and completed traversing of main access roads and geological ground-truthing at the T25 and T27 proposed turbine sites and their associated proposed access routes. Aside from some minor hematization of the granodiorite bedrock and similarly altered nearby boulders, no visible alteration or mineralization typical of proximity to uranium deposits identified to date in this area of the SMB were observed at any of the proposed turbine sites.

In addition to the proposed turbine sites and access roads, Mercator staff visited one of the historical Millet Brook Deposit uranium showings (the F1 occurrence) and several historical exploration drill hole locations. The F1 mineralized location is marked by a black star on **Figure 29** and located between the T25 and T27 proposed turbine sites. No physical evidence of the mineralized zone or the historical drill holes was observed during the visit.

In October 2022, three site visits were completed by Mercator staff to the PDA in October of 2022. The first two of these were to ground-truth geological information and to visit areas of recent Natural Forces intrusive activity on preliminary geotechnical core drilling sites at proposed turbine locations T14(borehole BH3), T15(borehole BH4), T17(Borehole H5), T18(Borehole H6), T19(Borehole BH7), T20(Borehole BH2), T21(Borehole H1), T22(Borehole BH8) and substation soil test pits 1 to 6. The visits were carried out on October 13th and 18th, 2022.

For these two site visits, a RS-125 Super-SPEC Handheld Gamma Ray Spectrometer was used in the field to measure gamma radiation present and to obtain associated concentrations of uranium, thorium and potassium. This instrument has multiple modes of operation: Survey, Scan and Assay. For the purposes of this project, the spectrometer was used in Survey and Assay modes. Survey mode measures gamma radiation in counts per second units (cps) and does not discriminate between potential radioactivity sources. Assay mode provides calculated concentrations of uranium (U), potassium (K) and thorium (Th) associated with the radiometric responses. This unit has the ability to acquire and set the background alarm threshold at any time/location by averaging 3 x 1 second samples, this avoids problems caused by local background changes. As mentioned previously, typical SMB granite has a background gamma radiation level in the order of 100 to 180 cps (O'Reilly et al., 2009), and during these visits the unit acquired background values ranging from 150-190 counts per second.

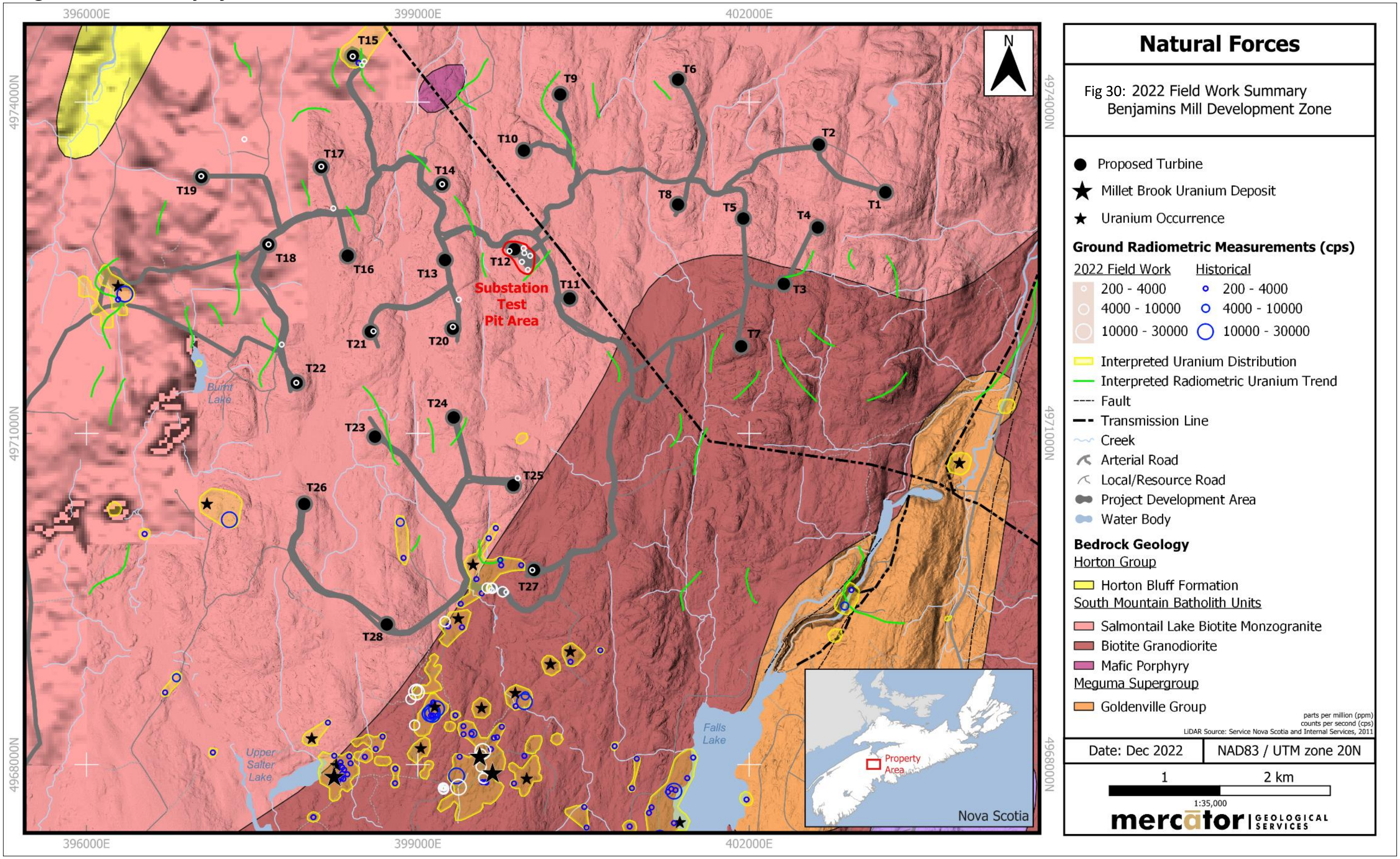
On October 13th, 2022, the site visit team consisted of two Mercator geologists who visited 12 of the 14 sites. While traversing the PDA, continual vehicle-based spectrometer surveying was preformed along access roads with anomalous areas being investigated further. Newly cleared access trails to the proposed turbine and borehole sites were also surveyed and anomalous areas (soil, boulders, bedrock) were assessed using the spectrometer's Assay mode for concentrations of potassium, uranium, and thorium. Additionally, sites T14(Borehole BH3), T15(Borehole BH4), T18(Borehole BH6), T20(Borehole BH2), T21(Borehole BH1), T22 (Borehole BH8) and substation test pits 1 through 6 were surveyed and assessed using the spectrometer for concentrations of potassium, uranium, and thorium. Sites T19(Borehole BH7) and T17(Borehole BH5), were surveyed in the same manner, but due to time constraints the sites themselves were not inspected until the following visit. On October 18th, 2022, two Mercator geologists visited the PDA and completed traversing, surveying and spectrometer assessment of access roads, newly cleared trails, and sites T19(Borehole BH7) and T17(Borehole BH5). Again, no visible alteration or mineralization typical of uranium deposits was identified at any of the visited sites.

The third site visit, on October 28th, 2022, was to revisit, survey and further assess with the spectrometer the anomalous radioactivity areas found during the July/August site visits.

Again, the RS-125 Super-SPEC Handheld Gamma Ray Spectrometer was used to measure gamma radiation present and to obtain concentration values for uranium, thorium, and potassium. Vehicle-based spectrometer surveying was preformed along local access roads and all anomalous radiation areas identified were investigated further and tested with the spectrometer. Mercator geologists also visited the historical Millet Brook Deposit C1 and C2 Zones at this time, which are not within the PDA, as well as the F1 and F2 uranium showings that are within the PDA.

Site photos, observation notes and associated spectrometer survey results can be found in **Appendix L**. Locations of fieldwork spectrometer surveys are shown on **Figure 30**.

Figure 5: Summary of 2022 Ground Radiometric Field Work.



Results

Mercator staff assessed a total of 50 locations in and around the PDA using scintillometer or spectrometer equipment. In total, 10 proposed turbine locations were visited (T14, T15, T17, T18, T19, T20, T21, T22, T25 and T27) and their respective access trails and borehole sites (where present) were traversed and assessed using the spectrometer. In addition to this, all of the project's existing access roads used to complete the field program were surveyed using the continual vehicle-based spectrometer surveying technique. The results of the 2022 field work, including drill core and test pits, are shown on **Figure 30**.

Of the 50 field sites assessed, the majority did not contain any evidence of uranium mineralization, uranium associated alteration, or highly anomalous radiation levels in either bedrock exposures or overburden materials. At 8 sites within the PDA, highly anomalous levels of radioactivity, defined as an order of magnitude higher than background levels, were recorded from material comprising the base of the main forestry access road system. These areas have field radiometric results ranging from 4,500 to 10,272 cps, with associated calculated metal concentrations ranging from 431.4 to 652.4 ppm uranium and 14.8 to 21.6 ppm thorium, respectively. The association of anomalous radioactivity levels with roadbed materials may indicate that a mineralized source area of the materials exists, such as a quarry or pit, or the incorporation of mineralized, locally derived till or bedrock within the roadbed has occurred. No visible signs of alteration or mineralization typical of uranium deposits was identified at any of the visited roadbed sites and at this time, the source of material used in construction of the access road system is not known.

There were 9 anomalously radioactive locations identified outside the PDA boundary. Five of these occur on roadways and were discovered using the vehicle-based method mentioned above. The remaining sites were discovered while traversing in the Millet Brook C1 Zone and C2 Zone areas. Spectrometer survey results ranged from 5,000 to 14,292 cps and associated metal concentrations ranged from 280 to 1,257 ppm uranium and 11.6 to 32 ppm thorium.

Anomalous readings taken in the PDA directly correlate with the areas identified as having underlying uranium levels as mapped in the compilation study's interpreted uranium distribution layer (Data Compilation Map 1 and 2). Specifically, along the access road to the proposed T27 site and also at the proposed turbine location itself, the anomalous uranium distribution trend follows an interpreted northeast-southwest oriented bedrock lineament with a till veneer. This same trend extends to the south-west, where it includes the Millet Brook Deposit area. It is also noted that the areas of historic soil geochemical samples within the PDA showing elevated uranium concentrations often coincide with areas of anomalous gamma radiation. This suggests that both bedrock and overburden materials can be sources of elevated uranium levels in this area.

5.1.2.3 Review of Geotechnical Program Drill Core and Soil Samples

Approach and Methodology

In coordination with Natural Force's geotechnical consultant, DesignPoint Engineering (DesignPoint), on October 20th, 2022, Mercator geologists conducted a review of the drill core from the 2022 geotechnical drill program and soil samples from the 2022 geotechnical test pit program. Prior to commencing the geotechnical investigations, Natural Forces discussed the plan to conduct these preliminary investigations with NSECC on September 22, 2022. Eight 63.5mm wide boreholes were drilled, accumulating to a total length of 128m of drill core to collect geotechnical data for the proposed turbine installations. The eight boreholes were quick-logged by Mercator staff and core gamma radiation levels were assessed using the RS-125 Super-SPEC Hand-held Gamma Ray Spectrometer. A total of 6 soil test pits for the proposed substation were also completed, with samples collected from each of these by DesignPoint for future laboratory analysis.

Drill cores were systematically quick-logged by Mercator and then surveyed top to bottom with the spectrometer. Highest and lowest gamma radiation values (based on cps) for cores were recorded and averages were calculated. Potassium, uranium, and thorium concentrations were then determined for the intervals of highest gamma ray response using the spectrometer. Additionally, Mercator surveyed 20 soil samples taken by DesignPoint at test pit locations. All samples were surveyed, highest and lowest gamma radiation levels (based on cps) were recorded, and an average value determined. Concentration values for potassium, uranium, and thorium were obtained for the soil sample with the highest radiation level using the spectrometer.

Results

Mercator geologists reviewed drill cores from 8 drill sites to create geological quick logs for each site and to measure the amount of gamma radiation present using a handheld spectrometer. The results of the 2022 field work, including drill core and test pits, are shown on **Figure 30**.

The geology was consistent in all eight of the boreholes. The Salmontail Lake Monzogranite was the dominant unit present but varied slightly in appearance based on colour and grain size. In its most common form, it was observed as a very coarse grained, light grey, biotite monzogranite with large plagioclase megacrysts and minor local amounts of disseminated pyrite and pyrrhotite. This lithology commonly exhibits iron staining along fractures and a 5cm zone of feldspar alteration was observed around fractures in the upper portion of BH2. The Salmontail Lake Monzogranite was also observed as a dark grey, fine grained, biotite monzogranite with sparse plagioclase phenocrysts and 1-3% disseminated sulphides. Notably, hole BH4, which was drilled at proposed turbine location T15, crossed a contact between the Salmontail Lake Monzogranite and an interval of Gold River Leucomonzogranite. The Gold River Leucomonzogranite occurs as a greyish-pink, medium grained, granitic lithology with sharp contacts represented in this hole.

None of the 8 boreholes displayed evidence of any significant hydrothermal alteration, uranium mineralization or anomalous gamma radiation levels. Spectrometer readings on core ranged from 116 to 228 cps and averaged 143.5 to 188 cps. Associated elemental concentrations ranged from 2 to 5% potassium, 2.3 to 4.1 ppm uranium and 5.8 to 9.4 ppm thorium.

In addition, 20 soil samples from previously excavated turbine site test pits were surveyed using the spectrometer. These were sampled during the test put component of the geotechnical program and consisted predominantly dark brown, sand and clay-rich material that returned readings ranging from 130 to 224 cps. The sample with the highest reading (TP3 BH2 26”) returned elemental concentrations of 2.1 % potassium, 2.9 ppm uranium and 6.6 ppm thorium.

5.1.3 Potential Interactions and Mitigation

It is possible that interactions with uranium could occur during the construction phase of the Project. A significant environmental effect would result if disruption to the areas geology caused dispersive uranium effects on groundwater or human health as the result of Project activities. **Sections 5.1.3.1 – 5.1.3.3** overview the technical summary of NORM benchmark standards, assessment of health and safety risk, and detail the uranium avoidance and mitigation plan detailed in **Appendix K**. Following the mitigation measure described in **Table 47** as well as the Avoidance and Mitigation Plan, the Project’s impact on geology is predicted to be minor in terms of significance of environmental effect.

To further reduce the likelihood of interactions between any phase of the Project to geology, the proposed mitigation measures summarized in **Table 47** will be implemented. The mitigation methods proposed have been developed in consultation with qualified professionals at Mercator and Dillon and have applied current best management practices.

TABLE 47: POTENTIAL INTERACTIONS AND PROPOSED MITIGATION MEASURES FOR GEOLOGY

Potential Interactions with Geology	Proposed Mitigative Measures
Soil and ground conditions may need to be altered or blasted during construction.	1) A geotechnical survey will determine the ground conditions and any potential limitations to construction. 2) A designated professional will provide recommendations for design and construction of the Project based on the geotechnical surveys.
Excavation and transportation of material for turbine foundations, crane pads and access roads during construction.	3) Topsoil will be stored separately from excavated material. 4) Topsoil and excavated material will be backfilled in a manner that does not result in soil inversion. 5) Areas susceptible to erosion will be stabilized and erosion will be minimized through the use of control measures (i.e. hay bales, coco mats, etc.). 6) Soil compaction will be limited to the Project footprint. 7) Soil and aggregate mixing will be minimized; and

Potential Interactions with Geology	Proposed Mitigative Measures
	8) Soil will be visually and olfactory inspected during earth moving activities and identification of any contaminated soils will be reported to NSE and managed utilizing Nova Scotia Contaminated Site Regulations.
The disturbance of existing road material has the ability to disrupt particulate dust potentially containing uranium during construction.	9) Desktop and field studies have been conducted to develop a robust avoidance and mitigation plan specific to the Project site. 10) A dust suppression plan has been developed based on results of the avoidance and mitigation. 11) A detailed uranium avoidance and mitigation plan is provided in **Appendix K.**
The disturbance of bedrock potentially containing uranium has the ability to introduce or increase uranium into the groundwater during construction.	12) The Project has been sited over 1 km from known residential wells, minimizing risk of introduction of uranium into groundwater. 13) Mitigation measures 9-11 are also applicable for potential introduction of uranium to groundwater. 14) Field validation with scintillometer have been conducted for areas within the PDA for which desktop information would indicate a potential for presence of uranium. This information is being used to inform the avoidance and mitigation plan.

5.1.3.1 Benchmark Standards for Uranium

In response to the Minister's comments specifically related to the presence of uranium in the vicinity of the Project, common benchmark standards for naturally occurring uranium mineralization and human health and safety considerations have been identified by qualified professionals (see **Appendix K**).

Uranium is both a chemical (measured in units of mass) and a radioactive material (measured in Bq or Sv). Therefore, different guidelines have been developed depending on the radiological and non-radiological toxicity considerations. Various national and international guidelines are available for both forms, however, the most applicable for the Project are the Canadian guidelines.

Non-Radiological Considerations and Human Health Guidelines

The main chemical toxicity effect of uranium is kidney damage (ATSDR, 2013). Chemical uranium is not considered by most regulatory agencies as being carcinogenic (e.g., Health Canada, US Environmental Protection Agency) (CCME, 2007; ATSDR, 2013).

The CCME (2007) has developed human health-based soil quality guidelines for uranium which considers the chemical aspects of naturally occurring uranium (expressed as units of mass) and do not consider radioactivity. The CCME soil quality guidelines for human health (SQGHH) were derived using Health Canada's (1999) tolerable daily intake (TDI) for chemical uranium based on oral ingestion. The Nova Scotia Environment and Climate Change (NSECC, 2022b) Tier I Environmental Quality Standards (EQS) for uranium in soil are the same as the

CCME (2007) SQGHH, with the exception of the guidelines for potable groundwater for commercial and industrial land use. The CCME SQGHH, and NSECC Tier I EQS for non-potable and potable water based on land use are provided in **Table 48**.

Table 48: CCME Human Health-Based Soil Quality Guidelines versus NSECC Human health Tier I Environmental Quality Standards for Potable and Non-Potable Water

Land Use	CCME SQG_{HH} (mg/kg)	NS Tier I EQS (Non-Potable) (mg/kg)	NS Tier II EQS (Potable) (mg/kg)
Agricultural	23	23	23
Residential/Parkland	23	23	23
Commercial	33	33	30
Industrial	300	300	30

Notes:
CCME – Canadian Council of Ministers of the Environment
NSECC – Nova Scotia Department of Environment and Climate Change
SQG_{HH} – Soil Quality Guideline for Human Health
EQS – Environment Quality Standard

The Health Canada (2022) guideline for Canadian drinking water (including well water) for uranium is 0.02 mg/L (20 µg/L). This guideline was developed in 2019 and is based on kidney effects. The Nova Scotia Environment and Climate Change (NSECC, 2022b) Tier I Environmental Quality Standards (EQS) for uranium in groundwater at a potable site are the same as the Health Canada (2022) guideline. Uranium is naturally occurring in NS groundwater in areas with granite, sandstone and shale bedrock (NSECC, 2022a). As such, it is not uncommon for the uranium drinking water quality guideline in these areas to be exceeded. NSECC recommends that well water be tested regularly for uranium and has developed an interactive map to identify uranium risk in bedrock water wells: (https://fletcher.novascotia.ca/DNRViewer/index.html?viewer=Uranium_Risk).

Federal ambient air quality guidelines for chemical uranium were not identified as uranium is not volatile.

Radiological Uranium Considerations and Human Health Guidelines

The primary radiological toxicity concern with uranium and NORM is an increased probability of an individual developing cancer. The ionizing radiation (such as gamma rays) emitted by NORM is a known carcinogen. The ICRP (International Commission on Radiological Protection) considers any exposure to ionizing radiation to be potentially harmful to health (Health Canada, 2014).

In Canada, NORM is managed under the jurisdiction of the provinces and territories which each have their own rules and regulations for the handling and disposal of NORM. To harmonize standards and reduce inconsistencies across the country, federal guidelines were developed. The Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) were established by the 2011 Canadian NORM Working Group; in which, representation from Nova Scotia was involved (Health Canada, 2014). These Canadian guidelines set out principles and procedures for the detection, classification, handling and management of NORM, in addition to providing guidance for compliance with national transport regulations.

Nova Scotia does not have NORM specific guidelines; however, since NS follows the federal guidance, site-specific NORM management plans will be developed in accordance with the "Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)". The NORM guidelines are applicable for radiological uranium.

The Health Canada NORM guidelines are based on the most recent international standards recommended by the International Commission on Radiological Protection (ICRP) and Canadian Nuclear Safety Commission (CNSC) regulations. The basic principle of the Guidelines is that persons exposed to NORM should be subject to the same radiation exposure standards that apply to persons exposed to CNSC-regulated radioactive materials. No distinction is made regarding the origin of the radiation, whether it is NORM in its natural state or NORM whose concentration of radioactive material has been increased by processing (Technologically Enhanced NORM or TENORM).

The annual effective dose limits for occupationally exposed workers (20 mSv) and incidentally exposed workers (1 mSv) or members of the general public (1 mSv) are provided below in Table 2. Radiation dose limits exclude natural background radiation. Health Canada (2014) has conservatively adopted an incremental dose constraint of 0.3 mSv as a first investigation level to allow for other potential sources of NORM without the annual public limit of 1 mSv being exceeded.

Table 49: Radiation Dose Limits (Health Canada, 2014)

Affected Group	Annual Effective Dose Limit (mSc)[a]	Five Year Cumulative Dose Limit (mSv)
Occupationally Exposed Workers[b]	20[c]	100
Incidentally Exposed Workers and Members of the Public	1	5

Notes
a: These limits are exclusive of natural background and medical exposures.
b: For the balance of a known pregnancy, the effective dose to an occupationally exposed worker must be limited to 4 mSv stipulated in the "Radiation Protection Regulations:, Canadian Nuclear Safety Act. This limit may differ from corresponding dose limits specified in current provincial legislation applicable for exposure to sources of x-rays.
c: For occupationally exposed workers, a maximum dose of 50 mSv in one year is allowed, provided that the total effective dose of 100 mSv over a five-year period is maintained. This translates into an average limit of 20 mSv/a.

NORM materials management can be classified as Unrestricted, or Release with Conditions. Under the Unrestricted classification, NORM can be released without restrictions when the associated incremental dose is <0.3 mSv/year. Unconditional derived release limits (UDRLs) meeting this criteria have been developed for both diffuse NORM (i.e., material generally large volume, with relatively low radioactive concentrations, uniformly dispersed) and discrete NORM (i.e., small in size, exceed the concentration criteria for a diffuse source). The sources of uranium at the Project site would be considered a diffuse NORM source. As such, the UDRLs for diffuse NORM provided in **Table 50** would apply. Health Canada (2014) provides a ratio approach for determining the sum of exposure to all isotopes of NORM.

TABLE 50: UNCONDITIONAL DERIVED RELEASE LIMITS - DIFFUSE NORM SOURCES (HEALTH CANADA, 2014)

NORM Radionuclide	Derived Release Limit		
	Aqueous (Bq/L)	Solid (Bq/kg)	Air (Bq/m³)
Uranium-238 Series (all progeny)	1	300	0.003
Uranium-238 (U-238, Th-234, Pa-234m, U-234)	10	10,000	0.05
Thorium-230	5	10,000	0.01
Radium-226 (in equilibrium with its progeny)	5	300	0.05

Notes
Pathways Considered:
Aquatic: 1. Value 10x Guideline for Canadian Drinking Water Quality.
Terrestrial: 1. External groundshine from soil contaminated to infinite depth. 2. Soil-veg-ingestion/soil ingestion. 3. Inhalation of resuspended material.
Air: 1. Inhalation at concentration resulting in 0.3 mSv. 2. Exposure factor of 25% assumed.
See Health Canada, 2014 for further table notes

While there are no NSECC Tier 1 EQS criteria for NORM, Nova Scotia does recognize the "Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM)" and as such potential NORM sources and exposures would be evaluated using the Health Canada framework.

5.1.3.2 Local Health and Safety Risks to Uranium

Potential Local Health and Safety Risks

As noted previously, NORM are naturally present over the earth's crust and within the tissues of living organisms. Concentrations of NORM in most natural areas is generally negligible; however, NORM can potentially become elevated if areas with higher concentrations are disturbed, exposing and potentially releasing naturally radioactive materials that are present.

Natural background radiation cause continual exposure, which makes up over half of an average person's yearly exposure to radiation (US EPA, 2022a). Sources of background radiation include, for example, radiation from the sun and outer space, and groundshine (radiation emitting from soil and rock) from naturally present radioactive minerals. some medical procedures may also cause exposure to radiation (Health Canada, 2014).

While people (and all living organisms) are continually being exposed to low levels of radiation which can cause damage to living cells, the body is very efficient at repairing this damage. However, if one is exposed to very high levels of radiation over time, and the damage is not repaired correctly, it can lead to serious health problems such as cancer. Exposure to low levels of radiation, including natural radiation, over time does not cause an immediate health effect, but can result in a small increase in the potential risk of cancer over a lifetime (US EPA, 2002b). Exposures to high levels of radiation, can result in higher potential risks of cancer over a lifetime.

Potential Human Receptors

During the construction phase of the project, the human receptor with the greatest potential for exposure to chemical and radiological uranium is the site construction worker. The site construction worker will be on site for eight (8) to 10 hours per day, five (5) days a week during construction season for up to two (2) years and may be in direct contact with soils/rock potentially containing uranium during access road and foundation construction work.

Other people could potentially use the site passively during the construction phase, such as someone walking through the area for recreational purposes or for activities such as tree cutting. However, access to the site by these individuals during construction will be limited. Security/project staff will be monitoring access to the site during construction, and signs will be posted indicating that the site is not to be trespassed. The site is also remote and is not considered a prime location for recreational hiking. Based on the steps that will limit access to the site, even if an occasional site visitor were to passively be on the site, their exposures would be of short duration and infrequent, and lower than that of the construction worker.

For the most part, site construction workers will have limited direct contact with uranium enriched soils/rocks and as such, exposures to alpha and beta radiation is expected to be low. As noted above, Alpha particles are heavy and don't move far from their source, and cannot penetrate the skin. Beta particles are lighter and can travel further than alpha particles; however, they can be stopped with a layer of clothing (US EPA, 2022b). Gamma rays can travel further distances and easily penetrate skin and clothing. Direct contact and incidental ingestion of chemical uranium in soils and soil dusts could potentially occur, but are limited by the amount of exposed bedrock and limited soil cover in the area, and can be reduced with proper hand hygiene and dust suppression. While radioactive uranium can be absorbed through the skin, the potential for dermal exposure of chemical uranium is low and can be limited by common personal protective equipment such as gloves, wearing pants, covering skin.

Uranium in groundwater is often a concern in NS, particularly in areas with high uranium in soils. The project area occurs within the SMB granite region, and 25% of wells drilled within the SMB area had uranium concentrations higher than the CDWQG (Mercator, 2022). Although groundwater is potentially an important exposure pathway, this pathway is screened out for the Benjamins Mill project for a number of factors including:

- Construction work on the site is limited to geotechnical work and excavating overburden soils to expose the bedrock surface, drilling holes into the bedrock to anchor foundation structures and the construction and backfilling of the foundations to construct towers above grade, therefore no contact with groundwater and no groundwater disturbances are anticipated.

- Construction workers and occasional site visitors will not be drinking groundwater from the project area. There is no groundwater consumption in the area, the nearest groundwater wells are greater than 1km from the potential turbine locations (NS Groundwater Atlas; NSECC, 2022).
- This distance of the nearest potable well is greater than the common monitoring distance for blasting which is approximately 800m. No blasting will be occurring in the area.
- Potable water screening for industrial activities is generally conducted for potable wells within 1 km of a site, as typically required in an industrial approval through NSECC. As no potable wells are noted within 1 km of the site, pre- and post-construction groundwater monitoring is not anticipated to be required through industrial approval. Although risks to wells beyond 1 km are not anticipated, the Proponent will conduct a water testing program in coordination with residents.

Avoidance and Mitigation Plan

The scintillometer data were used as an initial screening tool for potential uranium hazards at the site (see Mitigations section below). Once the chemical and radiological sampling for uranium in soils and rock is completed, it will be incorporated into the screening tool to provide a field screening limit or background above which further NORM sampling would be required prior to site development. The components that will be used as part of the avoidance and mitigation plan to determine the potential hazards associated with uranium (in soils/rock) at the proposed turbine locations and surrounding areas include:

- Field Screening with Scintillometer
- Chemical Sampling of Soil/Rock
- Radiological Sampling of Soil/Rock

Protective measures are being put in place for this project to limit exposures to workers (and the general public) in areas that have the potential for elevated concentrations of radiation. In general, the primary protective measure to reduce exposures to radiological uranium on the site is to understand where they exist, and to minimize disturbance to this area as much as feasible, and minimize time spent in the vicinity of the radioactive material as much as possible.

Once potential NORM material is identified (through screening with field reading using a scintillometer), NORM sampling and testing is then required for material that is potentially above background. Work is currently underway to establish the background screening limit using scintillometer readings collected by Mercator and samples being collected for both chemical uranium testing (mg/kg) and NORM isotopic analysis (Bq/kg). As discussed above (in the Background section), scintillometer readings can be used to identify elevated NORM, but cannot be used for regulatory compliance as analysis must be completed for both chemical and radiological content.

The Avoidance and Mitigation plan for the naturally occurring uranium mineralization present in the area is graphically summarized in **Figure 31**. It is composed of three screening steps with four possible outcomes based on both potential chemical and potential radiological exposure. The screening tool conservatively utilizes the NSECC Human Health Tier I EQS for agricultural, residential, commercial and industrial land use with potable groundwater.

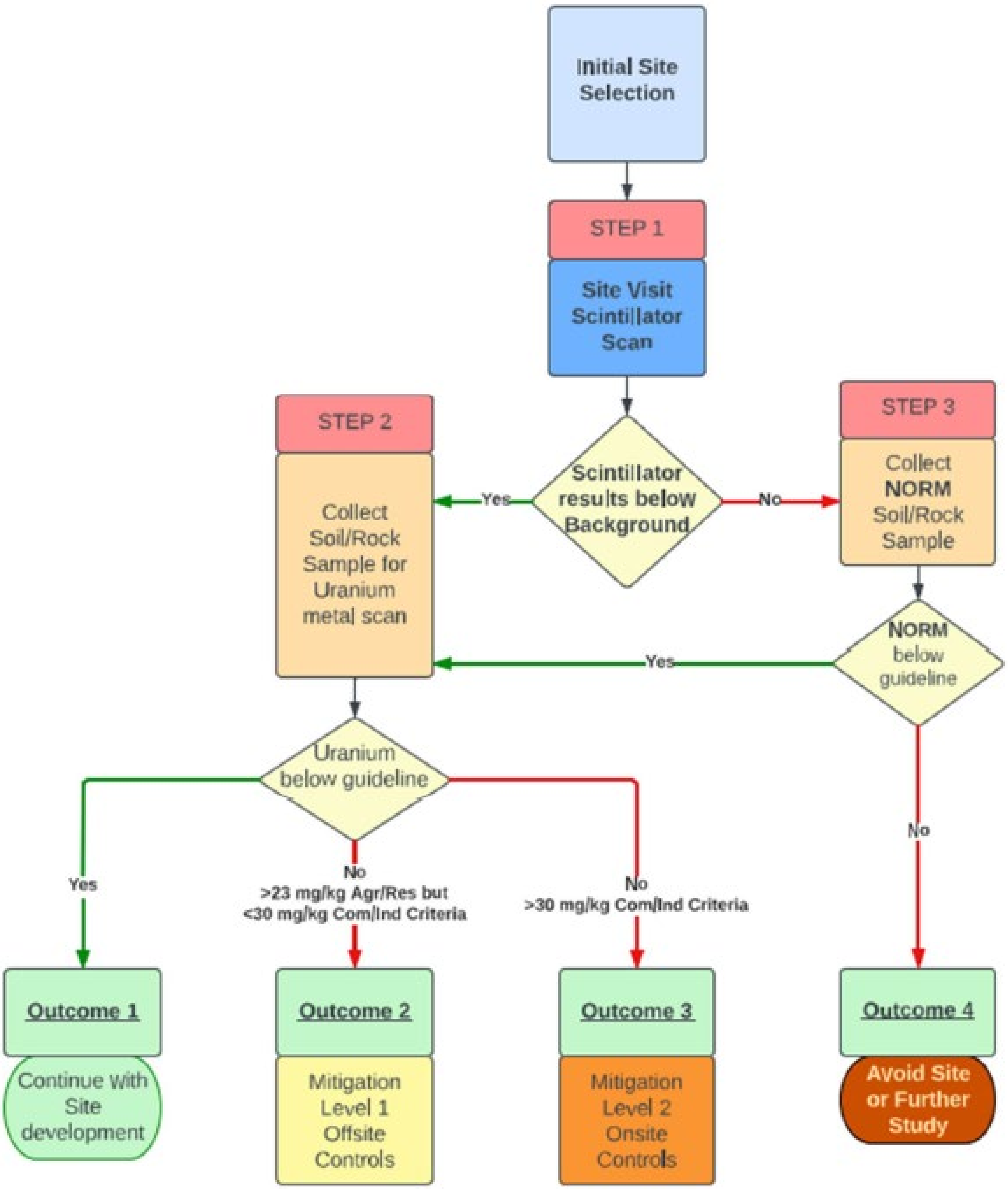


FIGURE 31: AVOIDANCE AND MITIGATION PLAN FOR NATURALLY OCCURRING URANIUM MINERALIZATION

Screening Step 1 occurs during initial site visits and includes the completion of georeferenced scintillometer scans of surface material across the site. Step 2 is the collection of soil/rock samples for uranium chemical concentration (mg/kg) based on the results of the scans; and, Step 3 (when required) is the collection of NORM soil/rock samples for analysis of NORM isotopes. These screening steps are described in more detail in the following paragraphs.

Step 1

This step consists of the collection and recording of georeferenced scintillometer scans of soil/rock within the construction foot print of the project (i.e., everywhere there is going to be construction/ground disturbance). The end result of Screening Step 1 is simply the determination of whether or not NORM radiological sampling is required in addition to uranium chemical sampling.

Step 2

Screening Step 2 also begins during the initial site visit with the collection of a soil/rock sample from the locations of the highest scintillometer readings for chemical analysis of uranium. The scintillometer readings do not have to be above background for this sampling as chemical uranium concentrations above NSECC Tier 1 EQS can still occur if samples are not radiologically elevated. Collected samples will be submitted to an accredited laboratory for uranium soil analysis. Sample results should be assessed relative to the NSECC Tier 1 EQS for uranium which is 23 mg/kg for both agricultural land use and residential land use and 30 mg/kg for both commercial and industrial and use. As presented in **Figure 31**, results below NSECC Tier 1 EQS indicate no further action is required provided NORM results (if required as per step 1 when scintillometer readings are above background) are also below background and the UDRLs.

Step 3

If the scans completed in Screening Step 1 indicate readings above the background, Screening Step 3 should be initiated with the collection and submission of NORM samples to Bureau Veritas laboratory for NORM radiological analysis. It should be noted that these analyses typically take upwards of four (4) to six (6) weeks depending on laboratory backlog and extensive analysis time and for this reason NORM sampling, when required, should take place in a manner to prevent construction delays.

If results of NORM analysis are below the UDRLS presented in **Table 50** then mitigative measure would simply be driven by Screening Step 2 above, based on the chemical uranium results. If results exceed the UDRLs, then site development should not proceed unless a NORM risk mitigative approach is developed and approved through consultation with NSECC. It should be noted that this approach would likely be time consuming and costly with limited potential for success as there are currently no approved facilities for disposal of NORM within the province. In this case, the simplest approach would likely be to avoid the development of the specific infrastructure.

Based on the results of Steps 1, 2 and 3 there are four possible outcomes as presented in **Figure 31**. **Outcome 1:** Proceed with construction where chemical and radiological results are below criteria no mitigation is required; **Outcome 2:** Mitigation Level 1 where chemical results are above agricultural/residential criteria but radiological results are below criteria; **Outcome 3:** Mitigation Level 2 where chemical results are above commercial/industrial criteria but radiological results are below criteria; and **Outcome 4:** Avoidance or further study where radiological results are above criteria.

Outcome 1 – No Uranium Mitigation Required

Should both chemical and radiological results be below criteria then construction can proceed without the requirement for additional consideration of uranium.

Outcome 2 - Mitigation Level 1

Should uranium concentrations be above NSECC Tier 1 EQS for agricultural/ residential, but below the NSECC Tier 1 EQS commercial/industrial, Mitigation Level 1 would be required if the location is selected to be developed. This requires the mitigation of potential offsite migration of soil or sediment during construction. Construction will include the following erosion and sediment control measures:

- Limit the removal of riparian zone vegetation;
- Minimize the use of heavy equipment within 30 m of a watercourse to the extent possible;
- Proper erosion and sediment control measures will be installed and checked regularly during the construction phase and prior to, and after, storm events to ensure they are continuing to operate properly to minimize potential effects to adjacent habitat;
- Sufficient staff and equipment to manage erosion and sediment control during storm events and other emergencies will be provided;
- Runoff will be controlled, and sediment will be prevented from leaving the Site at all times; and
- Equipment shall be kept in good working order and maintained to avoid noise disturbances.

Final site grading should also include solid cover/clean fill of sufficient thickness feasible and can be done to a sufficient extent to cover material exceeding NSECC Tier 1 EQS for agricultural/residential to prevent offsite migration of material above the Tier 1 EQS. Further study could also be completed to delineate the uranium chemical concentrations above criteria with additional sampling and potentially avoid this portion of the site.

Outcome 3 – Mitigation Level 2

Should uranium concentration be above NSECC Tier 1 EQS for both agricultural/ residential and commercial/industrial, then Mitigation Level 2 would be required if the location is selected to be developed. This requires the measures from Mitigation Level 1, above, and also requires the addition of prevention of worker exposure through the use of work site signage, and requirement for appropriate personal protective equipment (PPE) during construction. Workers who could potentially come in contact with the material would be required to use respiratory protection for prevention of dust inhalation while on site, and should wear protective clothing and gloves to prevent dermal exposure to the soil/dust while on site. Further study could also be completed to delineate the uranium chemical concentrations above criteria and potentially avoid this portion of the site.

Outcome 4 – Avoidance or Further Study

Should radiological results for NORM be above the UDRLs then the site will be required to undergo further additional study. If the radiological results are below the UDRLs, then the development would default back to the chemical results and Outcomes 1 through 3 above. Further study could also be completed to delineate the UDRL above criteria and potentially avoid this portion(s) of the site(s).

Summary of Outcomes

In summary there are four potential outcomes associated with this avoidance and mitigation plan, if a location is selected for development:

1. Outcome 1 Uranium concentrations are below NSECC Tier 1 EQS for all land uses and NORM are below UDRLs – no mitigation required for naturally occurring uranium mineralization.
2. Outcome 2 Uranium concentrations are below NSECC Tier 1 EQS for commercial and industrial land uses but above NSECC Tier 1 EQS for agricultural and residential land uses and NORM are below UDRLs – mitigation level 1 – mitigation of potential offsite migration of soil/sediment is required.
3. Outcome 3 Uranium concentrations are above NSECC Tier 1 EQS for all land uses and NORM are below UDRLs – mitigation level 2 – mitigation of potential worker exposure and offsite migration of soil/sediment is required.
4. Outcome 4 NORM concentrations are above the UDRLs – additional studies will be conducted.

Should results from any step indicate the need for mitigative measures to develop the site, the Proponent can realign the Project to avoid certain areas or conduct further study to delineate the uranium chemical/radiological concentrations above criteria and potentially avoid this portion(s) of the site(s). The Proponent will continue coordinate with NSDNRR Geological Survey Division Mineral and Management Division-to ensure BMPs are employed in the development of the Project.

5.2 Ambient Sound Levels

This section serves to fulfill the following request from the Minister's AIR:

6. *Provide justification for the noise assessment methodology used and how the modelling software addresses these larger scale commercial wind-turbines (5 MW) and their sound level outputs at the nearest receptor locations. Refer to Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (Health Canada, 2017) as necessary. The noise assessment should also ensure the modulation of sounds from operations, low frequency noise, proposed mitigation and monitoring.*

5.2.1 Sound Level Assessments

The Project is located in Hants County, approximately 10 km southwest of Windsor. The Project is located predominantly on privately owned forested land that has undergone several generations of wood harvesting and has an existing network of forest service roads located throughout the Project site. **Figure 1** is a map showing the 28 proposed turbine locations and associated infrastructure.

Due to the site elevation and wind resource, ambient noise levels in the area may be elevated during short periods of time. As the site was chosen for its excellent wind resources, particularly windy days can increase existing ambient sound levels. Prior to this assessment, careful siting of the turbines has reduced the majority of sound impacts to neighbouring residents. Based on the Guide to Preparing an EARD for Wind Power Projects in Nova Scotia, the maximum allowable sound level from wind turbines at a receptor is 40 dB[A] in Nova Scotia.

The Proponent has undertaken a sound level impact assessment for the proposed 28 turbines to determine the impact of the sound emissions from the Project on the dwellings, seasonal residences, and local businesses in the surrounding area during both construction and operation.

The Proponent reviewed the following documents in order to conduct the sound level impact assessment:

- Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (2021);
- Federal Guidance for Evaluating Human Health Impacts in Environmental Assessment: NOISE (2017).
- Highway Traffic Noise Analyses and Abatement: Policy and Guidance. U.S. Department of Transportation (US Department of Transportation, 1995)
- Biological Assessment Preparation for Transportation Projects – Advanced Training Manual (Washington State Department of Transportation, 2017)

All turbines have been set back over a kilometre from the nearest dwellings. There are no schools, care homes, or other sensitive receptors within 2 km of the turbines and no other wind turbines within 3 km of the Project. The area is currently used for forestry. The current vegetation cover of trees and thick shrubs will aid in the absorption of sound from both construction and operation of the Project. The Project is not near the ocean.

There are 64 receptors located within 2 km of the turbine locations that consist of year-long dwellings and seasonal dwellings. They have been identified based on online geographical data from the Data Catalogue available from the Government of Nova Scotia and cross referenced with aerial photography, as well as site visits. The geographical coordinates of these receptors are included in **Appendix M**.

While several turbine models are being considered, this assessment has been completed using the Enercon E-160 EP5 E2 turbine. This model has a nameplate capacity of 5.5 MW, a hub height of 120 m and a rotor diameter of 160 m. The geographical coordinates of the 28 proposed turbines are included in **Appendix M**. Should an alternate turbine model be selected, a new sound assessment will be conducted.

The sound level impact assessment study consisted of the following assessments:

- Construction Sound Assessment;
- Operation Sound Assessment; and,
- Operational Low Frequency Sound Assessment.

The construction sound assessment was conducted using standard methodology. Construction noise is not always constant and can produce impulsive and variable sounds at different noise levels, which could create heightened annoyance levels in the surrounding community. The construction noise assessment has considered the maximum noise levels produced by various construction equipment to determine maximum sustained noise levels when all equipment is running.

The operational sound assessment was conducted using the ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation model within the Decibel module of the software package, windPRO version 3.5. The *Guide to Preparing an EA Registration Document for Wind Power Projects* was consulted during this assessment.

5.2.1.1 Construction Sound Assessment

General construction activities include those associated with vegetation clearing, road building, foundations, and turbine erection. These activities will likely involve the use of backhoes, concrete mixers and pumps, cranes, dump trucks, excavators and light-duty pickup trucks with the associated sound levels predicted in **Table 51.**

Construction noise is not always constant and can produce impulsive and variable sounds at different noise levels. It is not expected that all equipment would be running at the same time, but to determine maximum expected sound levels during construction, the WSDoT (2017) guidelines for decibel addition were used to determine that 86 dB[A] is the highest expected sound level during combined construction activities (WSDoT 2017).

Table 51: Sound Power Levels Associated with Construction Equipment (WSDoT 2017)

Equipment	Max Sound Power Level (dB{A})
Backhoe	78
Concrete Mixer	79
Concrete Pump	81
Crane	81
Dump Truck	76

Equipment	Max Sound Power Level (dB{A})
Excavator	81
Pick-up Truck	75

In addition, occasional blasting may be associated with impact equipment use and that noise can reach 126 dBA (WSDOT 2017); however blasting is anticipated to occur infrequently and be of short duration. It is not expected that all equipment would be running at the same time, but to determine maximum expected sound levels during construction, the WSDoT (2017) guidelines for decibel addition were used to conclude that 86 dB[A] is the highest expected sound level during combined construction activities.

The environment in which the Project construction will occur is considered a soft environment with normal unpacked earth. The normal unpacked earth and topography will facilitate attenuation of noise emissions at shorter distances. **Table 52** identifies the sound levels predicted to be observed at various distances from the construction site determined using WSDoT (2017) guidelines.

TABLE 52: WORST-CASE SOUND LEVELS IN THE SURROUNDING ENVIRONMENT CALCULATED USING WSDOT (2017) GUIDELINES*

Distance	Construction Sound Level (dB[A])
50 ft. (15.2 m)	86
100 ft. (30.5 m)	78.5
200 ft. (61 m)	71
400 ft. (122 m)	63.5
800 ft. (244 m)	56
1600 ft. (488 m)	48.5
3200 ft. (975 m)	41

* Assuming sound levels in soft environment attenuate at -7.5 db[a] per doubling of distance

Many sound level scales refer to 70 dB[A] as an arbitrary base of comparison where levels above 70 dB[A] can be considered annoying to some people (Purdue University 2017). As indicated in **Table 52**, at 61 m from the construction site, noise levels are approximately 70 dB[A], similar to that of a car travelling at 100 km/h and just at the threshold of possible annoyance (Purdue University 2000). Also indicated in **Table 52**, sound levels from the construction site reach approximately 40 dB[A] at 1 km from the site. With the nearest dwelling located approximately 1.5 km from a proposed turbine, construction noise is not expected to impact dwellings in the area. Further, the construction noise is not expected to be annoyingly high beyond 61 m from the construction site as sound levels at this distance have already attenuated to approximately 70 dB[A].

Additionally, this site has been chosen due to its excellent wind resource. Wind generally increases ambient sound levels in an area and in combination with the vegetative cover will aid in making construction noise less noticeable at even shorter distances (WSDoT 2017).

5.2.1.2 Operational Sound Assessment

The *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* requires that wind farm design and siting does not cause sound levels to exceed 40 dBA at the exterior of receptors. The more detailed recommendations included in the New Brunswick guidance document *Additional Information Requirements for Wind Turbines* created to outline additional requirements to the *Environmental Impact Assessment Regulation* are outlined in **Table 53**.

TABLE 53: RECOMMENDED SOUND CRITERIA FOR WIND TURBINES (ADDITIONAL INFORMATION REQUIREMENTS FOR WIND TURBINES).

Wind Speed (m/s)	4	5	6	7	8	9	10	11
Wind Turbine Sound Criteria [dB(A)]	40	40	40	43	45	49	51	53

Using both the Nova Scotia and New Brunswick guidance documents, a threshold of 40 dB(A) for sound levels at the exterior of a receptor for all wind speeds was selected.

The operational sound pressure level was calculated at each point of reception using the Decibel module of WindPRO v.3.5, which uses the ISO 9613-2 method “Attenuation of sound during propagation outdoors, Part 2: A general method of calculation”. The ISO 9613-2 method is a general standard used to fit the requirements of any wind farm.

5.2.1.2.1 Model Assumptions

Ambient Noise Assumptions

In order to assess the cumulative sound impacts of adding wind turbines to the existing landscape, Natural Forces considered local existing noise sources, and reviewed guidelines on ambient noise modelling in other jurisdictions. For site-specific context, the following anthropogenic noise sources exist near the Project and in surrounding communities. These sources include but are not limited to:

- Passenger vehicles, transport trucks, forestry equipment, all-terrain vehicles, and snowmobiles operating on local roads and trails;
- Forestry activities;
- Existing transmission lines;
- Recreational activities; and
- Local pits and quarries.

The temporal frequency, duration, and specific locations of the above-mentioned noise vary significantly throughout the day and across seasons. As detailed in the Alberta Utilities Commission Noise Control Guidelines (AUC, 2021), this variation poses challenges to assessment and in some situations assumptions about existing noise levels are appropriate. As such, an assumption for ambient noise was determined. 35 dB[A], the average nighttime ambient sound level in rural Alberta (AUC, 2021) was applied to the model. As this project is located in rural Nova Scotia, 35dB[A] was determined to be an appropriate estimate of nighttime ambient noise.

Low Frequency Sound Model Assumptions

A low frequency sound assessment was conducted Finland Low Frequency module of windPRO v3.5. This calculation looks at frequencies between 20 and 300 Hz. There is no specific damping profile included in the Finnish code; however, WindPRO suggests the use of three publicly available profiles.

5.2.1.2.2 Methodology

The realistic-case sound assessment used site-specific information in calculating sound levels by utilizing existing wind direction data. This model assumes downwind propagation is occurring simultaneously in all directions of the wind turbines. Sound propagation in an upwind direction would result in a significant reduction of sound levels at any receptor located upwind from the turbine. This means that the resulting sound levels from the assessment are likely calculated as higher than they would be experienced.

A ground attenuation value of 1 was used in this model to account for some absorption of sound by the surrounding environment. An ambient value of 35 dB(A) was added to the receptors in order to account for existing sound levels in addition to any sound produced by the WTGs. A demand type "2: WTG plus ambient noise is compared to ambient noise plus margin" to compare the sound levels from just the WTGs, and with the added ambient value.

No correction for special audible characteristics, such as clearly audible tones, impulses, or modulation of sound levels, was made as part of this assessment. These are not common characteristics of modern WTGs in a well-designed wind farm. It is common that WTG manufacturers guarantee the absence of tonal sound produced by the WTG. Furthermore, impulses and modulation of sound levels from the wind farm under normal conditions would not be of a level to necessitate the application of any penalty.

5.2.1.2.3 Results

Realistic-Case Sound Assessment

The results of the realistic-case sound prediction model for the receptors that are predicted to receive the expected sound levels are summarized in **Table 54**. A map of the Project area and the realistic case sound assessment contours with the receptors is included in **Appendix M.** The full results from windPRO are included in **Appendix M**. All receptors adhere to the *Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia* in that the sound levels do not exceed 40 dBA at the receptors.

Table 54 shows the expected modeled sound levels that are predicted to be experienced at each of the 11 receptors predicted to receive the highest sound levels for any wind speed from

4.0 m/s to 12.0 m/s. The highest perceived sound (WTG + Ambient) is anticipated to be 36.2 dB(A) according to the current modelling.

TABLE 54: OPERATIONAL SOUND LEVEL SUMMARY OF THE 11 RECEPTORS PREDICTED TO RECEIVE THE HIGHEST ANTICIPATED SOUND LEVELS FOR ANY WIND SPEED MODELLED BETWEEN AND INCLUDING 4 TO 12 M/S.*

Receptor ID	Realistic Case Max Sound Level from WTG [dB(A)]	Realistic Case Max Sound Level from WTG and Ambient [dB(A)]	Compliance with Nova Scotia's Requirements (under worst case assessment)
BE	29.9	36.2	Yes
Y	28.3	35.8	Yes
CD	28.3	35.8	Yes
DQ	28.3	35.8	Yes
U	28.2	35.8	Yes
V	28.2	35.8	Yes
W	28.2	35.8	Yes
BZ	28.2	35.8	Yes
CA	28.2	35.8	Yes
CB	28.2	35.8	Yes
DP	28.2	35.8	Yes

* Model assumes an ambient noise level of 35 dB[S]. The combined sound level from WTGs and ambient were combined and calculated in Windpro.

Low Frequency Sound Assessment

An additional assessment was completed through the Finland Low Frequency module of windPRO v3.5. This assessment showed a minimum frequency of 80 Hz observed at all receptors, 60 Hz higher than the threshold for infrasound.

A description of this model, its assumptions and methodologies are included in **Appendix M**. The results of the infrasound modeling show that the infrasound is not expected at the receptors since the lowest frequency created by the Project is expected to be much higher than the frequency designated as infrasound (20 Hz or less).

5.2.2 Potential Interactions and Mitigations

The potential interactions of the Project with the ambient sound levels and the proposed mitigation measures are summarized in **Table 55**.

TABLE 55: POTENTIAL INTERACTIONS AND PROPOSED MITIGATION MEASURES FOR AMBIENT SOUND LEVELS

Potential Interactions with Ambient Sound Levels	Proposed Mitigation Measures

Potential Interactions with Ambient Sound Levels	Proposed Mitigation Measures
Disturbance to receptors within the surrounding area due to use of equipment and machinery during construction and decommissioning. Disturbance to receptors within the surrounding area due to sound levels generated during operations.	1) Per industry standards, turbines have been sited minimum 1 km away from residences. 2) A sound level impact assessment has been conducted showing that sound levels anticipated at nearby dwellings are below provincial guidelines of 40 dB(A). 3) The wind turbine model selected for the Project will incorporate noise reduction technologies to mitigate sound levels generated by the moving blades, if feasible. 4) Site preparation, construction, and decommissioning activities will be limited to daytime hours when feasible. 5) Clearing of flora on the Project site will be minimized to aid in attenuation of sound levels. 6) Events with particularly high sound levels, such as blasting, will be communicated to local residents adequately and with ample time. 7) Blasting will be conducted by a certified contractor and will be limited to that which is necessary to enable the Project to be carried out. 8) A complaint resolution plan has been developed to address sound level concerns (**Appendix P**). 9) Proper sound level management measures following the Environmental Management and Protection Plan (**Appendix O**) will be instated.
Disturbance to receptors within the surrounding area due to infrasound from wind turbines during operations.	10) Infrasound from wind turbines is not anticipated to be a concern based on the project modeling and given the distance the wind turbines are located relative to dwellings.

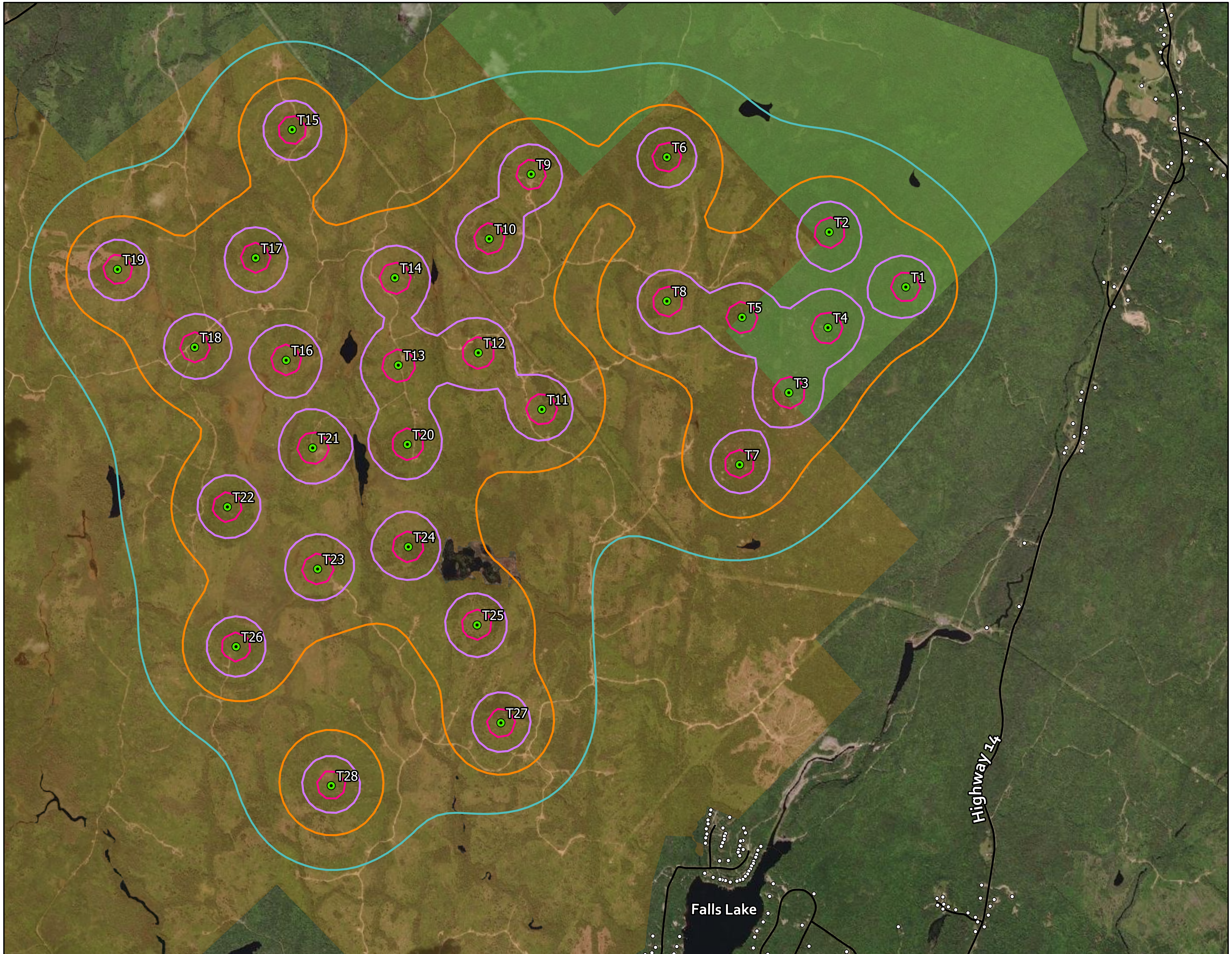
Significance of Residual Effects

Elevated sound levels caused by the construction and decommissioning phases will be temporary, during the day when possible, and short term. Sound level production from the turbines during operation have been mitigated by setback distances and confirmed by a sound level impact assessment. By using the mitigation identified above, the Project is not anticipated to have any significant residual environmental effect on sound levels for humans or wildlife outside the Project site. While any effect on ambient noise will be negative, the significance of residual effects on ambient noise is considered negligible and no follow up monitoring post-construction is recommended.

While heightened sound levels during construction activities are unavoidable, the sound level assessment for the construction period shows that sounds levels at nearby residences are not expected to be significant. Various mitigation measures will be put in place during construction to limit the heightened sound levels.

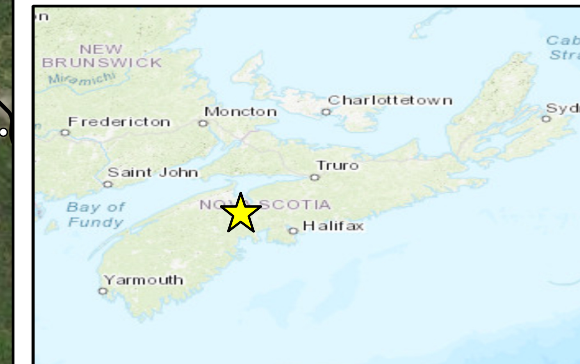
The operational sound level modelling for the Project demonstrates that the sound levels expected to be experiences at receptors under realistic conditions including ambient sound adhere to the Nova Scotia guidance. Should excessive sound emissions from the Project be reported during operation at nearby receptors, screening mitigations will be explored for feasibility in the area. Such mitigation measures for heightened sound levels could include increasing vegetation between the receptor and emitting source, and any other appropriate technology available at the time of the required mitigation.

As mentioned before, a complaint resolution plan (**Appendix P**) has also been developed for handling sound level concerns from surrounding communities. The Proponent will start the review process for complaints within 5 business days of the concern or complaint being received. The Proponent will then conduct an investigation into the complaint in collaboration with relevant parties.



Benjamins Mill Wind Project

Realistic Case Sound Assessment



Legend

- Preliminary Turbine Layout
- Receptors
- Trails
- Existing Roads
- Crown Land
- Private Lands

Sound Assessment Contours

- 35 dB(A)
- 40 dB(A) [regulated max.]
- 45 dB(A)
- 50 dB(A)

Notes

Sources
- Basedata provided by the Province of Nova Scotia
- Basemap: ESRI World Topo Map

N

Meters

0 275 550 1,100

Scale: 1:28,800

Spatial Reference: NAD 1983 UTM Zone 20N

Page Size: 11" x 17"

Production Date: Dec 7, 2022

Natural Forces

6 Archaeological and Cultural Resources

This section serves to fulfill the following request from the Minister's AIR:

8. *Provide the final Archaeological Resource Impact Assessment, reviewed and approved by Nova Scotia Communities, Culture, Tourism and Heritage.*

6.1 Archaeological Resource Impact Assessment

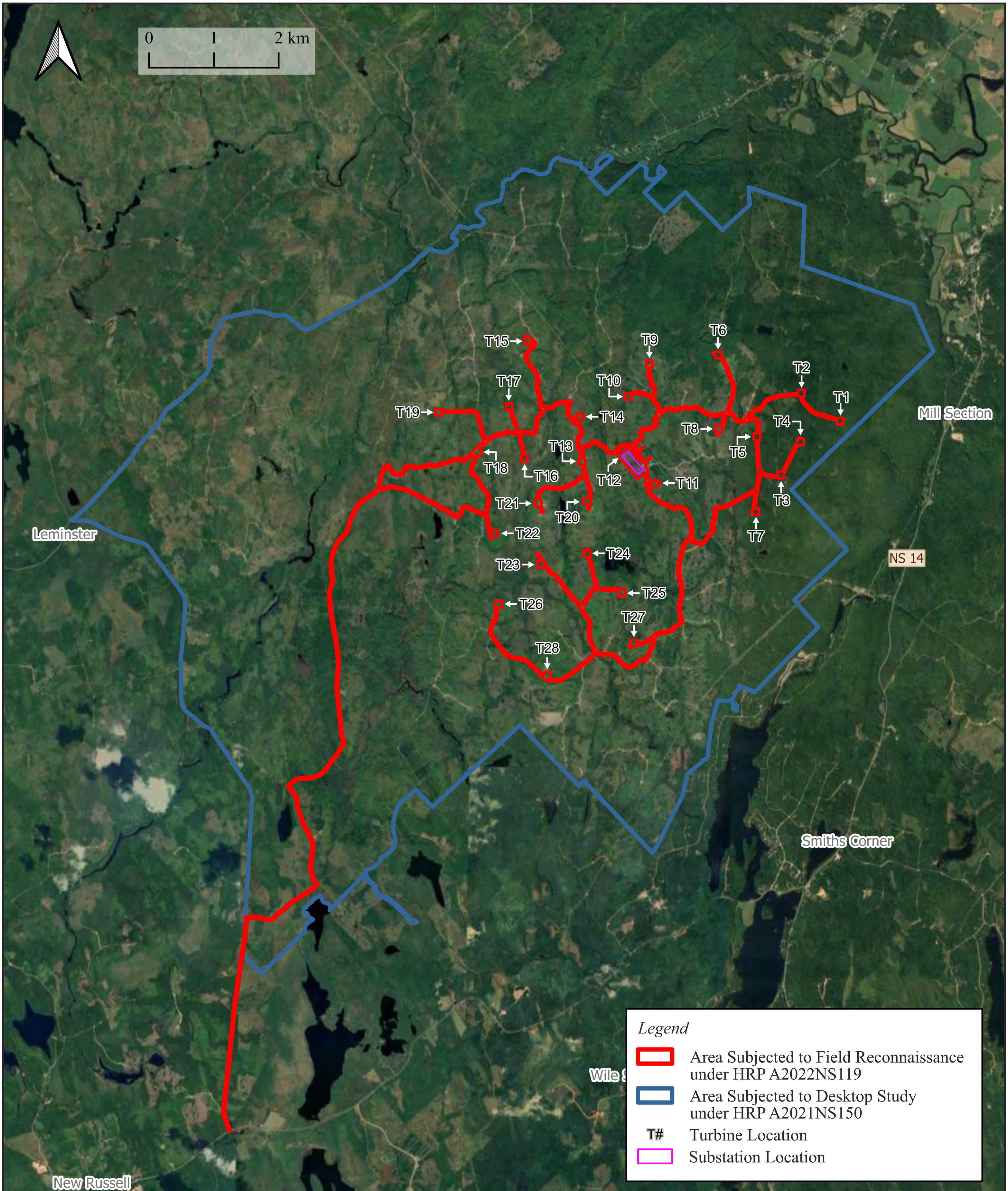
In 2021, under Heritage Research Permit A2021NS150, Cultural Resource Management (CRM) Group conducted a desktop study to screen for areas of archaeological potential within the proposed development area. It consisted of the proposed impact areas for 28 turbines (each measuring 100 metres by 100 metres), access road improvements (with a 40-metre-wide assessment corridor), collector circuits, and a substation. The study area occupied an approximate area of 70.8 hectares. Based on the desktop study, a program of archaeological field reconnaissance was recommended within any proposed infrastructure impact areas prior to any ground disturbance activity.

In 2022, an Archaeological Resource Impact Assessment (ARIA) was conducted by CRM Group Limited within the PDA under Heritage Research Permit A2022NS119. The purpose of the assessment was to determine the potential for archaeological resources within the Project and to provide recommendations for further mitigation if required. In keeping with Nova Scotia's Special Places Protection Act Heritage Research Guidelines for Category 'C' Permits, the 2022 ARIA involved Mi'kmaq engagement, potential modeling, previous work searches, historic background study and field reconnaissance within the study area identified in 2021. The ARIA was reviewed by the Department of Communities, Culture, Tourism, and Heritage (CCTH) and their Special Places program issued a response on November 24th, 2022, finding the report and recommendations for the Project acceptable. The full ARIA and the corresponding letter of approval are included in **Appendix N.**

The Study Area for the 2022 ARIA consisted of 100 m by 100 m areas around turbine bases and a 20 m buffer along new roads, collector lines, the substation, and transmission lines (**Figure 32**). In total, the study area measures approximately 70.8 hectares.

In recognition of past, present, and future Mi'kmaw ties to lands and waters in the vicinity of the Project in the Mi'kmaw district of Sɨpɨkne'katik, CRM Group contacted Kwilmu'kw Mawklusuaqn's Archaeological Research Division (KMK-ARD) to inform them of the various phases of the Project and to request any available information pertaining to traditional or historical Mi'kmaw use of the study area. The information provided by KMK-ARD assisted CRM Group in conducting background research with an approach that considered the diversity of views witnessed and experienced by a broad range of representative groups. The knowledge gained from this engagement expanded upon the results of other forms of background research, providing a better understanding of the cultural and archaeological importance of the study area. It also helped enhance a relationship of information sharing.

In response to CRM Group's inquiry, KMK-ARD provided traditional Mi'kmaw land use information that was taken into consideration when preparing the archaeological assessment. Aside from information not disclosed out of respect for its sensitive or confidential nature, the contributed knowledge is presented in the ARIA and throughout this section.



CRM Group
Cultural Resource Management Group Ltd.

Detailed Study Area

BENJAMINS MILL WIND ENERGY PROJECT
ARCHAEOLOGICAL FIELD RECONNAISSANCE 2022
BENJAMINS MILL, NOVA SCOTIA

Figure 32

November 2022

Scale: 1:75,000