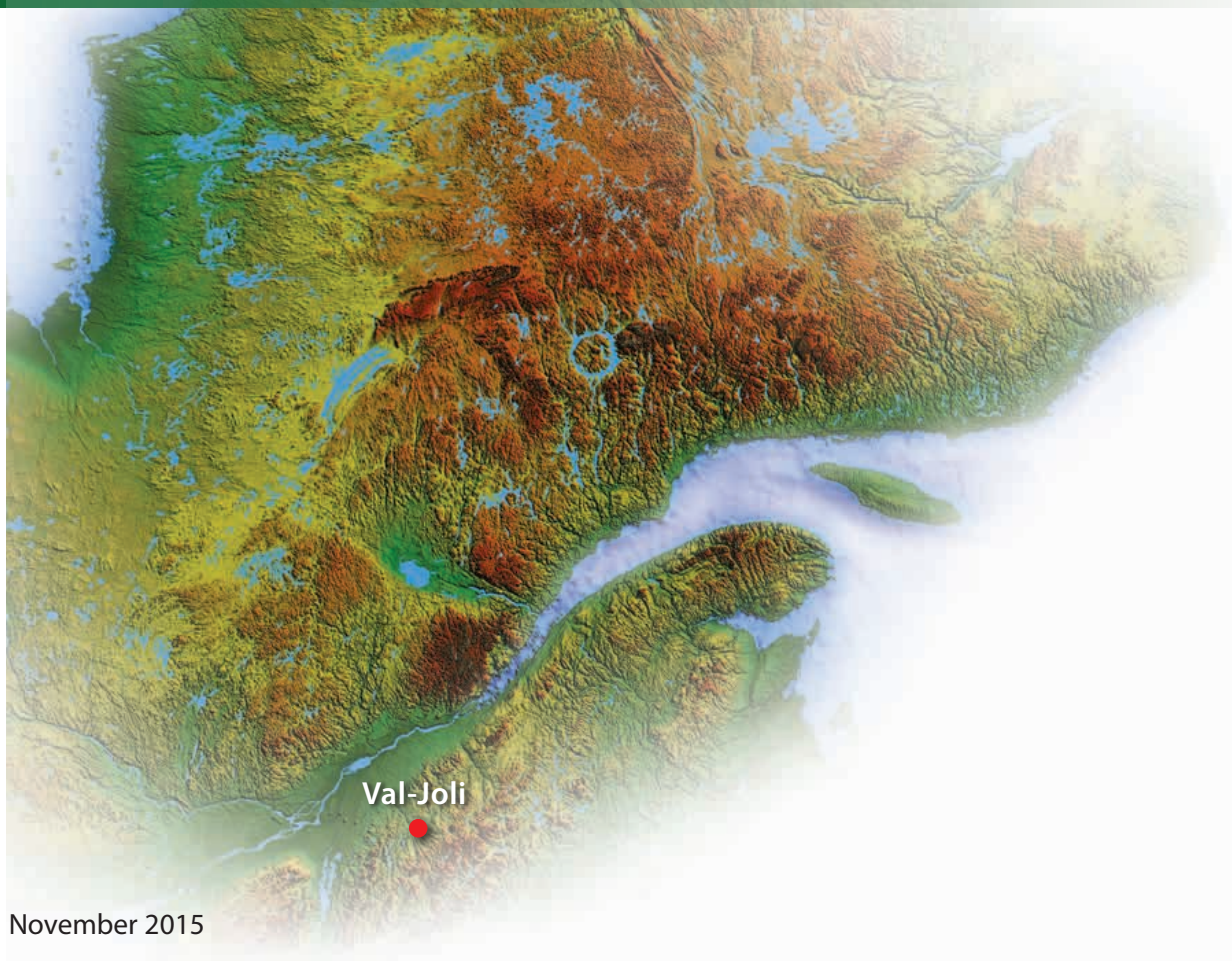
Hydro Québec
TransÉnergie

Québec–New Hampshire Interconnection

Environmental Impact Statement

Volume 2 – Appendices



November 2015

Produced by
Services de communication
Hydro-Québec

Québec–New Hampshire Interconnection

Environmental Impact Statement

Volume 2 – Appendices

Hydro-Québec TransÉnergie
November 2015

Hydro-Québec TransÉnergie is submitting this Environmental Impact Statement to the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques du Québec [Québec department of sustainable development, the environment and the fight against climate change] in accordance with section 31.1 of the Environment Quality Act*, with a view to obtaining the approvals required for construction of a 320-kV direct-current transmission line between Québec and New Hampshire.*

Given that the line will cross an international boundary, the Environmental Impact Statement, which was produced in accordance with the provincial environmental assessment procedure, will also be filed with the National Energy Board.

This is a translation of the original French text. Only the French version is official.

The Environmental Impact Statement is divided into the following three volumes:

- Volume 1 – Report
- Volume 2 – Appendices
- Volume 3 – Pocket Insert Maps

This assessment was carried out for Hydro-Québec TransÉnergie
by Hydro-Québec Équipement et services partagés and Aménatech,
in collaboration with Hydro-Québec's Direction – Affaires régionales et collectivités
and Direction – Communications.

The list of main contributors is provided in Appendix A.

Summary

Hydro-Québec plans to build a direct-current transmission line approximately 79.2 km long between Des Cantons substation and the Québec–New Hampshire border. The goal of the project is to increase our capacity to export power to New England's grids. The planned line will enable us to provide New England with up to 1,090 MW of power at 320 kV.

Des Cantons substation has been chosen as the starting point for the new transmission line for a number of reasons. Des Cantons is the 735-kV transmission substation closest to the border. Furthermore, it is already connected to the grid by three 735-kV lines that provide it with a reliable supply of power, and the substation's existing transformer capacity is sufficient to supply the new interconnection.

Since the Hydro-Québec and New England grids are not synchronized, they must be interconnected using direct-current technology. Equipment for converting alternating current to direct current will therefore be installed at Des Cantons substation, which has enough space to accommodate it.

From the very beginning of the draft-design phase and throughout the months that followed, Hydro-Québec worked with regional administrators to gather information relevant to the project and took note of their concerns. The different stages of the public participation process allowed Hydro-Québec to keep community representatives and residents informed as the project evolved, gather their comments and concerns and answer their questions.

Following a geographic narrowing-in process, Hydro-Québec determined the best location for running the line based on inventory information and environmental elements sensitive to passing a power transmission line. The inventory and analysis of the planned line's host environment shows that the area offers little possibility for opening a new line corridor. Instead, the best solution is to take advantage of the right-of-way of the existing 450-kV DC line crossing the study area from north to south and, where feasible, run the planned line beside it.

The new line can thus be paired with the existing line over about 80% of its route. Creating a new corridor cannot be avoided, however, for the south part of the line. Hydro-Québec has developed different variants for this part of the line route, taking into account the presence of a number of sensitive elements, as well as the concerns expressed by regional administrators. Over 800 m high, Mont Hereford is a major influencing factor in the area, as well as an obstacle that must be skirted for technical and landscape/environmental reasons.

After conducting a comparative analysis of the route variants for the south part of the study area, the company concluded that West Variant B would be the best option from a land-use and landscape standpoint. Furthermore, though longer in absolute terms, this variant has the advantage of being shorter in terms of the new corridor to open. Lastly, meetings with local representatives revealed that there is consensus for routing the line west of Mont Hereford.

Hydro-Québec has implemented a number of measures to ensure that the new transmission line is well integrated into the landscape all along the new route. In the north part of the route, where the new line will share the existing 450-kV line corridor, the two rights-of-way will have an average 10 m overlap, which will make the new right-of-way about 43 m wide. In particular, Hydro-Québec has developed a new tower design that will blend in with the existing one, but will not be as high. To minimize land clearing required in Forêt Hereford, Hydro-Québec will also conduct a pilot project in which trees up to 12 m high within a 9-m-wide strip of woodland on either side of the right-of-way will be preserved. This will reduce the width of the area to be cleared from 53 m to 35 m. Moreover, local communities have expressed concern about the opening of the territory in the south part of the study area, particularly in regard to the possible propagation of non-native invasive plant species (NNIS), which are not yet pervasive in the area. This concern led Hydro-Québec to propose a pilot research project, in collaboration with Université de Montréal and Forêt Hereford, with the aim of achieving better control of NNIS and plant species incompatible with power transmission lines.

Reducing the width of the right-of-way clearing area in the south part of the line route from 53 m to 35 m and using appropriate land-clearing methods in the different line segments will make it possible to limit forest stand losses to 281.5 ha. The planned right-of-way contains 53.6 ha of wetland, 44.1 ha of which will be affected by the clearing operations. However, the ecological function of these areas will not be affected. Despite concerted efforts on the part of Hydro-Québec, constraints associated with the line route, including at the point where the two lines cross and at the locations of the towers in the north part of the route (where the two lines share the same corridor), will create permanent encroachments into some wetlands. After the final distribution of the support structures has been established, but before the start of construction, Hydro-Québec will file a request with the MDDELCC for a sector-related authorization concerning the affected wetlands.

To minimize the effects on birds and bats, the land clearing will be done outside the breeding season. However, due to the anticipated loss of habitat, clearing will have an impact on forest birds, including the Canada warbler. Most of the impacts on plant and wildlife species will be reduced, due to Hydro-Québec's efforts to gain an in-depth understanding of the area and the application of the many mitigation measures established, as well as the pilot projects described above.

Along the entire length of its route, the new line will cross through private land, 82% of which falls within the protected agricultural zone. Running the new line alongside and to the east of the existing 450-kV DC line will make it possible to mitigate the impact on the properties and buildings located within the area crossed. However, one house and two buildings currently located within the right-of-way will have to be removed. Hydro-Québec has already informed the owners and is available to answer their questions and concerns. There are also six houses at the outer limit of the right-of-way. Hydro-Québec has offered to purchase these properties from the owners, if they do not wish to keep them. Discussions will be held in the near future to establish the terms under which these properties would be acquired. In regard to the acquisition of properties on protected agricultural lands, the work to be carried out and use of the right-of-way once the transmission line is in operation, Hydro-Québec will apply the provisions of the *Hydro-Québec–UPA Agreement on the Siting of Power Lines on Farms and in Woodlands*.

Communicating with property owners and land users and applying the planned measures will make it possible to mitigate the effects of the work on recreational activities practised in the area (i.e., snowmobiling, ATV riding, hiking, cross-country skiing, hunting and fishing). In addition, the scheduling and short duration of the work in each line segment will minimize inconveniences, including those caused by heavy vehicle and machinery traffic.

Running the transmission line through an existing right-of-way will reduce the impact on the landscape in the north part of the line route. In the south part, running the line to the west of Mont Hereford will significantly reduce the line's visual impact by keeping it away from the most frequented areas. From the summit of Mont Hereford, only one line segment about 10 km long (where the new line shares a corridor with the existing one) will be visible from a distance. Towers will be sited so as to to mitigate their impact in the few more open spaces in agricultural fields.

In the northern line route, perceived noise at the limits of the right-of-way will essentially be generated by the existing 450-kV transmission line. Since the new line will generate significantly less noise than the existing one, its presence will not change the noise levels in the area around the right-of-way. In the southern line route, where the new line will stand alone, any noise it generates will be so low that the crackling from the line will not be audible near the right-of-way.

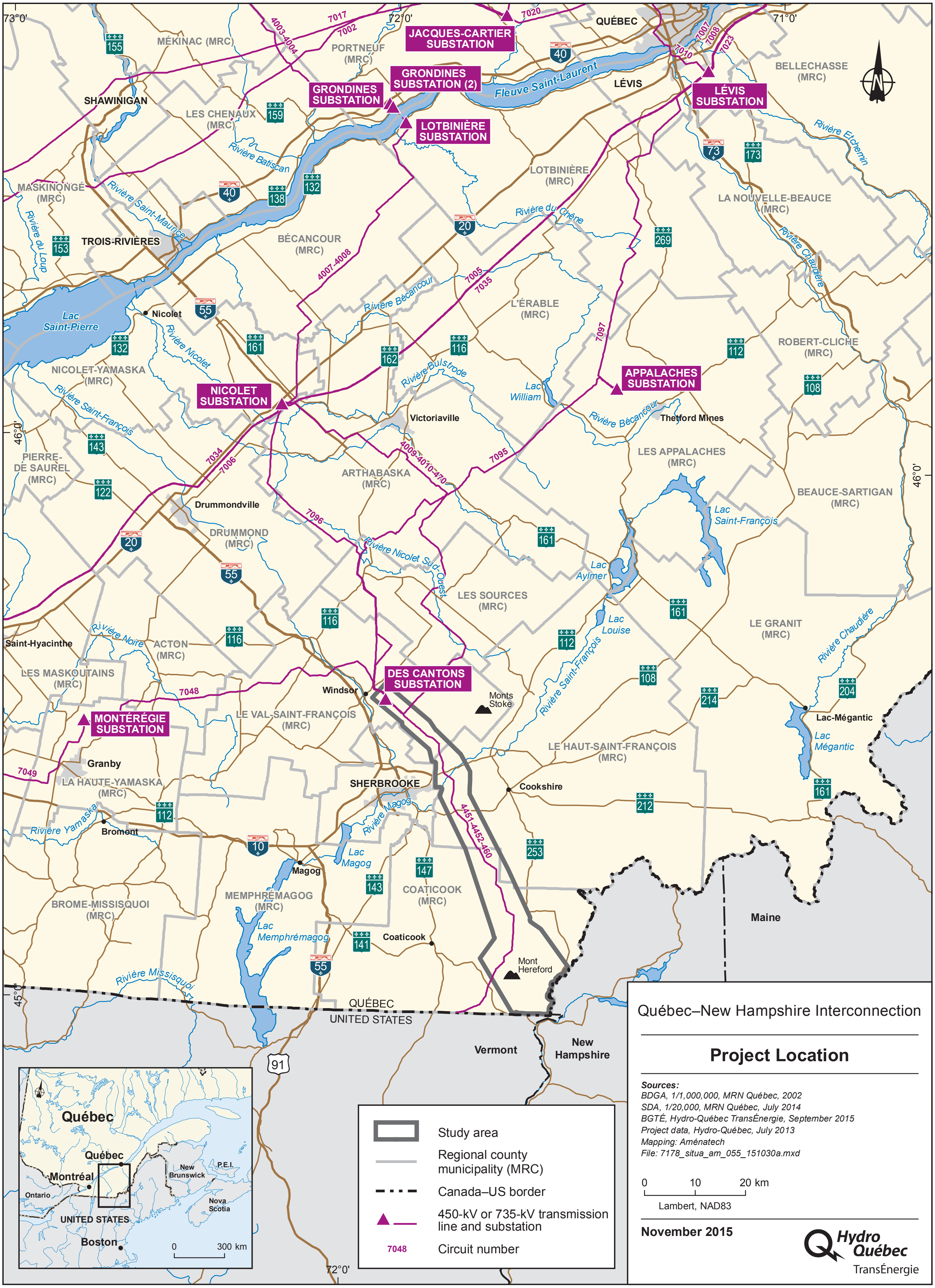
Any other impacts from the project will be minor and of a temporary nature, since they will be generated by the work itself. Hydro-Québec will implement mitigation measures that have proven effective on past projects, as well as measures specifically designed for this project.

During the public participation process, Hydro-Québec organized a number of communication activities with local residents and representatives to keep them continually informed of how the project was evolving and to take note of the public's

concerns. The option selected and presented to the public incorporates the preferences expressed by the many individuals who took part in the process.

The cost of the 320-kV transmission line between Québec and New Hampshire is estimated at $125 million. This amount includes the costs associated with building the crossing structure for the two lines, reconfiguring the 450-kV lines around Des Cantons substation and dismantling the 44-kV line.

Land clearing will begin in fall 2017. Construction of the line is slated to start in spring 2018, with a view to commissioning in spring 2019.



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B Biophysical Environment Inventory Methods

Certain components of the biophysical environment were the subject of detailed inventories whose scope and methods had been agreed on with the authorities concerned. As a basis for discussion, Hydro-Québec filed a biophysical environment inventory program in February 2014 for a meeting with representatives of the Québec and Estrie offices of the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC) and the Ministère des Forêts, de la Faune et des Parcs (MFFP). The initial inventory program was then modified and expanded based on meetings and exchanges with the Estrie regional branches of these ministries (e.g., the bat inventory method was modified and investigation of habitat potential for southern flying squirrel and rock vole was included).

This Appendix describes the methods used for each inventoried component, taking into account the modifications requested by the MDDELCC and the MFFP. Inventory stations and findings are shown on Map C, Volume 3.

B.1 Description of study area and detailed inventory area

Two scales of analysis were used, depending on the work planning stage: the study area and the detailed inventory area.

The **study area** was used mainly to obtain greater knowledge of the project's host environment: species potentially present over a large area were identified and an overall picture of the surrounding environment was obtained. The study area is a 5- to 7-km band running northwest–southeast that follows the route of the existing 450-kV line south from Des Cantons substation to about 15 km from the Canada–U.S. border and then widens to about 15 km, to include the different line route variants considered, before connecting up with the New Hampshire grid. The study area covers a total of 571 km^2 in the regional county municipalities (MRCs) of Val-Saint-François, Haut-Saint-François and Coaticook. It is shown on a three-sheet 1/35,000-scale map in Volume 3 (Map A).

The **detailed inventory area** was used for more precise planning of the inventories to be carried out (see Map C). A closer-scale picture of the environment was thus obtained and species directly affected by the planned line were identified. The components of the study area are described in general, while the detailed inventories provide more in-depth information about some of them.

The detailed inventory area was determined based on the different route variants studied, as follows:

- In the north part of the line route (where the planned line is paired with the existing 450-kV line), the inventory area is a strip 100 m wide east of the existing power line.
- In the south part of the line route, the inventory area is a strip 50 m wide on either side of the proposed route variants.

Specific plant and animal surveys were conducted in the detailed inventory area. For certain components (birds, for example), the size of the detailed inventory area varied. Details are given in the description of the method used for the component concerned.

B.2 Wetlands

Hydro-Québec has adopted the definition of wetlands accepted and used by the MDDELCC: land areas saturated with water or flooded for long enough to affect components of soil and vegetation present (Couillard and Grondin, 1986, cited by Bazoge et al., 2014).

The wetland classification system used by Hydro-Québec is based on the guide entitled *Identification et délimitation des milieux humides du Québec méridional* (Bazoge et al., 2014). However, the system was adapted to the wetlands found in the study area based on photo interpretation (see Table B-1).

B.2.1 Photo interpretation

In 2011, photo interpretation of 1:15,000-scale panchromatic aerial photographs from flyovers in 2007 (the most recent aerial photo coverage available in stereoscopic pairs) was used to check wetland presence throughout the study area[1]. Two types of interpretation criteria were used: indicative and deductive.

[1] An environmental assessment was launched in 2010-2011 for construction of a new line in the same study area. The environmental inventories and technical studies conducted at the time included wetland photo interpretation.

Table B-1: Wetland Categories

Type of wetland	Definition	Category
Shallow water	Areas of shallow water (less than 2 m deep at low water) with less than 25% areal cover of emergent vegetation and submerged or floating aquatic vegetation.	Shallow water
Beaver pond	Body of water upstream of a beaver dam.	Beaver pond
Marsh	Site dominated by herbaceous vegetation (emergent vegetation, grasses or broad-leaved plants) growing in mineral or organic soil. Trees and shrubs, when present, constitute less than 25% of the areal cover. Marshes are generally associated with fluvial, riparian or lacustrine areas, with water level varying depending on tides, flooding and evapotranspiration. A marsh can be flooded permanently, semi-permanently or temporarily.	Marsh (low marsh) Wet meadow (High marsh)
Swamp	Site dominated by woody plants (trees or shrubs) growing on poorly or very poorly drained mineral soil and constituting more than 25% of the areal cover. Riparian swamps are subject to seasonal flooding or characterized by a high water table and circulation of water rich in dissolved minerals. Isolated swamps are fed by runoff or groundwater resurgence.	Shrub swamp Treed swamp
Peatland	Wetland where production of organic matter exceeds its decomposition, regardless of the composition of the plant remains. The result is a natural accumulation of peat, an organic soil. Peatland soil is poorly or very poorly drained, and the water table is generally at ground level or close to the surface. Peatland can be open (no trees) or treed. In treed peatland, trees over 4 m high make up at least 25% of the areal cover. There are two types of peatland: • Fens – Groundwater is the main source of minerals and water – Mineral-rich acidic water – Presence of brown mosses and herbaceous plants • Bogs – Precipitation and wind are the main sources of minerals and water – Mineral-poor acidic water – Dominated by peat moss, together with trees and shrubs	Open fen Treed fen Open bog Treed bog

Indicative criteria

"Indicative criteria" refers to variables that can easily be identified on aerial photographs and that have a direct influence on wetland formation. Indicative criteria are of two types:

- Geomorphologic: variables likely to affect drainage and surface water flow patterns (e.g., terrain, slope, nature of the soil and hydrographic features).
- Anthropogenic: variables of anthropogenic origin likely to affect drainage conditions and promote wetland formation at a particular site. In some cases, these interfere with drainage (e.g., a road or embankment) and in others they cause an increase in runoff at the site (e.g., a storm sewer).

Deductive criteria

Deductive criteria were used to complement the indicative criteria. These criteria refer to variables that cannot be identified on an aerial photo—for example, when trying to determine the boundaries of a wet brushland formed recently due to a rise in the water table. Application of these criteria relies on the experience of the photo interpreter and his/her ability to interpret the simultaneous presence of several variables, such as shape, size, texture, color and spatial organization.

The maps of the study area were then compared with available databases, such as the MFFP's ecoforestry information system (SIEF), the Québec topographic database (BDTQ) and data from Canards Illimités Canada, to ensure that all previously identified wetlands were included. In addition, the wetlands in the detailed inventory area were visually verified using the 2010 digital orthophotos.

As the photo interpretation of 2011 was deemed still valid, a new one was not performed. However, the wetlands present in the detailed inventory area were verified using the 2013 orthophotos to update the maps based on current land use.

B.2.2 Field inventories

The guide entitled *Identification et délimitation des milieux humides Québec méridional* (Bazoge et al., 2014) was used for wetland delineation and characterization. Wetland spatial boundaries were determined using the basic vegetation rule, soil characterization (hydromorphic or not) and field observations of hydrological indicators (e.g., appearance of litter and configuration of tree roots).

In characterizing the wetlands, special attention was paid to hydrologic connections, special-status plants and non-native invasive plant species. All signs of animal presence were also noted. All information was manually entered on standard field data sheets and the delineation was performed using a portable GPS unit.

In the case of large wetlands, or wetlands mainly located outside the detailed inventory area, the focus was on delineating and characterizing areas likely to be affected by the project. When necessary, several observation points were used to cover each homogeneous sector of the wetland that might be subject to possible impacts.

B.2.3 Validation period

All wetlands in the detailed inventory area of any of the variants studied, a total of 58 wetlands, were inspected in the spring and summer of 2015. Sphagnum bogs, however, were inspected early in the spring of 2015 to check for presence of four-toed salamander nests.

B.2.4 Ecological value assessment

Ecological value was assessed using a multivariate analysis developed by Groupe S.M. International (SMi) that incorporates a range of ecological indicators. The method is based on the MDDEP's *Guide d'élaboration d'un plan de conservation des milieux humides* (Joly et al., 2008) together with the method suggested by Renaud and Sabourin (2006) and the one recommended in the *Guide de caractérisation des milieux humides* (Hydro-Québec Distribution, 2011).

For purposes of this project, it was the "absolute" value of the wetlands that was determined on the basis of their overall interest in the detailed inventory area.

B.2.4.1 Criteria

The following criteria were used for the multivariate wetland analysis:

- Size
- Presence of special-status species
- Presence of invasive species
- Uniqueness
- Maturity
- Degree of disturbance
- Occupation of adjacent uplands
- Habitat heterogeneity
- Presence of hydrologic connections
- Irreplaceability

Criterion 1: Size

Size is a key criterion in assessing biodiversity potential. MacArthur and Wilson's island biogeography theory (1967) establishes a correlation between size and biodiversity. In fact, a larger area allows for the appearance of a larger number of components in the biophysical environment, which in turn creates more ecological niches and greater species richness. Size is also a key variable in maintaining plant and animal habitats, because protecting a species of concern requires an area large enough to meet its needs. Table B-2 shows the scoring system for size.

Table B-2: Ecological Value of Wetlands – Scoring for Size

Wetland size	Points
More than 120.7 ha	5
66.9 to 120.7 ha	4
34.5 to 66.8 ha	2
10.9 to 34.4 ha	1
Less than 10.9 ha	0

Criterion 2: Presence of special-status species

The presence of threatened or vulnerable plant or animal species increases the ecological and conservation value of a biophysical environment. Special-status species are also generally good indicators of an environment that is mature or has rare features. Ecosystems harboring special-status species are thus environments of higher value whose conservation should be given priority. In addition, threatened and vulnerable species are legally protected in Québec.

Species designated as threatened or vulnerable are valued more highly than species likely to be designated as threatened or vulnerable, which in turn are valued more highly than species vulnerable to commercial harvest. Table B-3 shows the scoring system for presence of special-status species.

Table B-3: Ecological Value of Wetlands – Scoring for Presence of Special-status Species

Type of special-status species[a]	Points
Known presence of species designated as threatened or vulnerable	5
Known presence of species likely to be designated threatened or vulnerable (LDTV)	3
Known presence of species vulnerable to harvest	1
No special-status species	0

a. The number of species inventoried and the number of records are considered in the assessment.

Criterion 3: Presence of invasive species

Presence of invasive species is generally associated with a loss of biodiversity and major alterations in habitats and ecosystems. In this study, the scope of the problem is expressed by the total invasive species cover in the wetland. Table B-4 shows the scoring system for presence of invasive species.

Table B-4: Ecological Value of Wetlands – Scoring for Presence/Absence of Invasive Species

Invasive species cover	Points
Less than 5%	5
6 to 25%	3
26 to 50%	2
51 to 75%	1
More than 76%	0

Criterion 4: Uniqueness

The uniqueness criterion identifies biophysical environments that are rare in the area studied or the region. In determining whether a wetland was common, unusual or rare, the acreage it occupies within the study area was considered. The portrait of Estrie wetlands developed by Canards Illimités Canada was used to assess wetland type rarity (2007). In addition, the representativeness of the moist plant communities in each wetland type (pond, marsh, swamp and peatland) was also analyzed. The rarity of the wetland type and of the plant community was thus considered in calculating wetland uniqueness (see Table B-5).

Table B-5: Ecological Value of Wetlands – Scoring for Uniqueness

Wetland uniqueness	Points
(Rarity of wetland type + rarity of plant community) ÷ 2	0 to 5

Criterion 5: Maturity

This criterion is used to evaluate wetland maturity based on observed complexity or age, depending on the type. Ecological niches or habitats are generally more diverse in older or highly structured wetlands, which makes such wetlands more resilient and more likely to shelter a wider variety of species.

For purposes of analysis, when several wetlands of varying ages and complexity were present, the complexity or age that resulted in the highest score was used. Table B-6 shows the scoring system for wetland maturity.

Table B-6: Ecological Value of Wetlands – Scoring for Maturity

Wetland maturity	Points
Pond, marsh or shrub swamp – Structure	
Highly structured	5
Moderately structured	3
Poorly structured	0
Treed swamp – Age	
Mature, old, centenary (over 80 years old)	5
Intermediate-aged (30 to 80 years old)	3
Young (10 to 30 years old)	0

Criterion 6: Degree of disturbance

Disturbance includes encroachment or destruction. Disturbance intensity affects a wetland's biodiversity and reduces its carrying capacity. Higher ecological value is accorded to wetlands that are intact or present little disturbance. Table B-7 shows the scoring system for degree of wetland disturbance.

Table B-7: Ecological Value of Wetlands – Scoring for Degree of Disturbance

Degree of wetland disturbance	Points
Minor disturbance, barely visible	5
Mild disturbance confined to a small part of the wetland (e.g., hiking trail)	3
Moderate disturbance (e.g., power line or ATV trail)	1
Major disturbance (e.g., clearing or construction)	0

Criterion 7: Occupation of adjacent uplands

The nature of the area around a biophysical environment often determines its sustainability and plays a key role in its diversity. A wetland mainly in natural surroundings is of greater interest and has a better chance of long-term survival than a wetland surrounded by agricultural, urban or industrial areas.

To score this criterion, the percentage (decimal value) of the mapped area devoted to different land uses within a 100-m radius of the wetland was determined. The values obtained were then multiplied by a factor of 5, 2 or 0, as appropriate (see Table B-8). The sum of the products gives a score ranging from 0 to 5.

Table B-8: Ecological Value of Wetlands – Scoring for Occupation of Adjacent Uplands

Type of environment in adjacent uplands	Points
Natural area	Percentage (decimal value) × 5
Agricultural area	Percentage (decimal value) × 2
Urban area	Percentage (decimal value) × 0
Total	**5 or under**

Criterion 8: Habitat heterogeneity

Habitat diversity in a wetland increases ecological value, as it determines the number of ecological niches available and the capacity to sustain a diversity of species. To score this criterion, the number of distinct moist plant communities was determined. Table B-9 shows the habitat heterogeneity scoring system based on the number of distinct plant communities within the wetland.

Table B-9: Ecological Value of Wetlands – Scoring for Habitat Heterogeneity

Number of distinct plant communities	Points
3 or more distinct plant communities	5
2 distinct plant communities	2
1 plant community	0

Criterion 9: Presence of hydrologic connections

The presence of a stream is a positive element when assessing the ecological value of a wetland. Water connects ecosystems and promotes exchanges between different environments mainly because wildlife species that use the water often also use the natural riparian corridors to move from one area to the next.

Taken into account as well were ditches, though not formally considered streams, because they constitute hydrologic connections for plants and animals. In the case of a wetland with several types of hydrologic connections, the type providing the most points was used. Table B-10 shows the scoring system for the presence of hydrologic connections.

Table B-10: Ecological Value of Wetlands – Scoring for Presence of Hydrologic Connections

Hydrologic connection	Points
Presence of a large stream (Rivière Saint-François)	5
Presence of a perennial stream	3
Presence of an intermittent stream	1
No direct connection to surface water network	0

Criterion 10: Irreplaceability

An irreplaceability value was attributed to each fragment (forest or wetland) within a given reference territory in Phase 1 of the identification of biodiverse environments in Estrie, which was part of the regional plan for integrated land and natural resources development (PRDIRT) drafted by the Commission régionale sur les ressources naturelles et le territoire de l'Estrie (CRRNT de l'Estrie, 2011). The territory covered by the PRDIRT includes the entire project study area. The PRDIRT's irreplaceability digital layer was used for the analysis.

Wetlands located in a polygon whose features are deemed irreplaceable were scored high. Given the scale of the analysis, if a wetland or a 50-m wide buffer zone around it was in contact with a polygon considered irreplaceable, it was also valued higher than other environments. Table B-11 shows the scoring system for irreplaceability.

Table B-11: Ecological Value of Wetlands – Scoring for Irreplaceability

Wetland irreplaceability	Points
More than 66% of the wetland within a polygon designated as irreplaceable	5
Wetland or 50-m wide buffer zone in contact with a polygon designated as irreplaceable	3
Wetland not considered irreplaceable	0

B.2.4.2 Weighting

Not only the criteria selected but the weight, or relative value, attributed to them are crucial factors in determining the ecological value of a biophysical environment (Joly et al., 2008). To facilitate comparisons, a 0-to-5 scoring system was used for all criteria. The scores were then weighted to accord greater importance to certain criteria. To determine the weighting, the Delphi method—a technique for consensus building among experts in a particular field through a feedback process—was used. A consensus was thus obtained on the weighting of each of the criteria given the context and objectives of this study. The weighting factors derived from this consensus are shown in Table B-12.

The ecological value is the sum of the weighted scores:

$$\text{Ecological value} = \frac{\sum (\text{score for criterion } x \times \text{weight of criterion } x)}{5}$$

Table B-12: Wetland Ecological Value – Criteria Weighting Factors

Criterion	Weighting factor
Size	15
Presence of special-status species	15
Presence of invasive species	5
Wetland uniqueness	10
Wetland maturity	5
Degree of disturbance	5
Occupation of adjacent uplands	10
Habitat heterogeneity	10
Presence of hydrologic connections	15
Wetland irreplaceability	10
Total	**100**

B.2.4.3 Ecological value categories

Table B-13 lists the ecological value categories.

Table B-13: Wetland Ecological Value Categories

Ecological value	Points
Very high	57 and over
High	46-56
Good	36-45
Moderate	26-35
Low	0-25

B.3 Special-status plant species

Endangered plant species in Québec are protected by the *Act respecting threatened or vulnerable species* (Section 16). Species protected by this law are designated as follows:

- **Threatened:** a species facing imminent extirpation.

  > Species designated as threatened are highly endangered. Population size and/or geographic range of the species is small or greatly reduced, and available evidence indicates the situation will inevitably get worse if nothing is done to reverse the factors leading to extirpation. In other words, if the current situation persists, extirpation of the species can be expected more or less in the short term (CDPNQ, 2008, our translation).

- **Vulnerable:** a species whose survival is at risk but whose extirpation is not anticipated.

  > Vulnerable species are those whose survival is at risk in the medium or long term. If measures are not taken to ensure the survival of these species, there is a risk that their populations will decline or their habitats deteriorate (CDPNQ, 2008).

- **Vulnerable to harvest:** a species subject to harvest pressure owing to its commercial value in food and horticultural markets. The general prohibitions under Section 16 of the Act do not apply in their entirety to these species; they apply only to harvesting of more than five whole specimens and trading of any specimens (aboveground or underground parts) harvested from a wild population (Québec, MDDELCC, 2014).

The designation "species likely to be designated threatened or vulnerable" has also been used, for species not yet officially designated but likely to be if their situation deteriorates, though the provisions of Section 16 do not apply to such species. These species are monitored by the Centre de données sur le patrimoine naturel du Québec (CDPNQ).

B.3.1 Assessment of potential presence

Hydro-Québec drafted a list of species potentially present in the study area based on the following: consultation of the CDPNQ database (2014); the document issued by the Commission régionale sur les ressources naturelles et le territoire de l'Estrie (CRRNT, 2010); the guides to identifying woodland habitats of threatened or vulnerable plant species in the Capitale-Nationale, Centre-du-Québec, Chaudière-Appalaches and Mauricie regions (Dignard et al., 2008) and in the Outaouais, Laurentides and Lanaudière regions (Couillard et al., 2012); and the Corridor appalachien report (ACA, 2011). The list is shown in Table B-14.

Table B-14: Special Status Plant Species Potentially Present in the Study Area

Species	Source(s) of reports	Status		Habitat [b]	Optimal survey period [c]	Potential presence in the study area			Planned inventory
		Québec [a]	Canada			Potential	Habitat	Rationale	
Lance-leaved arnica (*Arnica lanceolata ssp. lanceolata*)	CRRNT de l'Estrie, 2010	LDTV	—	Steep, rocky or gravel streambanks and wet bluff ledges.	Summer	Yes	Streams	Presence of streams	Summer
Canada wild ginger (*Asarum canadense*)	ACA, 2011	Vulnerable to harvest	—	Maple-hickory-linden stand. Rich calcareous settings or near a stream.	Spring and summer	Yes	Woodlands	Presence of maple stands and presence of the species in the study area	Summer
Rugulose grapefern (*Sceptridium rugulosum*)	CRRNT de l'Estrie, 2010	LDTV	—	Sandy clearings or brushland, open dunes and wooded streambanks.	Fall	Yes	Open environments and streams	Presence of open environments and wooded stream crossings	Summer
Blunt-lobe grapefern (*Sceptridium oneidense*)	CRRNT de l'Estrie, 2010	LDTV	—	Moist, acidic woodland and shady settings.	Fall	Yes	Woodlands	Presence of woodland	Summer
Calypso (*Calypso bulbosa var. americana*)	CRRNT de l'Estrie, 2010	LDTV	—	Moist, mossy, sometimes rocky coniferous forest, often close to water, cedar or spruce forest and peatland. Facultative wetland calcicole.	Spring	Yes	Wetlands	Presence of peatland and other types of wetland	Specific date
Two-leaved Toothwort (*Cardamine diphylla*)	ACA, 2011	Vulnerable to harvest	—	Maple-hickory-linden-yellow birch stands and elm-ash stands. Humus-rich soil that is very moist in spring.	Spring and summer	Yes	Woodlands	Presence of maple stands and presence of the species in the study area	Spring
Tinged sedge (*Carex tincta*)	CRRNT de l'Estrie, 2010	LDTV	—	Creeks, gravelly or sandy shorelines and fields, sandpits, gravel pits and ditches.	Summer	Yes	Streams	Presence of several stream crossings	Summer
Bailey's sedge (*Carex baileyi*)	CRRNT de l'Estrie, 2010	LDTV	—	Wet mountain woodland, wet semi-open settings (e.g., along creeks and logging roads), seeps and shorelines. Facultative wetland plant.	Summer	Yes	Wetlands and streams	Presence of wetlands and stream crossings	Summer
Swan's sedge (*Carex swanii*)	CRRNT de l'Estrie, 2010	LDTV	—	Semi-open, rocky, dry woodland, maple stands and hemlock stands.	Summer	Yes	Woodlands	Presence of maple stands and other woodland	Summer
Appalachian sedge (*Carex appalachica*)	CRRNT de l'Estrie, 2010	LDTV	—	Well-drained, rocky settings, dry to mesic woodland, forest edges, clearings and crags.	Summer	Yes	Woodlands and open environments	Presence of woodland and open environments	Summer
Prairie sedge (*Carex prairea*)	CRRNT de l'Estrie, 2010	LDTV	—	Wet meadows, fens and calcareous swamp. Facultative wetland calcicole.	Summer	Yes	Wetlands	Presence of peatland and other types of wetland	Summer
Long sedge (*Carex folliculata*)	CRRNT de l'Estrie, 2010	LDTV	—	Wetlands, marsh, swamps, peatland edges, red-maple forest. Facultative wetland plant.	Summer	Yes	Wetlands	Presence of peatland and other types of wetland	Summer
Showy lady's slipper (*Cypripedium reginae*)	CDPNQ, 2014	LDTV	—	Peatland, cedar groves, partially open or semi-open calcareous swamps and coniferous fens. Facultative wetland calcicole.	Early summer	Yes	Wetlands	Presence of peatland and other types of wetland	Summer
Walking-fern spleenwort (*Asplenium rhizophyllum*)	CRRNT de l'Estrie, 2010	LDTV	—	Sugar maple-butternut-bitternut hickory-yellow birch-white cedar forest, on shaded, mossy limestone. Calcicole.	At all times	Yes	Woodlands	Presence of maple stands	Summer
Ebony spleenwort (*Asplenium platyneuron*)	CRRNT de l'Estrie, 2010	LDTV	—	Open to shaded woodland on exposed calcareous rock, clearings and thickets. Calcicole.	At all times	Yes	Woodlands and open environments	Presence of woodland and open environments	Summer
Goldie's woodfern (*Dryopteris goldiana*)	ACA, 2011	Rare	—	Maple stands with moist, humus-rich soil, wet sites (e.g., streambanks) and sometimes rock slopes.	Summer	Yes	Woodlands	Presence of maple stands and presence of the species in the study area	Summer
Robbin's spikerush *(Eleocharis robbinsii*)	CRRNT de l'Estrie, 2010	LDTV	—	Shallow water, marshes and lake mud flats/shorelines. Obligate wetland plant.	Late summer	Yes	Wetlands	Presence of wetlands and shallow water areas	Summer
Lanceleaf wild licorice (*Galium lanceolatum)*	ACA, 2011	Rare	—	Dry woodland.	Summer	Yes	Woodlands	Presence of dry woodland	Summer
Roundleaf orchis (*Galearis rotundifolia*)	CRRNT de l'Estrie, 2010	LDTV	—	Northern white cedar-black spruce-larch-pine swamp, cedar groves and mossy, wet coniferous woodland. Obligate wetland calcicole.	Summer	Yes	Wetlands	Presence of peatland	Summer
Showy orchis (*Galearis spectabilis*)	CDPNQ, 2014	LDTV	—	Rich relatively open sugar maple-beech stands, sometimes at the bottom of slopes.	Spring	Yes	Woodlands	Presence of maple stands	Spring
Closed gentian (*Gentiana clausa*)	CRRNT de l'Estrie, 2010	LDTV	—	Rich forest edges, sunny prairies and moist meadows, open and often riparian swamps and mixed woodland, and ditches. Facultative wetland plant.	Late summer	Yes	Wetlands	Presence of wetlands	Summer
American ginseng (*Panax quinquefolius*)	CDPNQ, 2010	Threatened	Endangered	Rich woods, sugar maple-butternut-linden-bitternut hickory stands, often at the bottom of slopes on soil enriched by lateral drainage.	Summer	Yes	Woodlands	Presence of maple stands	Summer

Table B-14: Special-status Plant Species Potentially Present in the Study Area *(continued)*

Species	Source(s) of reports	Status		Habitat [b]	Optimal survey period [c]	Potential presence in the study area			Planned inventory
		Québec [a]	Canada			Potential	Habitat	Rationale	
Downy rattlesnake-plantain (*Goodyera pubescens*)	CRRNT de l'Estrie, 2010	Vulnerable	—	Mature deciduous or mixed, mesic or moist sugar maple-beech-red oak-white cedar-white pine-red maple stands on flat terrain or near a creek on sloping terrain.	At all times	Yes	Woodlands	Presence of maple stands and other woodland	Summer
Long-leaved bluets (*Houstonia longifolia*)	CRRNT de l'Estrie, 2010	LDTV	—	Dry, open rocky or gravel settings, shorelines, slopes and slaty ledges.	Spring	Yes	Streams	Presence of stream crossings	Spring
Bluntleaf waterleaf (*Hydrophyllum canadense*)	CDPNQ, 2010	Threatened	—	Rich, moist sugar maple forest.	Summer	Yes	Woodlands	Presence of maple stands	Summer
Whorled yellow loosestrife (*Lysimachia quadrifolia*)	CRRNT de l'Estrie, 2010	LDTV	—	Dry or wet open woodland, sandy heathland, thickets and sandy upper shorelines.	Summer	Yes	Woodlands and streams	Presence of woodland and stream crossings	Summer
Ostrich fern (*Matteuccia struthiopteris*)	ACA, 2011	Vulnerable to harvest	—	Moist, rich deciduous forest, floodplains and ditches.	Summer	Yes	Woodlands	Presence of maple stands and other woodland and presence of the species in the study area	Summer
Great St. John's-wort (*Hypericum ascyron subsp. pyramidatum*)	CRRNT de l'Estrie, 2010	LDTV	—	Ditch edges and open environments, upper shorelines, streambanks, and moist and partially shaded fields and bluffs.	Summer	Yes	Open environments and streams	Presence of open environments and wooded stream crossings	Summer
Woodland muhly (*Muhlenbergia sylvatica*)	CRRNT de l'Estrie, 2010	LDTV	—	Moist, rich deciduous forest and rocky shorelines. Facultative wetland plant.	Late summer	Yes	Wetlands and streams	Presence of wetlands and stream crossings	Summer
Butternut (*Juglans cinerea*)	CDPNQ, 2014	LDTV	Endangered	Rich mesic or wet relatively open forest, riverbanks, sugar maple forest, bottomland, brushland and fields.	At all times	Yes	Woodlands, open environments and streams	Presence of maple stands, other woodland, stream crossings and open environments	Summer
Green arrow-arum (*Peltandra virginica*)	CRRNT de l'Estrie, 2010	LDTV	—	Swamps, marshes, shores and shallows of rivers, lakes and streams. Obligate wetland plant.	Summer	Yes	Wetlands and streams	Presence of wetlands and stream crossings	Summer
Broad beechfern (*Phegopteris hexagonoptera*)	CRRNT de l'Estrie, 2010	Threatened	—	Sugar maple forest and bottomland forest with rich, often wet and rocky soil near a creek.	Summer	Yes	Woodlands	Presence of maple stands	Summer
Large round-leaved orchid (*Platanthera macrophylla*)	CRRNT de l'Estrie, 2010	LDTV	—	Mesic mixed sugar maple-hemlock-beech forest.	Early summer	Yes	Woodlands	Presence of maple stands and other woodland	Specific date
Van Brunt's Jacob's-ladder (*Polemonium vanbruntiae*)	CDPNQ, 2014	Threatened	Threatened	Alder thickets and riparian meadows, wet clearings in coniferous or mixed forest, seepy areas at the bottom of slopes and wet abandoned fields. Facultative wetland plant.	Early summer	Yes	Wetlands	Presence of wetlands and presence of species in the study area	Summer
Budding pondweed (*Potamogeton pusillus ssp. gemmiparus*)	CRRNT de l'Estrie, 2010	LDTV	—	Acidic shallow water of lakes, rivers, ponds and creeks. Obligate wetland plant.	Summer	Yes	Streams	Presence of several stream crossings	Summer
Marsh mermaidweed (*Proserpinaca palustris*)	CRRNT de l'Estrie, 2010	LDTV	—	Shallow, still or slow-moving water, muddy shoreline, marshes, swamps, lakes and fens. Obligate wetland plant.	Summer	Yes	Wetlands	Presence of peatland and other wetlands	Summer
Virginia mountainmint (*Pycnanthemum virginianum*)	CRRNT de l'Estrie, 2010	LDTV	—	Open, rocky or gravelly, often calcareous and rarely sandy, dry to wet shorelines and riparian alvars.	Late summer	Yes	Streams	Presence of stream	Summer
Northern dewberry (*Rubus flagellaris*)	CRRNT de l'Estrie, 2010	LDTV	—	Sandy savannas, dry peatland, acidic rocky shoreline and outcrops, bluffs, open woodland and roadsides.	Summer	Yes	Open environments and streams	Presence of open environments and stream crossings	Summer
Hidden spikemoss (*Selaginella eclipes*)	CDPNQ, 2010	LDTV	—	Relatively open wetlands, sand, wet meadows, bare shoreline, swamps, mossy calcareous outcrops in flood zones and riparian alvars. Facultative wetland plant.	Summer	Yes	Wetlands	Presence of wetlands	Summer
Case's lady's-tresses (*Spiranthes casei var. casei*)	CRRNT de l'Estrie, 2010	LDTV	—	Open, dry, acidic, rocky or sandy barrens, rock outcrops, clearings, sandpits, brushland and roadsides.	Late summer	Yes	Open environments	Presence of open environments	Summer
Shining lady's-tresses (*Spiranthes lucida*)	CRRNT de l'Estrie, 2010	LDTV	—	Rocky or sandy shorelines, swamps, riparian alvars and grassy wetlands flooded in spring. Obligate wetland calcicole.	Early summer	Yes	Wetlands and streams	Presence of wetlands and stream crossings	Specific date
Bog starwort (*Stellaria alsine*)	CRRNT de l'Estrie, 2010	LDTV	—	Calcareous, rocky, source wetland, river and creek banks. Obligate wetland calcicole.	Summer	Yes	Wetlands and streams	Presence of wetlands and stream crossings	Summer
Humped bladderwort (*Utricularia gibba*)	CRRNT de l'Estrie, 2010	LDTV	—	Shallow, still or slow-moving water, muddy areas and silty edges of lakes, ponds, marshes and wetland. Obligate wetland plant.	Late summer	Yes	Wetlands	Presence of peatland and other wetlands	Summer
Twin-stemmed bladderwort (*Utricularia geminiscapa*)	CRRNT de l'Estrie, 2010	LDTV	—	Still or slow-moving water and peatland pools, ponds and lakes. Obligate wetland plant.	Late summer	Yes	Wetlands	Presence of peatland and other wetlands	Summer

Table B-14: Special-status Plant Species Potentially Present in the Study Area *(continued)*

Species	Source(s) of reports	Status		Habitat [b]	Optimal survey period [c]	Potential presence in the study area			Planned inventory
		Québec [a]	Canada			Potential	Habitat	Rationale	
Swamp valerian (*Valeriana uliginosa*)	CRRNT de l'Estrie, 2010	Vulnerable	—	Treed or shrub peatland. Obligate wetland calcicole.	Early summer	Yes	Wetlands	Presence of peatland	Summer
Rand's goldenrod (*Solidago simplex ssp. randii var. racemosa*)	CRRNT de l'Estrie, 2010	LDTV	—	Calcareous, rocky terrain, shoreline, bluffs and cliffs. Calcicole.	Late summer	Yes	Streams	Presence of stream	Summer
Provancher's fleabane (*Erigeron philadelphicus var. provancheri*)	CRRNT de l'Estrie, 2010	Threatened	—	Fissures in rock outcrops and moist calcareous or shaly gravel, along rivers. Facultative wetland calcicole.	Summer	Yes	Streams	Presence of stream crossings	Summer
Roundleaf yellow violet (*Viola rotundifolia)*	ACA, 2011	Rare	—	Maple-hickory-linden-white birch forest, particularly in ravines or along creeks, in areas flooded in spring.	Spring	Yes	Woodlands	Presence of maple stands and presence of the species in the study area	Spring
Smooth arrowwood (*Viburnum recognitum*)	CDPNQ, 2010	LDTV	—	Wetlands, semi-open swampy woods, forest edges and upper shorelines. Facultative wetland plant.	Summer	Yes	Wetlands	Presence of wetlands	Summer

a. LDTV: likely to be designated threatened or vulnerable.
b. FloraQuebeca, 2009.
c. CDPNQ, 2008.

The criteria used to describe the preferred habitat of each species and to analyze species potential presence in the study area included the nature of the forest stands and the presence of wetlands or streams. Table B-14 shows the results of this preliminary analysis. A total of 48 special-status species are potentially present in the study area. Seven species were rejected because their habitat is absent from the study area. Of the species potentially present, five are easily observable in spring, 43 are easily observable in summer and three can be observed on specific dates. The CDPNQ's indications regarding the best period for observation (2008) were used to determine when to inventory each species (see Section B.3.4).

As there is no guide to identifying woodland habitats of threatened or vulnerable plants for the Estrie region, the guide for the regions geographically closest and in the same bioclimatic subdomain was used, that is, the guide for the Capitale-Nationale, Centre-du-Québec, Chaudière-Appalaches and Mauricie regions (Dignard et al., 2008). A list of potential woodland habitats was thus drafted. For species not included in the latter guide, the guide for the Outaouais, Laurentides and Lanaudière regions was used (Couillard et al., 2012). The habitats listed are known to harbor most of the threatened or vulnerable forest plants at high risk. Habitats where special-status species have been reported, according to the CDPNQ database, were also added to the list.

Potential habitats for special-status species in the detailed inventory area were then mapped via geospatial querying of digital ecoforestry maps. Wetlands were also included, as they are potential habitats for many special-status species. This mapping tool was used to select potential habitats to be inventoried in the detailed inventory area.

B.3.2 Selection of potential habitats

The potential habitat maps together with guesswork were used to select which habitats in the detailed inventory area would be inventoried. The following guidelines were used for the preliminary selection:

- For each species, select a representative number of stations based on the number of potential habitats in the inventory area.
- Give preference to potential habitats that might harbor several species or species designated as threatened or vulnerable.

Exact locations for the plant inventory stations were then determined, with the help of a botanist who knows the area well, following a helicopter flyover. The botanist's selection criteria included integrity of the environment and its surroundings, plant community maturity, calcareous soil, and local/regional rarity and uniqueness of the environment. Positions of all special-status plant inventory stations were entered in a GPS for field location. These stations were then inventoried in the spring or summer depending on the life cycle of the target species.

B.3.3 Inventory method

Walk-through surveys of selected potential habitats in the detailed inventory area were carried out with an experienced botanist. A total of 49 stations were inventoried, 38 of them in terrestrial habitats and 11 in wetlands (see Map C, Volume 3).

For each occurrence of a special-status species, the number of plants, the companion species (when identifiable) and the physical characteristics of the habitat (slope, type of soil, drainage, etc.) were recorded. Photos were also taken and the locations of the specimens were recorded using a GPS unit. All plant data collected during the potential habitat inventories was entered on plant fact sheets. Occurrences of inventoried species will be sent to the CDPNQ but do not appear on Map C for reasons of confidentiality.

B.3.4 Inventory period

As plant phenology varies depending on the species, two inventory periods were required to target the optimal survey periods of the largest number of species. The first inventory was conducted in the spring (May-June) and was used to look for species that are identifiable or more easily observable during this period only (e.g., wild leek). A second inventory was conducted in the summer (July) and was used to locate other species that might be present. In addition, spot checks were made for target species at appropriate times.

B.4 Non-native invasive plant species

The method used to inventory non-native invasive plant species (NNISs) stems from an agreement between the MDDELCC and Hydro-Québec that applies to projects subject to Section 31.1 of the *Environment Quality Act* (EQQ). This was the first time Hydro-Québec conducted systematic inventories of NNISs using this method.

The MDDELCC publishes a list of all NNISs present in Québec. It also offers an NNIS detection tool (Sentinelle) that targets the species of greatest concern and includes an interactive tool for geographically locating occurrences in Québec. NNIS inventories for the 320-kV Québec–New Hampshire Interconnection Project considered all NNISs, but special attention was paid to species known to be present in Estrie (see Table B-15).

Table B-15: Non-native Invasive Plant Species of Concern in Québec

Scientific name [a]	Common name	Vegetation type	Present in Estrie [b]
Acer negundo	Manitoba maple	Terrestrial	X
Acer platanoides	Norway Maple	Terrestrial	
Ægopodium podagraria	Bishop's goutweed	Terrestrial	X
Alliaria petiolata	Garlic mustard	Terrestrial	
Bromus inermis	Smooth brome	Terrestrial	
Butomus umbellatus	Flowering rush	Emergent	
Cardamine pratensis	Meadow bittercress	Terrestrial	
Celastrus orbiculatus	Oriental bittersweet	Terrestrial	
Cynanchum louiseæ	Black swallowwort	Terrestrial	
Cynanchum rossicum	European swallowwort	Terrestrial	
Eriochloa villosa	Woolly cupgrass	Terrestrial	
Euphorbia esula	Leafy spurge	Terrestrial	
Fallopia japonica var. japonica	Japanese knotweed	Terrestrial	X
Fallopia X bohemica	Bohemian knotweed	Terrestrial	X
Falloppia sachalinensis	Giant knotweed	Terrestrial	
Frangula alnus	Alder buckthorn	Terrestrial	X
Galium mollugo	False baby's breath	Terrestrial	X
Glyceria maxima	Reed mannagrass	Emergent	
Helianthus tuberosus	Jerusalem artichoke	Terrestrial	
Heracleum mantegazzianum	Giant hogweed	Terrestrial	X
Hesperis matronalis	Dames rocket	Terrestrial	
Hydrocharis morsus-ranæ	Common frogbit	Floating	
Impatiens glandulifera	Ornamental jewelweed	Terrestrial	
Iris pseudacorus	Pale yellow iris	Emergent	
Lysimachia nummularia	Creeping jenny	Terrestrial	X
Lythrum salicaria	Purple loosestrife	Emergent	X
Miscanthus sacchariflorus	Amur silvergrass	Terrestrial	
Myosotis scorpioides	True forget-me-not	Emergent	
Myriophyllum spicatum	Eurasian watermilfoil	Submerged	X
Nasturtium officinale	Watercress	Floating	
Nymphoides peltata	Yellow floatingheart	Floating	
Pastinaca sativa	Wild parsnip	Terrestrial	
Petasites japonicus	Japanese sweet coltsfoot	Terrestrial	

Table B-15: Non-native Invasive Plant Species of Concern in Québec *(continued)*

Scientific name [a]	Common name	Vegetation type	Present in Estrie [b]
Phalaris arundinacea	Reed canary grass	Emergent	X
Phragmites australis subs. Australis	Common reed	Emergent	X
Potamogeton crispus	Curly pondweed	Submerged	
Rhamnus cathartica	Common buckthorn	Terrestrial	
Rorippa amphibia	Great yellowcress	Emergent	
Saponaria officinalis	Bouncingbet	Terrestrial	
Trapa natans	Water chestnut	Floating	
Vinca minor	Lesser periwinkle	Terrestrial	

a. According to the *Liste des plantes vasculaires exotiques envahissantes prioritaires* (Québec, MDDELCC, 2015*c*).
b. According to *Sentinelle,* the MDDELCC's NNIS detection tool (Québec, MDDELCC, 2015*d*).

B.4.1 Areas inventoried

The following areas were inventoried: intersections between a highway and the planned right-of-way; intersections between the rights-of-way of two high-voltage (>120 kV) lines; selected wetlands; and plant habitats targeted by the special-status plant species inventory. In all, 30 of the 32 crossings identified were inspected. The inventory took place throughout the summer of 2015.

In addition, all observations of NNISs during other inventories or fields visits were recorded. Photographs were also taken of the plant communities, and their geographic coordinates were recorded with a GPS unit.

B.4.2 Inventory method

Where the planned line crosses a highway, a 20-m strip on either side of the highway and within the right-of-way was inventoried, to include ditches and cleared areas along the highway (see Figure B-1).

At intersections between the planned line and the right-of-way of an existing power line, the area of overlap of the two rights-of-way was inventoried (see Figure B-2).

Wherever NNISs were observed, the species and the approximate area affected were noted. Photographs were also taken and the geographic coordinates of the sites were recorded with a GPS unit.

Figure B-1: Inventoried Area at Intersection of Planned Line and Highway

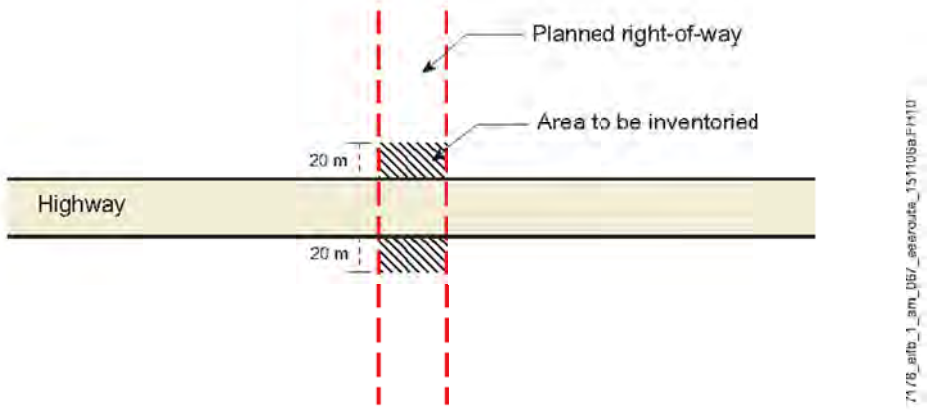
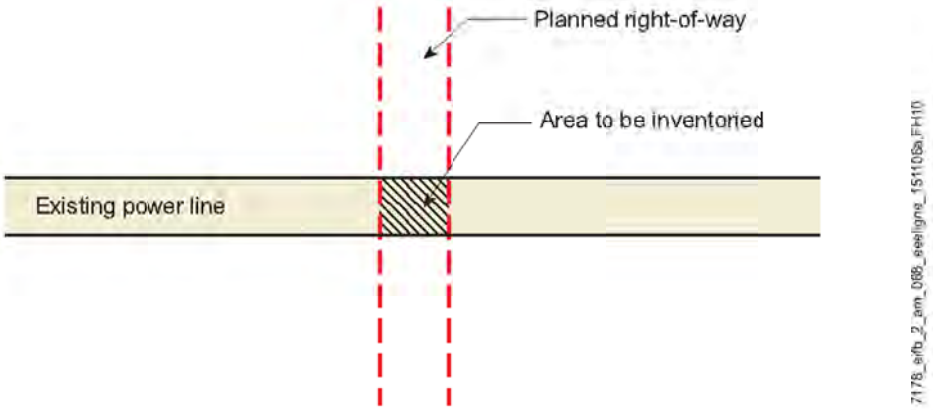


Figure B-2: Inventoried Area at Intersection of Planned Line and Existing Line



B.5 Fish

Thanks to the wide variety of aquatic habitats and the major river system in the study area, there is considerable diversity in the fish species present (see Table B-16). A total of 57 species have been reported in the lakes and streams of Estrie and may thus be present in the study area. Of these, seven are special-status species (see Table B-17).

Table B-16: Fish Species Present or Potentially Present in the Study Area

Common name	Scientific name	Status	
		Québec [a]	Canada
Salmonids			
Lake cisco	*Coregonus artedi*	—	—
Lake whitefish	*Coregonus clupeaformis*	—	—
Brook trout	*Salvelinus fontinalis*	—	—
Atlantic salmon	*Salmo salar*	—	—
Lake trout	*Salvelinus namaycush*	—	—
Rainbow trout	*Oncorhynchus mykiss*	—	—
Brown trout	*Salmo trutta*	—	—
Other families			
Largemouth bass	*Micropterus salmoides*	—	—
Smallmouth bass	*Micropterus dolomieu*	—	—
Brown bullhead	*Ameiurus nebulosus*	—	—
Chain pickerel	*Esox niger*	LDTV	—
Common carp	*Cyprinus carpio*	—	—
Slimy sculpin	*Cottus cognatus*	—	—
Stonecat	*Noturus flavus*	LDTV	—
Silver redhorse	*Moxostoma anisurum*	—	—
Greater redhorse	*Moxostoma valenciennesi*	—	—
Shorthead redhorse	*Moxostoma macrolepidotum*	—	—
Rock bass	*Ambloplites rupestris*	—	—
Pumpkinseed	*Lepomis gibbosus*	—	—
Walleye	*Sander vitreus*	—	—
Sauger	*Sander canadensis*	—	—
Rainbow smelt	*Osmerus mordax*	—	—
Brook stickleback	*Culæa inconstans*	—	—
Banded killifish	*Fundulus diaphanus*	—	—
Channel darter	*Percina copelandi*	Vulnerable	Threatened
Logperch	*Percina caprodes*	—	—
Northern pike	*Esox lucius*	—	—
Northern brook	*Ichthyomyzon fossor*	Threatened	Of special concern
Mooneye	*Hiodon tergisus*	—	—
Black crappie	*Pomoxis nigromaculatus*	—	—

Table B-16: Fish Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
Bluntnose minnow	*Pimephales notatus*	—	—
Blacknose shiner	*Notropis heterolepis*	—	—
Common shiner	*Luxilus cornutus*	—	—
Spottail shiner	*Notropis hudsonius*	—	—
Rosyface shiner	*Notropis rubellus*	LDTV	—
Northern redbelly dace	*Chrosomus eos*	—	—
Finescale dace	*Chrosomus neogæus*	—	—
Spotfin shiner	*Cyprinella spiloptera*	—	—
Eastern silvery minnow	*Hybognathus regius*	—	—
Bridle shiner	*Notropis bifrenatus*	Vulnerable	Of special concern
Emerald shiner	*Notropis atherinoides*	—	—
Golden shiner	*Notemigonus crysoleucas*	—	—
Brassy minnow	*Hybognathus hankinsoni*	LDTV	—
Sand shiner	*Notropis stramineus*	—	—
Mimic shiner	*Notropis volucellus*	—	—
White sucker	*Catostomus commersonii*	—	—
Longnose sucker	*Catostomus catostomus*	—	—
Creek chub	*Semotilus atromaculatus*	—	—
Pearl dace	*Margariscus margarita*	—	—
Longnose dace	*Rhinichthys cataractæ*	—	—
Blacknose dace	*Rhinichthys atratulus*	—	—
Trout-perch	*Percopsis omiscomaycus*	—	—
Fallfish	*Semotilus corporalis*	—	—
Yellow perch	*Perca flavescens*	—	—
Tessellated darter	*Etheostoma olmstedi*	—	—
Johnny darter	*Etheostoma nigrum*	—	—
Central mudminnow	*Umbra limi*	—	—

a. LDTV: likely to be designated threatened or vulnerable.

Sources: Québec, MDDELCC, 2015*a*; COGESAF, 2006; Canards Illimités Canada, 2007; personal communication, René Houle, MRNF, 2011; Canada, 2014*a*; Québec, MFFP, 2015*a*.

Table B-17: Special-status Fish Species Potentially Present in the Study Area

Species	Status		Habitat
	Québec [a]	Canada	
Chain pickerel (*Esox niger*)	LDTV	—	Shallow weedy lakes, ponds and sluggish streams.
Stonecat (*Noturus flavus*)	LDTV	—	Riffles and runs of rivers with boulder/cobble substrates.
Channel darter *(Percina copelandi*)	Vulnerable	Threatened	Sand or gravel beaches of lakes or sluggish rivers.
Northern brook lamprey (*Ichthyomyzon fossor*)	Threatened	Of special concern	Small swift streams with sand or gravel substrates.
Rosyface shiner (*Notropis rubellus*)	LDTV	—	Clear, fast-flowing small rivers with substrates of gravel or rubble.
Bridle shiner (*Notropis bifrenatus*)	Vulnerable	Of special concern	Grassy lake shores or banks or quiet streams with silt or sand bottoms.
Brassy minnow (*Hybognathus hankinsoni*)	LDTV	—	Dark-watered ponds and boggy creeks with silt bottoms covered with vegetation.

a. LDTV: likely to be designated threatened or vulnerable.

Sources: Reports: COGESAF, 2006; Québec, MDDELCC, 2015*a*; Canada, 2014*a*.
Habitat description: Bernatchez and Giroux, 2000.

Potential impacts on fish are limited to sites where the planned line crosses streams. Once the access roads required for line construction have been determined, fish habitats in the streams crossed will be characterized, before work starts, over at least 100 m on either side of the crossing point. The data sheet in Hydro-Québec's guide to good environmental practice (*Cahier des bonnes pratiques en environnement,* issued by Hydro-Québec Équipement et services partagés in 2014) will be used for the characterization. In addition, botanical as well as physical criteria will be used to determine the natural highwater mark.

B.6 Reptiles and amphibians

B.6.1 All species

According to the sources consulted, 17 amphibian species and seven reptile species are present or potentially present in the study area (see Table B-18). The species most often reported are American toad, green frog, wood frog, northern leopard frog, spring peeper and common garter snake (AARQ, 2014). Other species, such as gray treefrog, pickerel frog, redbelly snake, wood turtle and yellow-spotted salamander, are either less common or more difficult to detect—which explains the small number of reports of these species in the study area (AARQ, 2014).

Table B-18: Amphibian and Reptile Species Present or Potentially Present in the Study Area

Common name	Scientific name	Status	
		Québec [a]	Canada
Amphibians			
American toad	*Anaxyrus americanus*	—	—
Wood frog	*Lithobates sylvaticus*	—	—
Pickerel frog	*Lithobates palustris*	LDTV	—
Mink frog	*Lithobates septentrionalis*	—	—
Northern leopard frog	*Lithobates pipiens*	—	—
Green frog	*Lithobates clamitans*	—	—
Bullfrog	*Lithobates catesbeianu*	—	—
Spring peeper	*Pseudacris crucifer*	—	—
Gray treefrog	*Hyla versicolor*	—	—
Two-lined salamander	*Eurycea bislineata*	—	—
Blue-spotted salamander	*Ambystoma laterale*	—	—
Four-toed salamander	*Hemidactylium scutatum*	LDTV	—
Spring salamander	*Gyrinophilus porphyriticus*	Vulnerable	Of special concern
Eastern redback salamander	*Plethodon cinereus*	—	—
Yellow-spotted salamander	*Ambystoma maculatum*	—	—
Northern dusky salamander	*Desmognathus fuscus*	LDTV	—
Eastern newt	*Notophthalmus viridescens*	—	—
Reptiles			
Ringneck snake	*Diadophis punctatus*	LDTV	—
Redbelly snake	*Storeria occipitomaculata*	—	—
Common garter snake	*Thamnophis sirtalis*	—	—
Common snapping turtle	*Chelydra serpentina*	—	Of special concern
Wood turtle	*Glyptemys insculpta*	Vulnerable	Threatened
Painted turtle	*Chrysemys picta*	—	—
Spotted turtle	*Clemmys guttata*	LDTV	Endangered

a. LDTV: likely to be designated threatened or vulnerable.

Sources: AARQ, 2014; Desroches and Rodrigue, 2004; CDPNQ, 2010; ACA, 2011; CRRNT de l'Estrie, 2010 and 2011; Canada, 2014*a*; Québec, MFFP, 2015*a*.

Seven of the amphibian or reptile species potentially present in the study area are special-status species in Québec (see Table B-19). To these could be added the common snapping turtle, considered a species of special concern in Canada—though the species is relatively abundant in eastern Canada (Canada, 2014*b*).

The CDPNQ, Corridor appalachien and AARQ report five species in the study area: northern dusky salamander (likely to be designated threatened or vulnerable, LDTV), spring salamander (vulnerable), pickerel frog (LDTV), wood turtle (vulnerable) and common snapping turtle (of special concern in Canada).

B.6.2 Four-toed salamander

This species generally inhabits sphagnum swamps and bogs, where it lays its eggs in spring (Desroches and Rodrigue, 2004). In summer, the species lives in deciduous or mixed forest close to its breeding grounds.

With its abundant bogs and swamps, the study area offers good potential for presence of this species. However, neither the CDPNQ nor the Atlas of Amphibians and Reptiles of Québec (AARQ) confirms its presence.

Inventories were conducted between May 20 and May 27, 2015 at 27 stations in sphagnum bogs or swamps (see Map C, Volume 3). Salamander nests were actively sought. These are usually located in clumps of sphagnum moss or vertical moss mats overhanging stagnant water and can be recognized by the small clusters of eggs deposited in the moss or, on rare occasions, at the base of tufts of grass (Desroches and Rodrigue, 2004).

When a nest or salamander was found, its location was recorded with the help of a GPS unit, and information about what was observed and where (type of habitat, plant community) was recorded on a standard field data sheet.

B.6.3 Ringneck snake

Ringneck snake is a woodland species that prefers deciduous forests, mixed forests and certain evergreen stands. These snakes spend most of their time hidden under debris in moist areas. They also like to be close to lakes, ponds and forest creeks (Desroches and Rodrigue, 2004). This reclusive species is known for being difficult to spot.

A number of habitats in the study area are likely to be attractive to this species. There is one known occurrence near the detailed inventory area, in open woodland in the Johnville Bog and Forest Park (AARQ, 2014).

Table B-19: Habitats of Special-status Reptiles and Amphibian Species in Québec

Species	Source(s) of reports	Status		Habitat	Potential presence in the detailed inventory area		Inventories	
		Québec [a]	Canada		Potential	Rationale	Period	Type
Northern ringneck snake (*Diadophis punctatus edwardsii*)	CDPNQ, 2010	LDTV	—	Deciduous and mixed forests, some coniferous forests and rock outcrops. Frequently observed at high altitudes.	Yes	Presence of woodland in the study area.	Spring and fall	Artificial shelters[b]
Northern watersnake (*Nerodia sipedon sipedon*)	CRRNT de l'Estrie, 2010	LDTV	—	Edges of lakes and streams, marshes and ponds with abundant aquatic vegetation.	No	Found mainly in western Québec. Presence unlikely in the streams of study area.	—	—
Pickerel frog (*Lithobates palustris*)	CDPNQ, 2010	LDTV	—	Woodland near water (beaver ponds, clear creeks) and wetland. Associated with mountainous terrain.	Yes	Presence of peatland and other types of wetland and presence of the species in the study area.	Spring and summer	Visual observations near habitats during wetland characterization
Western chorus frog (*Pseudacris triseriata*)	CRRNT de l'Estrie, 2010	Vulnerable	Threatened	Brushland and woodland near breeding sites (fields and clearings flooded during snowmelt, shallow ponds, swamps, ditches and alder thickets).	No	Confined to southwestern Québec.	—	—
Four-toed salamander (*Hemidactylium scutatum)*	CRRNT de l'Estrie, 2010	LDTV	—	Wet mossy forest, sphagnum bogs and swamps and edges of beaver ponds.	Yes	Presence of peatland and other types of wetland.	Spring (May)	Search for nests in favorable spring habitats
Spring salamander (*Gyrinophilus porphyriticus*)	CDPNQ, 2010	Vulnerable	Of special concern	At high elevations, seeps and creeks with rock or gravel bottoms.	Yes	Presence of many forest streams and presence of the species in the study area.	Before work starts	—
Northern dusky salamander (*Desmognathus fuscus*)	CDPNQ, 2010	LDTV	—	At high elevations, seeps, springs and forest streams with rock or mud bottoms.	Yes	Presence of many forest streams and presence of the species in the study area.	Before work starts	—

Table B-19: Habitats of Special-status Reptiles and Amphibian Species in Québec *(continued)*

Species	Source(s) of reports	Status		Habitat	Potential presence in the detailed inventory area		Inventories	
		Québec [a]	Canada		Potential	Rationale	Period	Type
Common snapping turtle *(Chelydra serpentina*)	AARQ, 2014	—	Of special concern	Lakes, large marshes, rivers, ponds and canals where vegetation and submerged structures are abundant.	Yes	Presence of many streams, lakes and ponds and presence of the species in the study area.	Not required	—
Wood turtle (*Glyptemys insculpta*)	CDPNQ, 2010	Vulnerable	Threatened	Well-oxygenated meandering rivers and adjacent terrestrial habitats.	Yes	Presence of Rivière Saint-François, Rivière aux Saumons and other streams suitable for the species. One occurrence reported in the study area (CDPNQ).	Before work starts	—
Common map turtle (*Graptemys geographica*)	CRRNT de l'Estrie, 2010	Vulnerable	Of special concern	Rivers, lakes and their tributaries.	No	Confined to Outaouais, Lac Champlain and the Montréal area. Presence unlikely in Rivière Saint-François or Rivière aux Saumons.	—	—
Spotted turtle (*Clemmys guttata*)	CRRNT de l'Estrie, 2010	LDTV	Endangered	Swamps, marshes, peatland, ponds and flood zones.	Yes	Presence of peatland and other types of wetland.	Not required	—
Eastern spiny softshell turtle (*Apalone spinifera spinifera*)	CRRNT de l'Estrie, 2010	Threatened	Threatened	Large lakes and rivers and their tributaries.	No	A single known population in Québec (Baie Missisquoi). Presence unlikely in Rivière Saint-François or Rivière aux Saumons.	—	—
Species whose habitat is not represented in the study area and for which there is no potential presence in the detailed inventory area détaillés.								

a. LDTV: likely to be designated threatened or vulnerable.

b. An SEG (science, education or management) permit is required from the MFFP for the inventory.

Source : Habitat description: Desroches and Rodrigue, 2004.

An inventory was conducted from May 6 to June 23, 2015. Artificial shelters were installed every 5 km in the detailed inventory area, in open environments near wooded areas, for a total of 21 inventory stations (see Map C, Volume 3). The applicable MFFP protocol was used to monitor the artificial shelters (Larochelle et al., 2015).

When the species was observed during other planned inventories, the location was recorded with the help of a GPS unit, and information about what was observed and where (type of habitat, plant community) was recorded on a standard field data sheet.

B.6.4 Pickerel frog, wood turtle, spotted turtle and common snapping turtle

During the wetland inventories and when walking to where the planned line crosses streams, the presence of a number of species that live in or near streams and wetlands, i.e., pickerel frog, wood turtle, spotted turtle and common snapping turtle, was also verified.

If a specimen or a suitable habitat was encountered, the location was recorded with the help of a GPS unit, and information about what was observed and where (type of habitat, plant community) was recorded on a standard field data sheet.

B.7 Birds

Inventories of birds were conducted to identify the species present. Particular attention was paid to special-status species.

All species potentially present in the study area are listed in Table B-20. At the MFFP's request, the list was established from the most recent data of the Québec Breeding Bird Atlas (2015) and was completed with the help of the Étude des populations d'oiseaux du Québec database (EPOQ, 2011).

Thirteen special-status bird species are potentially present in the study area according to CDPNQ records (2010): golden eagle, eastern whip-poor-will, common nighthawk, peregrine falcon, Bicknell's thrush, chimney swift, olive-sided flycatcher, Canada warbler, Louisiana waterthrush, least bittern, loggerhead shrike, bald eagle and rusty blackbird. At the request of the MFFP, Hydro-Québec added the short-eared owl and barn owl to the list.

B.7.1 Assessment of potential presence

The information provided by Gauthier and Aubry (1995) was used to determine habitat potential for special-status bird species in the study area. Potential for presence of these species in the detailed inventory area was mapped. Table B-21 shows the habitat mapping parameters used for each species.

Given the results of the potential presence assessment, golden eagle and peregrine falcon were not inventoried as there are no known nests, cliffs or quarries in the study area. However, bald eagle nests were searched for near Rivière Saint-François during a helicopter flyover. Bicknell's thrush was not inventoried as the species is present only on Mont Hereford, which the route variants avoid.

Table B-20: Bird Species Present or Potentially Present in the Study Area

Common name	Scientific name	Status	
		Québec [a]	Canada
Golden eagle	*Aquila chrysætos*	Vulnerable	—
Horned lark	*Eremophila alpestris*		
Northern goshawk	*Accipiter gentilis*	—	—
Osprey	*Pandion haliætus*	—	—
American woodcock	*Scolopax minor*	—	—
Pectoral sandpiper	*Calidris melanotos*	—	—
Least sandpiper	*Calidris minutilla*	—	—
Short-billed dowitcher	*Limnodromus griseus*	—	—
Wilson's snipe	*Gallinago delicata*	—	—
White-winged crossbill	*Loxia leucoptera*	—	—
Red crossbill	*Loxia curvirostra*	—	—
Canada goose	*Branta canadensis*	—	—
Black-crowned night-heron	*Nycticorax nycticorax*	—	—
White-crowned sparrow	*Zonotrichia leucophrys*	—	—
White-throated sparrow	*Zonotrichia albicollis*	—	—
Song sparrow	*Melospiza melodia*	—	—
Lincoln's sparrow	*Melospiza lincolnii*	—	—
Field sparrow	*Spizella pusilla*	—	—
Swamp sparrow	*Melospiza georgiana*	—	—
Clay-colored sparrow	*Spizella pallida*	—	—
Savannah sparrow	*Passerculus sandwichensis*	—	—
Chipping sparrow	*Spizella passerina*	—	—
Fox sparrow	*Passerella iliaca*	—	—
American tree sparrow	*Spizelloides arborea*	—	—
Vesper sparrow	*Pocœcetes gramineus*	—	—
Northern harrier	*Circus cyaneus*	—	—
Red-shouldered hawk	*Buteo lineatus*	—	—
Red-tailed hawk	*Buteo jamaicensis*	—	—
Rough-legged hawk	*Buteo lagopus*	—	—

Table B-20: Bird Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
American bittern	*Botaurus lentiginosus*	—	—
Wood duck	*Aix sponsa*	—	—
Gadwall	*Anas strepera*	—	—
Mallard	*Anas platyrhynchos*	—	—
American wigeon	*Anas americana*	—	—
American black duck	*Anas rubripes*	—	—
Northern pintail	*Anas acuta*	—	—
Northern shoveler	*Anas clypeata*	—	—
Rose-breasted grosbeak	*Pheucticus ludovicianus*	—	—
Northern cardinal	*Cardinalis cardinalis*	—	—
Red-winged blackbird	*Agelaius phœniceus*	—	—
American goldfinch	*Carduelis tristis*	—	—
Spotted sandpiper	*Actitis macularius*	—	—
Solitary sandpiper	*Tringa solitaria*	—	—
Northern hawk-owl	*Surnia ulula*	—	—
Barred owl	*Strix varia*	—	—
Ruby-throated hummingbird	*Archilochus colubris*	—	—
Double-crested cormorant	*Phalacrocorax auritus*	—	—
American crow	*Corvus brachyrhynchos*	—	—
Yellow-billed cuckoo	*Coccyzus americanus*	—	—
Black-billed cuckoo	*Coccyzus erythropthalmus*	—	—
American kestrel	*Falco sparverius*	—	—
Wild turkey	*Meleagris gallopavo*	—	—
Pine grosbeak	*Pinicola enucleator*	—	—
Barn owl	*Tyto alba*	LDTV	Endangered
Eastern whip-poor-will	*Caprimulgus vociferus*	LDTV	Threatened
Common nighthawk	*Chordeiles minor*	LDTV	Threatened
Sharp-shinned hawk	*Accipiter striatus*	—	—
Cooper's hawk	*Accipiter cooperii*	—	—
European starling	*Sturnus vulgaris*	—	—
Merlin	*Falco columbarius*	—	—
Peregrine falcon	*Falco peregrinus*	Vulnerable	Of special concern
American coot	*Fulica americana*	—	—
Ring-necked duck	*Aythya collaris*	—	—
Common moorhen	*Gallinula chloropus*	—	—

Table B-20: Bird Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
Blue jay	*Cyanocitta cristata*	—	—
Ruffed grouse	*Bonasa umbellus*	—	—
Ring-billed gull	*Larus delawarensis*	—	—
Herring gull	*Larus argentatus*	—	—
Bobolink	*Dolichonyx oryzivorus*	—	—
Greater yellowlegs	*Tringa melanoleuca*	—	—
Common raven	*Corvus corax*	—	—
Common merganser	*Mergus merganser*	—	—
Great blue heron	*Ardea herodias*	—	—
Pileated woodpecker	*Dryocopus pileatus*	—	—
Great horned owl	*Bubo virginianus*	—	—
Great egret	*Ardea alba*	—	—
Pied-billed grebe	*Podilymbus podiceps*	—	—
Red-necked grebe	*Podiceps grisegena*	—	—
Brown creeper	*Certhia americana*	—	—
Swainson's thrush	*Catharus ustulatus*	—	—
Gray-cheeked thrush|	*Catharus minimus*	—	—
Bicknell's thrush	*Catharus bicknelli*	Vulnerable	Threatened
Wood turtle	*Hylocichla mustelina*	—	—
Veery	*Catharus fuscescens*	—	—
Hermit thrush	*Catharus guttatus*	—	—
Evening grosbeak	*Coccothraustes vespertinus*	—	—
Black tern	*Chlidonias niger*	—	—
Snowy owl	*Bubo scandiacus*	—	—
Hooded merganser	*Lophodytes cucullatus*	—	—
Red-breasted merganser	*Mergus serrator*	—	—
Green heron	*Butorides virescens*	—	—
Northern rough-winged swallow	*Stelgidopteryx serripennis*	—	—
Short-eared owl	*Asio flammeus*	LDTV	
Cliff swallow	*Petrochelidon pyrrhonota*	—	—
Tree swallow	*Tachycineta bicolor*	—	—
Bank swallow	*Riparia riparia*	—	—
Barn swallow	*Hirundo rustica*	—	—
Cedar waxwing	*Bombycilla cedrorum*	—	—
Dark-eyed junco	*Junco hyemalis*	—	—

Table B-20: Bird Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
Sora	*Porzana carolina*	—	—
Chimney swift	*Chætura pelagica*	LDTV	Threatened
Belted kingfisher	*Megaceryle alcyon*	—	—
Upland sandpiper	*Bartramia longicauda*	—	—
American robin	*Turdus migratorius*	—	—
Eastern bluebird	*Sialia sialis*	—	—
Boreal chickadee	*Pœcile hudsonicus*	—	—
Black-capped chickadee	*Pœcile atricapillus*	—	—
Tufted titmouse	*Bæolophus bicolor*	—	—
Gray jay	*Perisoreus canadensis*	—	—
House sparrow	*Passer domesticus*	—	—
Gray catbird	*Dumetella carolinensis*	—	—
Northern mockingbird	*Mimus polyglottos*	—	—
Brown thrasher	*Toxostoma rufum*	—	—
Olive-sided flycatcher	*Contopus cooperi*	LDTV	Threatened
Yellow-bellied flycatcher	*Empidonax flaviventris*	—	—
Alder flycatcher	*Empidonax alnorum*	—	—
Willow flycatcher	*Empidonax traillii*	—	—
Eastern phoebe	*Sayornis phœbe*	—	—
Least flycatcher	*Empidonax minimus*	—	—
Bonaparte's gull	*Chroicocephalus philadelphia*	—	—
Snow goose	*Chen cærulescens*	—	—
Greater white-fronted goose	*Anser albifrons*	—	—
Baltimore oriole	*Icterus galbula*	—	—
Wilson's warbler	*Cardellina pusilla*	—	—
Northern parula	*Setophaga americana*	—	—
Palm warbler	*Setophaga palmarum*	—	—
Yellow-rumped warbler	*Setophaga coronata*	—	—
Chestnut-sided warbler	*Setophaga pensylvanica*	—	—
Black-throated green warbler	*Setophaga virens*	—	—
Blackburnian warbler	*Setophaga fusca*	—	—
Nashville warbler	*Oreothlypis ruficapilla*	—	—
Bay-breasted warbler	*Setophaga castanea*	—	—
Magnolia warbler	*Setophaga magnolia*	—	—
Black-throated blue warbler	*Setophaga cærulescens*	—	—

Table B-20: Bird Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
Ovenbird	*Seiurus aurocapilla*	—	—
Pine warbler	*Setophaga pinus*	—	—
Northern waterthrush	*Parkesia noveboracensis*	—	—
Canada warbler	*Cardellina canadensis*	LDTV	Threatened
American redstart	*Setophaga ruticilla*	—	—
Louisiana waterthrush	*Parkesia motacilla*	LDTV	Of special concern
Yellow warbler	*Setophaga petechia*	—	—
Common yellowthroat	*Geothlypis trichas*	—	—
Black-and-white warbler	*Mniotilta varia*	—	—
Tennessee warbler	*Oreothlypis peregrina*	—	—
Blackpoll warbler	*Setophaga striata*	—	—
Cape May warbler	*Setophaga tigrina*	—	—
Mourning warbler	*Geothlypis philadelphia*	—	—
Indigo bunting	*Passerina cyanea*	—	—
Gray partridge	*Perdix perdix*	—	—
Least bittern	*Ixobrychus exilis*	Vulnerable	Threatened
Lesser yellowleg	*Tringa flavipes*	—	—
Broad-winged hawk	*Buteo platypterus*	—	—
Northern saw-whet owl	*Ægolius acadicus*	—	—
Black-backed woodpecker	*Picoides arcticus*	—	—
Hairy woodpecker	*Picoides villosus*	—	—
Northern flicker	*Colaptes auratus*	—	—
Yellow-bellied sapsucker	*Sphyrapicus varius*	—	—
Downy woodpecker	*Picoides pubescens*	—	—
Loggerhead shrike	*Lanius ludovicianus*	Threatened	Endangered
Northern shrike	*Lanius excubitor*	—	—
Rock pigeon	*Columba livia*	—	—
Eastern wood-pewee	*Contopus virens*	—	—
American pipit	*Anthus rubescens*	—	—
Scarlet tanager	*Piranga olivacea*	—	—
American black duck	*Plectrophenax nivalis*	—	—
Northern pintail	*Charadrius vociferus*	—	—
Northern shoveler	*Charadrius semipalmatus*	—	—
Rose-breasted grosbeak	*Haliæetus leucocephalus*	Vulnerable	—
Northern cardinal	*Quiscalus quiscula*	—	—

Table B-20: Bird Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
Red-winged blackbird	*Euphagus carolinus*	LDTV	Of special concern
American goldfinch	*Rallus limicola*	—	—
Spotted sandpiper	*Regulus satrapa*	—	—
Solitary sandpiper	*Regulus calendula*	—	—
Northern hawk-owl	*Carpodacus mexicanus*	—	—
Barred owl	*Carpodacus purpureus*	—	—
Ruby-throated hummingbird	*Anas discors*	—	—
Double-crested cormorant	*Anas crecca*	—	—
American crow	*Sitta carolinensis*	—	—
Yellow-billed cuckoo	*Sitta canadensis*	—	—
Black-billed cuckoo	*Acanthis flammea*	—	—
American kestrel	*Sterna hirundo*	—	—
Wild turkey	*Sturnella magna*	—	—
Pine grosbeak	*Spinus pinus*	—	—
Barn owl	*Zenaida macroura*	—	—
Eastern whip-poor-will	*Troglodytes hiemalis*	—	—
Common nighthawk	*Cistothorus palustris*	—	—
Sharp-shinned hawk	*Troglodytes ædon*	—	—
Cooper's hawk	*Troglodytes troglodytes*	—	—
European starling	*Myiarchus crinitus*	—	—
Merlin	*Tyrannus tyrannus*	—	—
Peregrine falcon	*Cathartes aura*	—	—
American coot	*Molothrus ater*	—	—
Ring-necked duck	*Vireo flavifrons*	—	—
Common moorhen	*Vireo solitarius*	—	—
Blue jay	*Vireo olivaceus*	—	—
Ruffed grouse	*Vireo gilvus*	—	—

a. LDTV: likely to be designated threatened or vulnerable.

Sources: EPOQ, 2011; BDOMQ, 2014; CDPNQ, 2010; ACA, 2011; CRRNT de l'Estrie, 2010 and 2011; Gauthier and Aubry, 1995; Canada, 2014*a*; Québec, MFFP, 2015*a*.

Table B-21: Special-status Bird Species Potentially Present in the Study Area

Species	Source(s) of reports	Status		Typical habitat	Map search	
		Québec [a]	Canada		Search items	Source or method
Golden eagle (*Aquila chrysaetos*)	Atlas, 2015	Vulnerable	—	Large expanses of wilderness featuring cliffs for nesting and open areas such as peatland and marshes. Ideally, cliffs surrounded by 3,000 ha or more (≥20% of the area) of open land (peatland, marshes, burns, lichen heath, dry barrens, clear cuts, shrubland, brushland or area of insect infestation) within a 7-km radius. Generally present where mountains are intercut by valleys and canyons with steep rocky slopes.	Cliffs: slopes of 70° to 90°	Digital terrain model and photo interpretation
					Wetlands: peatland and marsh Disturbances: cutting Disturbances: severe disease, wildland and total burn (ES, FR and BR)	Ecoforest maps
Barn owl (*Tyto alba*)	—	LDTV	Endangered	Varied low-altitude rural as well as urban open areas, wet meadows, pastureland, abandoned or cultivated fields and marshes.	Wetlands: marsh	Photo interpretation
					Crops: field crop or pasture on category A and B or C and X soil	La Financière agricole and photo interpretation
Eastern whip-poor-will *(Caprimulgus vociferus)*	EPOQ, 2011	LDTV	Threatened	Different types of dry forest stands with openings and clearings; near cultivated fields with scattered bushes; young pine, oak and beech forests. Avoids mountainous areas.	Drainage classes: 00, 10, 20 and 30 Tree species groupings: PR, PB, PBFT, PGE, PIG, PIR, PG and CH Forest age classes: 10, 1010, 1030,1050, 30, 3010, 3030, 3050 50, 5010, 5030 and 5050	Ecoforest maps
					Presence of clearings or forest openings	Photo interpretation

Table B-21: Special-status Bird Species Potentially Present in the Study Area *(continued)*

Species	Source(s) of reports	Status		Habitat	Map search	
		Québec [a]	Canada		Search items	Source or methods
Common nighthawk (*Chordeiles minor*)	EPOQ, 2011	LDTV	Threatened	Open areas with little or no vegetation, such as clearings, forest openings, rock outcrops, gravel or sand beaches and burns. Also, pastureland and gravel-covered flat roofs.	Rock outcrops and sand or gravel beaches	Photo interpretation
					Disturbances: burns and windfalls	Ecoforest maps
					Brushland	—
					Crops: field crop or pasture on category A and B or C and X soil	La Financière agricole and photo interpretation
Peregrine falcon (*Falco peregrinus*)	EPOQ, 2011	Vulnerable (*ssp. anatum*)	Of special concern	Cliffs near water; also nests on the ground or in trees and even on skyscrapers and under bridges.	Quarries, cliffs (slopes of 70° to 90°) and major bridges	Digital terrain model and photo interpretation
Bicknell's thrush (*Catharus bicknelli*)	BDOMQ, 2014	Vulnerable	Threatened	Montane and coastal maritime coniferous forests and stands regenerating after forest fires or cutting. In Estrie, this species seeks mainly coniferous forests above elevation 700 m or on barren summits.	MFFP mapping redone	
Short-eared owl (*Asio flammeus*)	—	LDTV	Of special concern	Unforested habitats. Generally inhabits wide open spaces such as prairie grasslands, marshes, shrubland, peatland and arctic tundra.	Wetlands: marsh	Photo interpretation
					Crops: field crop or pasture on category A and B or C and X soil	La Financière agricole and photo interpretation
Chimney swift (*Chaetura pelagica*)	BDOMQ, 2014	LDTV	Threatened	Nests in well-sheltered, hidden sites (e.g., tree hollows, caves, chimneys, barns and ventilation shafts). Large standing hollow trees open at the top in old forest (≥90 years old).	Forest age classes: VIN and 90	Ecoforest maps

Table B-21: Special-status Bird Species Potentially Present in the Study Area *(continued)*

Species	Source(s) of reports	Status		Habitat	Map search	
		Québec [a]	Canada		Search items	Source or methods
Olive-sided flycatcher *(Contopus cooperi)*	EPOQ, 2011; BDOMQ, 2014	LDTV	Threatened	Relatively open habitats featuring perches, in particular snags or sparse crowns and dead limbs on live trees. Prefers coniferous or mixed forests near water. Burns, edges of cuts, clearings and peatland, wooded banks of creeks and beaver ponds.	Population types: M and R Canopy density class: D Less than 100 m from water	Ecoforest maps and map query (100-m radius)
					or	
					Disturbances: burn	Ecoforest maps
					or	
					Disturbances: cutting Canopy density class: D	Ecoforest maps and photo interpretation
					or	
					Wetlands: peatland and beaver ponds Open areas	Photo interpretation
Canada warbler (*Cardellina canadensis*)	EPOQ, 2011; ACA, 2011	LDTV	Threatened	Relatively open predominantly deciduous mixed forest with a particularly well-developed shrub layer. Nests in groupings of saplings or tall shrubbery of forests near wetlands bordering rivers or streams.	Population type: M Canopy density classes: C and D Drainage classes: 3, 4, 5 and 6	Ecoforest maps
					Less than 100 m from adjacent wetlands and streams	Map query
Louisiana waterthrush *(Parkesia motacilla)*	CDPNQ, 2010; BDOMQ, 2014	LDTV	Of special concern	Highly specialized species: forest with a ≥ 75% canopy cover and water are essential for nesting. Large deciduous forests (probably more than 100 ha) on the slopes of ravines.	Cover type: F Canopy density class: A Slope classes: D, E and F Adjacent forest stands of 100 ha. Less than 400 m from streams, lakes and ponds	Ecoforest maps and map query (400-m radius)
Loggerhead shrike (*Lanius ludovicianus*)	—	Threatened	Endangered	Pasture, meadows and old fields of 5 ha or more with hedges, thorny bushes and conifers.	No reports of nesting for more than 20 years	—

Table B-21: Special-status Bird Species Potentially Present in the Study Area *(continued)*

Species	Source(s) of reports	Status		Habitat	Map search	
		Québec [a]	Canada		Search items	Source or methods
Least bittern *(Ixobrychus exilis)*	BDOMQ, 2011	Vulnerable	Threatened	Freshwater marshes, ponds and sluggish streams with dense vegetation cover.	Wetland: marshes and beaver ponds	Photo interpretation
Bald eagle (*Haliaeetus leucocephalus)*	EPOQ, 2011	Vulnerable	—	Nests in large trees near lakes or rivers with plenty of fish.	Forest age classes: VIN, VIR, 70, 90 and 120 (SIEF))	Ecoforest maps
					Less than 200 m from a lake or a major river	Map query (radius) and photo interpretation (major river)
Rusty blackbird (*Euphagus carolinus*)	EPOQ, 2011; BDOMQ, 2014	LDTV	Of special concern	Peatland, swamps or marshes on forest edges, wet woodland, lake and beaver pond edges, and alder and willow thickets near rivers or creeks.	Wetlands: peatland, swamps, marsh and beaver ponds	Photo interpretation
					Land category code: AL (willow brush)	Ecoforest maps

a. LDTV: likely to be designated threatened or vulnerable.

Source : Habitat description: Gauthier and Aubry, 1995.

B.7.2 Inventory method

To inventory breeding birds, point counts were conducted in all habitat types in the detailed inventory area. Count stations were also set up in special-status species habitats. There were a total of 42 stations (see Map C, Volume 3).

A 50-m fixed-radius point count and an unlimited distance point count were performed at each station, the former to determine average nesting pair density and the latter to draft a more complete list of species present. All birds seen and heard at the station during two 5-minute count periods were recorded. At the end of the count period, call playbacks were used for special-status birds. A 3-minute settle down period preceded each count.

To standardize the data collected, the data required on the standard form used by Hydro-Québec Équipement et services partagés was collected at each count station: observer identification, geographic information (sector, station, etc.), weather information (temperature, cloud cover, precipitation and wind), list of species noted, number of birds (sex and age when possible) and signs of nesting according to the *Québec Breeding Bird Atlas* (Gauthier and Aubry, 1995). In addition, for each recorded occurrence of a special-status species, the physical features of the habitat (slope, type of soil, drainage) were recorded. Photographs were also taken and the location of the observation was recorded using a GPS unit.

B.7.3 Inventory period

The point count surveys took place from May 30 to June 19, at the height of the breeding season. The surveys were conducted early in the morning, starting about a half-hour before sunrise and lasting about five hours. For some species, nighthawk and whip-poor-will, for example, the surveys were conducted in the evening if the potential habitats could not be visited at dawn. No surveys were conducted if it was raining, windy or unusually hot or cold.

B.8 Mammals

As the study area has such a wide variety of habitats, many mammals species are potentially present (see Table B-22). In addition, the availability of large wooded areas, particularly in the south part of the study area, increases the potential for presence of a number of species with large home ranges, such as black bear.

A list of 14 special-status mammal species potentially present in the study area was drafted based on information provided by the CDPNQ, the paper issued by CRRNT de l'Estrie (2010) and an analysis of habitats in the study area (see Table B-23). Of these, 12 are likely to be designated threatened or vulnerable in Québec and two have no special status in Québec but are endangered in Canada (Schedule 1, *Species at Risk Act*). Some of these species were reported in inventories of the Johnville Bog and Forest Park: rock vole, southern bog lemming, silver-haired bat and hoary bat.

Table B-22: Mammal Species Present or Potentially Present in the Study Area

Common name	Scientific name	Status	
		Québec [a]	Canada
Artiodactyla			
White-tailed deer	*Odocoileus virginianus*	—	—
Moose	*Alces alces*	—	—
Carnivores			
Long-tailed weasel	*Mustela frenata*	—	—
Least weasel	*Mustela nivalis*	LDTV	—
Mountain lion	*Puma concolor*	LDTV	—
Coyote	*Canis latrans*	—	—
Ermine	*Mustela erminea*	—	—
River otter	*Lutra canadensis*	—	—
Gray wolf	*Canis lupus*	—	—
Lynx	*Lynx canadensis*	—	—
Bobcat	*Lynx rufus*	—	—
American marten	*Martes americana*	—	—
Striped skunk	*Mephitis mephitis*	—	—
Black bear	*Ursus americanus*	—	—
Fisher	*Martes pennanti*	—	—
Raccoon	*Procyon lotor*	—	—
Gray fox	*Urocyon cinereoargenteus*	—	—
Red fox	*Vulpes vulpes*	—	—
American mink	*Neovison vison*	—	—
Rodents			
American beaver	*Castor canadensis*	—	—
Red squirrel	*Tamiasciurus hudsonicus*	—	—
Northern flying squirrel	*Glaucomys sabrinus*	—	—
Snowshoe hare	*Lepus americanus*	—	—
Woodchuck	*Marmota monax*	—	—
Southern flying squirrel	*Glaucomys volans*	LDTV	—
American porcupine	*Erethizon dorsatum*	—	—
Muskrat	*Ondatra zibethicus*	—	—
Eastern chipmunk	*Tamias striatus*	—	—

Table B-22: Mammal Species Present or Potentially Present in the Study Area *(continued)*

Common name	Scientific name	Status	
		Québec [a]	Canada
Insectivores			
Star-nosed mole	*Condylura cristata*	—	—
Northern short-tailed shrew	*Blarina brevicauda*	—	—
Masked shrew	*Sorex cinereus*	—	—
Smoky shrew	*Sorex fumeus*	—	—
Rock shrew	*Sorex dispar*	LDTV	—
American water shrew	*Sorex palustris*	—	—
Pygmy shrew	*Sorex hoyi*	—	—
Hairy-tailed mole	*Parascalops breweri*	—	—
Other rodents			
Southern red-backed vole	*Clethrionomys gapperi*	—	—
Meadow vole	*Microtus pennsylvanicus*	—	—
Rock vole	*Microtus chrotorrhinus*	LDTV	—
Southern bog lemming	*Synaptomys cooperi*	LDTV	—
Woodland vole	*Microtus pinetorum*	LDTV	Of special concern
Gray squirrel	*Sciurus carolinensis*	—	—
Norway rat	*Rattus norvegicus*	—	—
White-footed mouse	*Peromyscus leucopus*	—	—
House mouse	*Mus musculus*	—	—
Woodland jumping mouse	*Napæozapus insignis*	—	—
Meadow jumping mouse	*Zapus hudsonius*	—	—
Deer mouse	*Peromyscus maniculatus*	—	—
Bats			
Silver-haired bat	*Lasionycteris noctivagans*	LDTV	—
Hoary bat	*Lasiurus cinereus*	LDTV	—
Northern long-eared bat	*Myotis septentrionalis*	—	Endangered
Eastern small-footed bat	*Myotis leibii*	LDTV	—
Red bat	*Lasiurus borealis*	LDTV	—
Big brown bat	*Eptesicus fuscus*	—	—
Little brown bat	*Myotis lucifugus*	—	Endangered
Eastern pipistrelle	*Perimyotis subflavus*	LDTV	Endangered

a. LDTV: likely to be designated threatened or vulnerable.

Sources: CDPNQ, 2010; ACA, 2011; CRRNT de l'Estrie, 2010 and 2011; Prescott and Richard, 2004; personal communication, René Houle, MRNF, 2011; Canada, 2014*a*; Québec, MFFP, 2015.

Table B-23: Special-status Mammal Species Potentially Present in the Study Area

Species	Source(s) of reports	Status		Habitat	Potential presence in the study area		Inventory
		Québec [a]	Canada		Potential	Rationale	
Least weasel (*Mustela nivalis*)	CDPNQ, 2010	LDTV	—	Open areas such as prairies, wet meadows, swamps and streambanks.	Yes	Presence of wetlands and streams.	Not required
Rock vole (*Microtus chrotorrhinus*)	CDPNQ, 2010; Johnville Bog and Forest Park, n.d.	LDTV	—	Cliffs and rock outcrops in mixed or coniferous forest. Edges of clearings at higher elevations, near moist talus areas, among mossy rocks and near water. Edge environments between open habitats and mature forest.	Yes	Presence of several forested areas.	Not required
Woodland vole (*Microtus pinetorum*)	CRRNT de l'Estrie, 2010	LDTV	Of special concern	Well-drained wooded habitats with dense vegetation cover.	Yes	Presence of several forested areas.	Not required
Southern bog lemming (*Synaptomys cooperi*)	CRRNT de l'Estrie, 2011; Johnville Bog and Forest Park, n.d.	LDTV	—	Sphagnum and heath bogs, grass marshes and mixed forest surrounding peatland.	Yes	Presence of peatland and other types of wetland.	Not required
Silver-haired bat (*Lasionycteris noctivagans*)	CDPNQ, 2010; Johnville Bog and Forest Park, n.d.	LDTV	—	Woodland near water.	Yes	Presence of several forested areas.	Yes
Hoary bat (*Lasiurus cinereus*)	CDPNQ, 2010; Johnville Bog and Forest Park, n.d.	LDTV	—	Wooded and semi-wooded areas near clearings and water.	Yes	Presence of several forested areas and bodies of water.	Yes
Northern long-eared bat (*Myotis septentrionalis*)	Prescott and Richard, 2004	—	Endangered	Near lakes, streams and clearings. Generally roosts alone in rock crevices, caves and sometimes under raised bark.	Yes	Presence of several forested areas and bodies of water.	Yes
Eastern small-footed bat (*Myotis leibii*)	Prescott and Richard, 2004	LDTV	—	Mountainous regions covered with conifers and deciduous trees.	Yes	Presence of several forested areas.	Yes
Red bat (*Lasiurus borealis*)	CRRNT de l'Estrie, 2010	LDTV	—	Woodland.	Yes	Presence of several forested areas.	Yes

Table B-23: Special-status Mammal Species Potentially Present in the Study Area *(continued)*

Species	Source(s) of reports	Status		Habitat	Potential presence in the study area		Inventory
		Québec [a]	Canada		Potential	Rationale	
Mountain lion (*Puma concolor*)	CRRNT de l'Estrie, 2010	LDTV	—	Woodland with diversified vegetation cover.	Yes	Presence of several forested areas.	Not required
Rock shrew (*Sorex dispar*)	CRRNT de l'Estrie, 2010	LDTV	—	Mountainous terrain in coniferous forests.	Yes	Presence of several forested areas.	Not required
Southern flying squirrel (*Glaucomys volans)*	MFFP, 2015	LDTV	—	Deciduous forest (beech, maple, oak, walnut and poplar) and mixed forest (with pine), often close to a watering hole.	Yes	Presence of several forested areas.	Not required
Little brown bat (*Myotis lucifugus*)	Prescott and Richard, 2004	—	Endangered	Woodland near lakes, streams, swamps and clearings. Abundant in urban areas. Males often roost alone in cavities or behind shutters.	Yes	Presence of several forested areas and bodies of water.	Yes
Eastern pipistrelle (*Perimyotis subflavus*)	CRRNT de l'Estrie, 2010	LDTV	Endangered	Rural areas and forest edges.	Yes	Presence of open areas.	Yes

a. LDTV: likely to be designated threatened or vulnerable.

Source : Habitat description: Prescott and Richard, 2004.

B.8.1 Bats

The eight species of bats found in Québec inhabit the southern part of the province and may therefore occupy the study area (Prescott and Richard, 2004). Of these eight species, five are likely to be designated threatened or vulnerable in Québec: silver-haired bat, hoary bat, eastern small-footed bat, red bat and eastern pipistrelle. The latter species is considered "endangered" in Canada, as are the northern long-eared bat and little brown bat. These species and their preferred habitats are listed in Table B-24.

Table B-24: Habitats of Special-status Bats

Species	Source(s) of reports	Status		Habitat [b]
		Québec [a]	Canada	
Silver-haired bat (*Lasionycteris noctivagans*)	CDPNQ, 2010	LDTV	—	Woodland near water.
Hoary bat (*Lasiurus cinereus*)	CDPNQ, 2010	LDTV	—	Wooded and semi-wooded areas near clearings and water.
Northern long-eared bat (*Myotis septentrionalis*)	—	—	Endangered	Closely associated with boreal forests. Near lakes, streams and clearings. Often hunts above small streams and clearings or along roads.
Eastern small-footed bat (*Myotis leibii*)	—	LDTV	—	Mountainous areas covered with conifers and deciduous trees.
Red bat (*Lasiurus borealis*)	CRRNT de l'Estrie, 2012	LDTV	—	Coniferous and mixed forests. Forages over glades, rivers and watering holes. Adapted to urban environments.
Little brown bat (*Myotis lucifugus*)	—	—	Endangered	Forests near lakes, streams, swamps and clearings. Very widespread in urban areas.
Eastern pipistrelle (*Perimyotis subflavus*)	CRRNT de l'Estrie, 2012	LDTV	Endangered	Rural areas and forest edges.

a. LDTV: likely to be designated threatened or vulnerable.
b. According to Prescott and Richard, 2004.

The silver-haired bat and hoary bat had already been reported in the study area, in the Johnville Bog and Forest Park (CDPNQ, 2014).

Bats are generalists and can be found in a variety of habitats: woodland, farmland and even urban areas. As they are insectivores, many bat species prefer edge habitats close to water, generally where insects are abundant or the hunting is easy. Arboreal bats generally use cavities in large trees (rot holes, woodpecker holes, raised bark, etc.) as day roosts (Tremblay and Jutras, 2010).

The methodological approach used for this project was based on the recommendations of the MFFP. Thus Hydro-Québec used two types of inventories to check for

the presence of habitats suitable for bats: passive inventories at fixed stations and active inventories along monitoring routes.

Passive inventory

In the north part of the line route, where the planned line is paired with the existing 450-kV line, Hydro-Québec conducted acoustic inventories from fixed stations. Two sampling sites about 20 km apart were selected in habitats suitable for bats, with the agreement of the MFFP: one near Johnville Bog and Forest Park and the other in the Rivière aux Saumons valley.

Two stations were set up at each sampling site. One Wildlife Acoustics SM3 song meter was placed in an open area and another in an enclosed (wooded) area. The stations were located in the most favorable habitats, about 200 m apart. The song meters were left in place for five to seven days to ensure three days of good weather (temperature about 20°C, winds less than 5 km/h, no precipitation). They were then moved to the second site for a second five-to-seven day period (three days of good weather). Last, they were moved back to the first site for a last five-to-seven day period. The inventories took place between July 1 and August 8.

Tests were performed prior to the acoustic inventories to rule out the possibility of interference between the song meter and the existing power line at the open-area station.

Active inventory

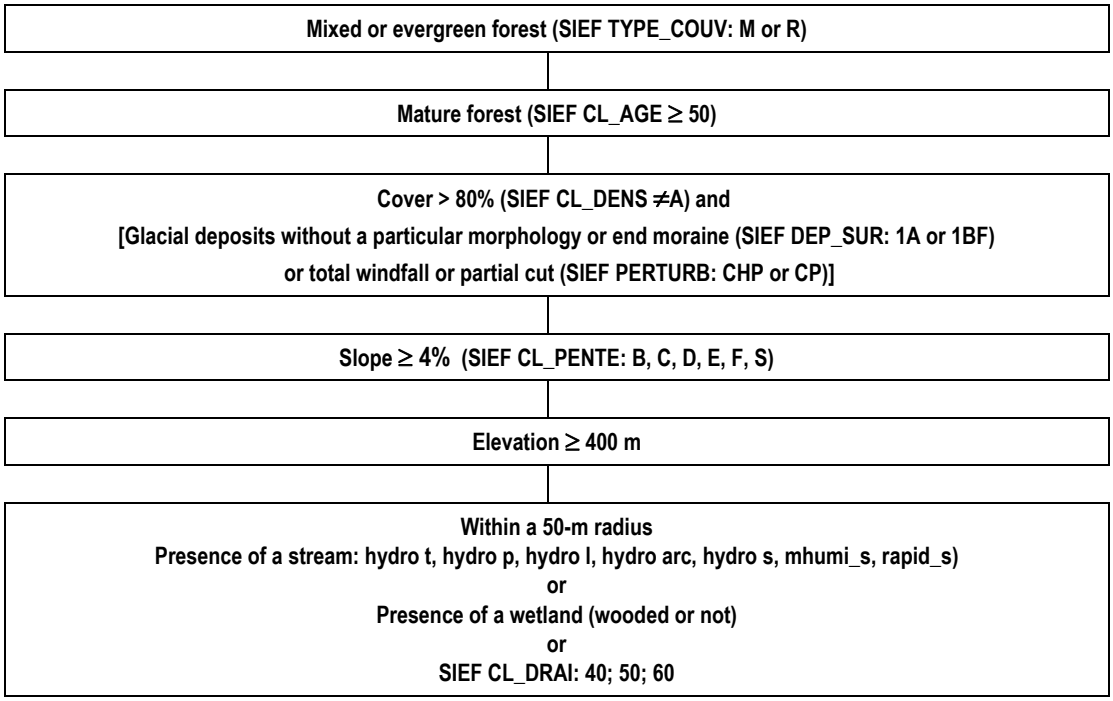
An acoustic inventory was conducted along a monitoring route in the south part of the planned line using a Titley Scientific AnaBat detector. The monitoring route was 30 km long and was run twice on each of three nights (July 20, July 27 and August 13), for a total of 15 hours of recording. In addition, potential hybernacula (caves, abandoned mines, etc.) were checked during other inventories in the summer of 2015.

B.8.2 Rock vole and southern flying squirrel

Given concerns expressed by the MFFP, Hydro-Québec assessed the potential for presence of two mammal species likely to be designated threatened or vulnerable: rock vole (*Microtus chrotorrhinus*) and southern flying squirrel (*Glaucomys volans*). Geospatial tools were used for this assessment, and a multivariate analysis was performed based on data from the Système d'information écoforestière (SIEF), land use data and the hydrography and topography of the study area. The criteria used were based on the ecological characteristics of the two species according to the scientific literature as well as confirmed reports in Estrie provided by the MFFP.

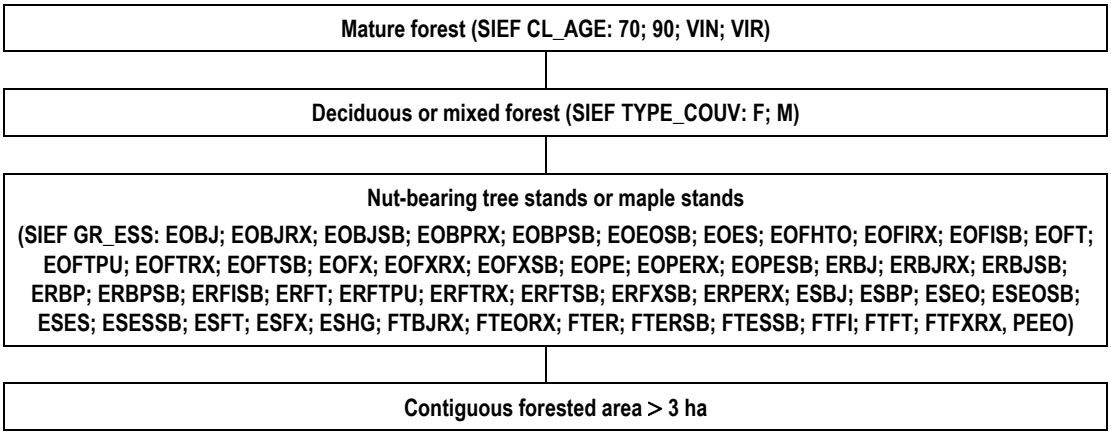
Rock vole is a woodland species that inhabits mixed evergreen forest. According to data reported by the MFFP (Québec, MFFP, 2015*b*), it prefers areas where the forest cover is sparse and the shrub stratum is not too dense. The rock vole is also sometimes found in small clearings, fresh cuts or edge environments between open areas and mature forest. The species is generally found in cool, damp habitats as well as at the feet of cliffs and on rock outcrops at high altitudes. Given the characteristics of rock vole habitat and the components of the detailed inventory area, the parameters listed in Figure B-3 were used for the multivariate analysis.

Figure B-3: Multivariate Analysis of Rock Vole Habitat



Southern flying squirrel, on the other hand, generally seeks out mature nut-producing trees with nest holes. The species is thus found mainly in relatively old deciduous forests (American beech, northern red oak, white ash and maple) with a few evergreens (pine and hemlock). The stand or forest fragment must also be large enough relative to the home range of the species, which is generally greater than 4 ha. Given these habitat characteristics and the components of the detailed inventory area, the multivariate analysis was based on the parameters listed in Figure B-4.

Figure B-4: Multivariate Analysis of Southern Flying Squirrel



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C Classification of Environmental Components

The inventoried components were classified according to their resistance to the project. Hydro-Québec's *Méthode d'évaluation environnementale – Lignes et postes* (1990) uses the term "resistance." There are two types of resistance in the case of components: environmental and technical.

Landscape units were also classified according to resistance. In the case of landscape units, resistance is solely environmental. It is analyzed according to Hydro-Québec's *Méthode d'étude du paysage pour les projets de lignes et de postes de transport et de répartition* (1992).

The environmental resistance assigned to an environmental component or landscape unit is based on two separate concepts: the anticipated impact on it, and the value accorded to it (see Table C-1). Technical resistance, on the other hand, is based on the technical and economic characteristics and criteria of the planned structures.

Table C-1: Grid for Determining Environmental Resistance of Environmental Components

		Value			
		Legal	**High**	**Moderate**	**Low**
Anticipated impact	**High**	Constraint	Very high resistance	High resistance	Moderate resistance
	Moderate	Constraint	High resistance	Moderate resistance	Low resistance
	Low	Constraint	Moderate resistance	Low resistance	Very low resistance

C.1 Environmental resistance

C.1.1 Biophysical and human environment components

Anticipated impact

The anticipated impact depends on the alterations that an environmental component may undergo following construction of the planned facilities. This assessment takes into account the general mitigation measures (taken from the *Standard Environmental Clauses*, reproduced in Appendix F) prescribed by Hydro-Québec, since they are part and parcel of the company's business practices. There are three levels of anticipated impact: *high, moderate* and *low*.

Value

A component's value is an overall judgment as to whether the component should be preserved or protected because of its intrinsic value, uniqueness, rarity, importance or situation in the area. Other factors include legislation, the socioeconomic characteristics of the area and the opinions expressed by communities, organizations, associations and the media. There are four possible values: *legal, high, moderate* and *low*.

Levels of resistance

Combining the three levels of anticipated impact and four values yields five levels of environmental resistance (see Table C-1):

- *Constraint* applies to a component that is protected, or in the process of becoming protected, by a law or regulation that prohibits or strictly controls the implementation of the planned facilities there, or when it would be very difficult to obtain government authorization to build the project there, with the result that the component must be avoided at all costs.
- *Very high resistance* applies to a component that may only be crossed in cases of extreme necessity, since the value and anticipated impact are deemed high.
- *High resistance* applies to a component to be avoided if possible due to its value or the extent of the disturbance anticipated.
- *Moderate resistance* applies to a component that, with a few reservations, can be selected for implementation of the planned facilities; however, special mitigation measures are required.
- *Low resistance* applies to a component that can be selected for implementation of the planned facilities. The new structures will not significantly disturb the functions of the area or its use by humans or wildlife. If they do, the mitigation measures will be easy to apply.

C.1.2 Landscape units

Anticipated impact

Anticipated impact on landscape units translates the landscape's ability to assimilate the planned facilities. The more the landscape is able to accommodate the facilities without being altered, the lower the anticipated impact. Two parameters are used to estimate the anticipated impact: absorption capacity and blending capacity.

Absorption capacity

Absorption capacity means a landscape's ability to hide the planned facilities. Generally speaking, visual absorption capacity has to do with the openness of the visual fields (potential visual accessibility) and the relationship between the land features (relief, bodies of water, vegetation cover or built components) and the planned facilities. The more open the landscape and the larger the facilities, the lower the absorption capacity. There are three levels of absorption capacity: *high, medium* and *low*.

Blending capacity

The blending capacity of a landscape unit means the physical compatibility of its dominant characteristics with the project components in terms of scale and character. The greater the contrast between the physical characteristics of the planned facilities and the character and scale of the landscape components, the lower the blending capacity. There are three levels of blending capacity: *high, medium* and *low*.

Levels of anticipated impact

There are three levels of anticipated impact: *high*, *moderate* and *low*.

- The anticipated impact is *high* when the landscape unit could be greatly altered by the implementation of the planned facilities, that is, when it has low absorption and blending capacities.
- The anticipated impact is *moderate* when the landscape unit could be altered by the presence of the planned facilities without its overall character being jeopardized, that is, when it has
  - medium absorption and blending capacities,
  - low absorption capacity and medium or high blending capacity, or
  - low blending capacity and medium or high absorption capacity.
- The anticipated impact is *low* when there is little risk that the landscape unit will be altered by the implementation of the planned facilities, that is, when it has
  - high absorption and blending capacities,
  - high absorption capacity and medium blending capacity, or
  - high blending capacity and medium absorption capacity.

Value

The value of a landscape unit is based on two parameters: the intrinsic quality of the landscape and the interest accorded on the basis of land use in the area.

Intrinsic landscape quality

Intrinsic landscape quality is determined by the quality of uniqueness recognized in the components making it up. The more a landscape is recognized for its aesthetic, visual or symbolic qualities, the higher its intrinsic value. The quality of the landscape compared with the landscape components is determined by the specialists or reference works consulted. There are four levels of intrinsic quality: *legal*, *high*, *medium* and *low*.

Interest accorded on the basis of land use

The interest accorded on the basis of land use is based on several different indicators. Depending on the activity practised, the user's interest in the landscape can vary significantly. The more directly the activity is related to appreciation of the landscape, the greater the interest accorded. For example, the interest of a tourist, resident or vacationer in the landscape is different from a motorist's interest in the landscape visible from a tertiary road. The number of observers in a landscape unit also influences the interest accorded. There are four levels of interest accorded on the basis of land use: *legal*, *high*, *medium* and *low*.

Values

There are four possible values assigned to landscape units:

- *Legal*, when one or more components of the visible landscape are protected, or in the process of becoming protected, by a law or regulation that prohibits or strictly controls the implementation of the planned facilities there.
- *High*, when the landscape unit is assigned a high intrinsic quality (because of its unity, uniqueness and integrity) and a high level of interest (because it is used for recreational purposes or has been found to contain signs of occupation linked to observation of the landscape).
- *Medium,* when it is assigned a medium intrinsic quality and medium interest based on land use, or a high intrinsic quality and medium interest, or low or medium intrinsic quality and high interest.
- *Low*, when it is assigned a low intrinsic quality and medium interest based on land use, or a medium intrinsic quality and medium interest, or medium intrinsic quality and low interest. The value is also low when the unit is assigned a low level of interest and a low intrinsic quality.

Levels of resistance

Combining the three levels of anticipated impact and the four levels of value assigned to landscape units yields five levels of resistance (see Table C-1).

- *Constraint* applies to landscape units whose main components are protected, or in the process of becoming protected, by a law or regulation.
- *Very high resistance* applies to landscape units that should be altered only in cases of extreme necessity. These landscape units have low absorption capacity and low blending capacity (high anticipated impact), combined with high value. They contain a significant number of valued components (area of visual interest, remarkable vista, visual attraction, observation site, etc.) and land use is focused on appreciation of landscapes (region of visual interest, scenic route, scenic lookout, etc.).
- *High resistance* applies to landscape units to be avoided if possible. These are units of medium value where the project's impact would be high or, inversely, units of high value where the anticipated impact is moderate.
- *Moderate resistance* applies to landscape units that can be selected for siting of the planned facilities, provided mitigation measures are implemented. These are units with the following characteristics:
  - low anticipated impact but high value;
  - moderate anticipated impact and medium value;
  - high anticipated impact but low value.
- *Low resistance* applies to landscape units that can be selected for siting of the planned facilities. These are units where the anticipated impact is low and the value is medium or low, or where the anticipated impact is moderate and the value is low.

C.2 Technical resistance

Like technical sensitivity, the technical resistance attributed to an environmental component is based on the technical and economic characteristics and criteria associated with the planned facilities, such as conductor vertical ground clearance, span length, soil stability and load-bearing capacity, and equipment reliability and safety.

There are five levels of technical resistance:

- *Constraint* applies to a component that poses technical difficulties that are almost insurmountable or would be much too expensive to overcome and therefore, must be avoided at all costs.
- *Very high resistance* applies to a component that may be crossed only in cases of extreme necessity, due to the major technical difficulties it poses and the resulting excessive costs.

- *High resistance* applies to a component to be avoided as much as possible due to the risk of technical difficulties that could give rise to large additional costs.
- *Moderate resistance* applies to a component that can be selected for implementation of the planned facilities, but with reservations, since it may pose technical difficulties that could give rise to significant additional costs.
- *Low resistance* applies to a component that poses minimal techno-economic restrictions.

C.3 Resistance of biophysical and human environment components

The biophysical and human environment components inventoried are classified according to their resistance. Table C-2 shows the level of anticipated impact on the components and the value accorded to each, along with the levels of environmental and technical resistance. The highest level of resistance, whether environmental or technical, was the one retained.

Constraint

The study area does not contain any component posing a constraint on the project.

Very high resistance

There are 14 components with very high resistance against the project. Some are site-specific and can be avoided.

Sugar bush operation

The anticipated impact on sugar bush operations is high because of right-of-way clearing and the expected loss of the resource. Sugar bush operations in private forest are highly valued by their owners, and maple syrup production contributes significantly to the local economy. In addition, sugar bush operations are fairly rare in relation to the number of maple stands in the study area. Sugar bush operations therefore present a very high level of environmental resistance.

Table C-2: Resistance of Biophysical and Human Environment Components

Environmental component	Anticipated impact	Value	Environmental resistance	Techno-economic resistance
Physical environment				
Erosion zone	Moderate	High	High	High
Flood zone	Low	High	Medium	Medium
Perennial stream	Low	High	Medium	Low
Intermittent stream	Low	Medium	Low	Low
Wildlife				
White-tailed deer yard	Low	Medium	Low	—
White-tailed deer wintering ground	Low	Medium	Low	—
Muskrat habitat	Moderate	Medium	Medium	—
Waterfowl staging area	Moderate	Medium	Medium	—
Fish habitat	Low	High	Medium	—
Special-status wildlife species	Moderate	High	High	—
Vegetation				
Wetland	Moderate	High	High	Medium
Sugar bush operation	High	High	Very high	—
Potential sugar bush on protected agricultural land	High	Medium	High	—
High-potential sugar bush according to MAPAQ	High	Low	Medium	—
Special-status plant species	High	High	Very high	—
Tree plantings	Moderate	High	High	—
Other woodland	High	Low	Medium	—
Brushland	Low	Low	Low	—
Clear cut	Low	Low	Low	—
Tree alignment	High	High	Very high	—
Built environment				
Residential, commercial or community use	High	High	Very high	—
Planned urban development	High	Medium	High	—
Industrial use	Low	Medium	Low	—
Sand or gravel pit	Moderate	Medium	Medium	Medium

Table C-2: Resistance of Biophysical and Human Environment Components *(continued)*

Environmental component	Anticipated impact	Value	Environmental resistance	Techno-economic resistance
Vacationing, recreation and tourism				
Johnville Bog and Forest Park	High	High	Very high	—
Réserve naturelle Neil-et-Louise-Tillotson	—	—	Very high	—
Vacation or recreation area	High	High	Very high	—
Campground	High	High	Very high	—
Recreational, tourism or agritourism site	Moderate	High	High	—
Rest stop	Moderate	High	High	—
Scenic lookout or observation platform	Moderate	High	High	—
Recreational trail (hiking, biking, cross-country ski, snowshoeing or multi-use)	Moderate	High	High	—
Snowmobile or ATV trail	Moderate	Medium	Medium	—
Scenic road	Moderate	High	High	—
Agricultural production				
Field crop or pasture on category A or B soil	Moderate	High	High	—
Field crop or pasture on category C or X soil	Moderate	Medium	Medium	—
Land used for horticulture and specialty crops	High	High	Very high	—
Orchard	High	High	Very high	—
Fish farm	Low	High	Medium	—
Specialized livestock operations	Moderate	High	High	—
Specialized plant production	High	High	Very high	—
Organic farming operation	High	High	Very high	—
Infrastructure				
Border crossing	Low	Medium	Low	—
Municipal drinking water intake	High	High	Very high	—
Telecommunications tower	Low	Medium	Low	—
Transmission substation	Low	Low	Low	—
450-kV transmission line	Low	Medium	Low	—
Other transmission line	Low	Medium	Low	—
Gas pipeline	Low	Medium	Low	—

Table C-2: Resistance of Biophysical and Human Environment Components *(continued)*

Environmental component	Anticipated impact	Value	Environmental resistance	Techno-economic resistance
Railway	Low	Low	Low	—
Dry waste disposal site	Low	Low	Low	—
Vehicle graveyard	Low	Low	Low	—
Heritage and archaeology				
Official heritage site or building	High	High	Very high	—
Prehistoric archaeological potential	Moderate	Medium	Medium	—

Special-status plant species

The anticipated impact on this component is high, since the construction of power infrastructure could destroy rare plants or disturb their habitat. The value of this component is high, according to the *Act respecting threatened or vulnerable species* (CQLR c E-12.01) and the *Regulation respecting threatened or vulnerable plant species and their habitats* (CQLR c E-12.01, r 3), which protect species with dwindling populations. Special-status plant species often constitute local components that can be avoided; moreover, a number of proven mitigation measures can be applied to ensure protection of a species. The environmental resistance of this component is therefore ranked as very high.

Tree alignment

The anticipated impact on tree alignments is high because trees will have to be cut down to allow for construction of the line. The value accorded to this component is high, since tree alignments improve the rural landscape by giving it a pastoral appearance, and they also demonstrate the importance people place on their surroundings. The MRC of Haut Saint-François, in its land use plan, protects "tree tunnels" including the one located at the Johnville west exit on Highway 251, in the municipality of Cookshire-Eaton. The environmental resistance of this component is ranked as very high.

Residential, commercial or community use

The anticipated impact on these uses, along with their buildings, is high because of the risk of disturbing the built environment. Construction of the power line could severely disturb areas or facilities that are highly frequented by the population. In addition, their value is high because of the importance local people place on preserving their quality of life. Environmental resistance is therefore ranked as very high.

Official heritage site or building

The study area contains one heritage site (the township of Sainte-Edwidge-de-Clifton heritage site) and one heritage church (Saint-Herménégilde). The anticipated impact is ranked as high, since the attraction of these locations could be greatly diminished by the presence of power infrastructure. Since they are protected under the *Cultural Heritage Act*, their value is high. The environmental resistance of these heritage sites is ranked very high.

Johnville Bog and Forest Park

The anticipated impact on the Johnville Bog and Forest Park is high because the construction and maintenance work, along with the permanent presence of the line, would significantly alter the ecosystems found there, some of which contain special-status plant and wildlife species. The value of Johnville Bog and Forest Park is high because it has an important educational and scientific role in addition to its primary role of protecting ecosystems.

Réserve naturelle Neil-et-Louise-Tillotson

The anticipated impact on the Réserve naturelle Neil-et-Louise-Tillotson is high because the construction and maintenance work, along with the permanent presence of the line, would significantly alter the ecosystems found there, some of which contain special-status plant and wildlife species. A ranking of "very high resistance" is therefore justified.

Vacation or recreation area and campground

The anticipated impact of a power line on vacation areas and campgrounds in the study area is high, given the risk of disturbing the present environment as well as future developments. The vacation areas are densely occupied, and more and more seasonal residences are being converted into permanent residences. Their value is ranked high, mainly because vacation areas and campgrounds are rare in the study area and because the quality of the natural surroundings is an important factor for vacationers and campers. These components therefore have a very high level of environmental resistance to the project.

Orchards, specialized plant production and land used for horticulture and specialty crops

The anticipated impact on specialized plant production, on orchards and on other land used for horticulture or specialty crops is high, given that the surface areas in question are generally small in comparison with field crops and pasturage. Such crops require particular growing conditions. Moreover, the producer generally lives solely off the sale of these products, whereas field crops and pasturage are often associated with

livestock operations. For these reasons, and because the crops concerned are relatively rare, this component is assigned a high value and a very high level of environmental resistance.

Organic farming operations

The anticipated impact on organic farming operations is high, because such operations are subject to numerous constraints imposed by the certifying body. The specialists place a high value on such operations, because they are relatively rare and require special knowledge and production techniques. The environmental resistance of this component is therefore very high.

Municipal water intake

The anticipated impact is high, given the vulnerability of community water supply sites. The value accorded—both by specialists and by users of the water supply and distribution system—is high because water quality is important and good sites for supplying a community are rare. As a result, the level of resistance is very high.

High resistance

A high level of environmental resistance is assigned to the 10 components that are considered sensitive to the construction of a power line and must be avoided as much as possible for environmental reasons.

Erosion zone

The impact of building a power line in or near an erosion zone can be moderate; however, as these areas are fragile, technical and environmental difficulties should be anticipated. Moreover, having been designated as a constraint to land occupation in the revised land use plans of the MRCs of Val-Saint-François and Haut-Saint-François, these zones are accorded a high value. They are therefore assigned a high level of environmental and techno-economic resistance.

Special-status wildlife species

The anticipated impact on a wildlife species that is threatened or vulnerable, or likely to be designated as such, is moderate since construction of a power line could alter its habitat but not necessarily lead to its disappearance or to a significant decrease in its population. The value accorded to this component is high, since such species are subject to extensive monitoring in Québec. Its environmental resistance is ranked as high.

Potential sugar bush on protected agricultural land

The anticipated impact on high-potential maple stands on protected agricultural land is high, due to the vegetation clearing that will precede construction. Maple syrup production is among the activities covered by the *Act Respecting the Preservation of Agricultural Land and Agricultural Activities* (CQLR c P-41.1). However, there is no syrup production in these maple stands and no capital has been invested there. The value accorded is therefore medium and the environmental resistance is high.

Wetlands

Wetlands and their characteristics (vegetation cover, soil characteristics, drainage, etc.) can be altered during power line construction. The anticipated impact is moderate, since general mitigation measures are planned for the routing of a line through this type of environment. The value accorded is high, since the MDDELCC strictly supervises any work in wetlands, especially when they have a hydrologic interconnection with a stream. Consequently, this component is assigned a high level of resistance. Its techno-economic resistance is ranked as medium, due to the technical difficulties associated with crossing it.

Tree plantings

Tree plantings in the study area include Christmas tree farms. The anticipated impact is moderate, since Christmas trees not exceeding a certain height can remain in the line right-of-way. Tree plantings have been invested in by woodlot owners or Christmas tree producers. Like sugar bush operations, tree plantings are a source of primary or significant secondary income for their owners. Christmas tree production is widespread in the Estrie region and gives a very characteristic aspect to the landscape, especially in the south study area. Tree plantings therefore have a high value and a very high environmental resistance.

Planned urban development

The anticipated impact on planned urban development areas is high, given that the presence of the power line could limit future real estate projects. The value accorded is medium, since the projects are not yet built and could still be modified to adapt to the presence of the line. The environmental resistance of this component is high.

Recreational, tourism or agritourism site

The anticipated impact on recreational, tourism or agritourism sites in the study area is moderate, since the site will still be able to exist in the line's presence, although it might draw less interest. The value is high, given the relative rarity of such sites in the study area. These sites support the development of tourism, which contributes to the regional economy. Their environmental resistance is therefore high.

Recreational or tourist facility (rest stop, scenic lookout or observation platform, recreational trail or scenic road)

The anticipated impact on most of the recreational or tourist facilities in the study area is considered moderate because the line will not compromise their existence or integrity, although it could alter their quality and diminish people's interest in them. Some of these facilities are accorded a high value, mainly because they are rare or linked to recreational activities for which the quality of the natural surroundings is important. Their resistance is therefore high.

Field crop or pasture on category A or B soil

The presence of a power line on cultivated land or pasturage would have certain disadvantages, such as changing the land use, but would not compromise farming operations in a major way. The anticipated impact is therefore considered moderate. Owing to the relative rarity of categories A and B soils in the region and their high agricultural potential, the value accorded to agricultural operations on these soils is high. These agricultural areas therefore have a high level of resistance to the construction of a power line.

Specialized livestock operations

Specialized livestock operations (sheep, goats, horses, emus and rabbits) are present in the study area. The anticipated impact on this type of operation is moderate, because the animals are sensitive to noise and the herd could be disturbed, especially during construction and maintenance, although they would not be harmed in any way. Because of the rarity of such businesses, this component has a high value. Specialized animal husbandry contributes to the vitality of rural agriculture through diversification. The environmental resistance of this component is therefore high.

Moderate resistance

The 11 components with a moderate level of environmental resistance can receive the power transmission facilities with a few restrictions. In the study area, these components are mainly unprotected woodlots or cropland on lower-potential soil, as well as snowmobile or ATV trails (often linear) which the line can easily cross or run alongside.

Flood zone

The reliability and safety of power line structures can be compromised if built in a flood zone. However, given the relatively small footprint of the towers and the possibility of optimizing their siting, the anticipated impact on flood zones is considered low. However, the value accorded to these sensitive zones is high, since work and structures are restricted, and environmental and land use specialists agree

that disruptions there should be limited. As a result, this component is assigned moderate levels of resistance, both environmental and techno-economic.

Permanent stream

In light of Hydro-Québec's proven mitigation measures aimed at protecting water quality and stream banks during power line construction or maintenance near bodies of water, the anticipated impact on perennial streams is low. The value accorded is high, due to the social consensus on maximum protection of streams. Perennial streams in the study area therefore have moderate resistance to construction of a line. The techno-economic resistance is considered low.

Muskrat habitat and waterfowl staging area

The anticipated impact on the waterfowl staging area and muskrat habitats in the study area is generally moderate. Habitat quality could diminish during construction, but there is no threat to their integrity or long-term existence. These components are of medium value since, being on private land, they are not wildlife habitats within the meaning of the *Regulation respecting wildlife habitats* (CQLR c C-61.1, r 18). Consequently, their resistance is moderate.

Fish habitat

As the possible effects on perennial and intermittent streams are not significant, the anticipated impact on fish habitat is low. Fish habitat means any stream used by fish. This component has a high value since fish habitat, even on private land, constitutes a protected wildlife habitat under the *Act Respecting the Conservation and Development of Wildlife* (CQLR c C-61.1). Its resistance is therefore considered moderate.

High-potential sugar bush according to MAPAQ

The anticipated impact on sugar bushes with good production potential according to MAPAQ is high because of the clearing that will precede construction. Maple syrup production is among the activities covered by the *Act Respecting the Preservation of Agricultural Land and Agricultural Activities* (CQLR c P-41.1). However, there is no syrup production in these maple stands and no capital has been invested there. The value accorded is therefore low and the environmental resistance is moderate.

Other woodland

The anticipated impact on the other woodlands inventoried in the study area (not already discussed) is high, since the vegetation clearing and maintenance will result in destruction of the resource. The value accorded to these private woodlands is low, since their owners can conduct any activity they wish there without any restrictions apart from those imposed by the interim control bylaws of MRCs in the study area. Similarly, other maple stands are not protected under the *Act Respecting the Preservation of Agricultural Land and Agricultural Activities* (CQLR c P-41.1). The environmental resistance of these two components is therefore considered moderate.

Sand or gravel pit

From an environmental and techno-economic standpoint, the anticipated impact on sand and gravel pits is moderate, since construction of a line inside a borrow pit would hinder operations by limiting the usable surface, but would not compromise their integrity. The value is medium due to the relative rarity of these environmental components in the study area. The environmental resistance is therefore moderate, as is the techno-economic resistance, because a number of technical requirements apply to the passage of a line through such areas.

Prehistoric archaeological potential

The anticipated impact on areas with prehistoric archaeological potential is moderate, because line construction could disturb the soil and destroy potential archaeological sites. Conducting an inventory before the work begins will reveal the presence of any such sites and allow for the application of any necessary mitigation measures for protecting archaeological assets. The value accorded to this component is medium, since there are no known sites. The environmental resistance is therefore moderate.

Snowmobile or ATV trail

The anticipated impact on recreational and tourism facilities and areas is considered moderate, because the project will not compromise the areas or the existence or integrity of the trails. The line may nevertheless alter the quality of the trails and diminish people's interest in them. The value accorded to the snowmobile and ATV trails is medium, because they are not used by a large proportion of the population, there is no consensus about them, and they are not rare. Their resistance is therefore moderate.

Field crop or pasture on category C or X soil

The presence of a power line on cultivated land or pasturage would have certain disadvantages, such as changing the land use, but would not compromise farming operations in a major way. The anticipated impact is therefore considered moderate.

Owing to the low agricultural potential of categories C and X soils, the value accorded to agricultural operations on these soils is medium. These agricultural areas therefore have a moderate level of resistance to the construction of a power line.

Fish farming

The anticipated impact on fish farming is low, since the operations in the study area will not be disturbed by either line construction or operation. But, because of their rarity, they have a high value. And, like specialized livestock, fish farming contributes to the vitality of rural agriculture. Its environmental resistance is therefore moderate.

Low resistance

The five components with low environmental resistance are the ones that can receive the planned facilities with very few constraints. They are mainly located in grassy or shrubby brushland, logging areas and existing infrastructure.

Intermittent streams

As in the case of perennial streams, Hydro-Québec's proven mitigation measures for protecting water quality and stream banks during power line construction or maintenance near bodies of water justify a ranking of low anticipated impact on intermittent streams. The value accorded is medium since the flow in these streams is not perennial. The intermittent streams in the study area therefore have low resistance to the line construction. The techno-economic resistance is also considered low.

White-tailed deer yard and wintering ground

The anticipated impact is considered low, because the quality of these areas will be altered primarily during construction and proven mitigation measures will reduce the impacts during the work. Deer yards and wintering grounds on private land are accorded medium value since they are not protected under the *Regulation respecting wildlife habitats* (CQLR c C-61.1, r 18). Moreover, the deer population in the Estrie region is very large and approaching the threshold of social acceptance (excessive grazing, crop damage, traffic accidents, etc.). The resistance of these two components is therefore low.

Clear cut

The anticipated impact on these areas is low, since the presence of a power line will not affect their integrity. They are of little economic interest and are generally not valued by local residents. Their environmental resistance is therefore low.

Industrial use

The anticipated impact on industrial use is low, since the construction of a power line near industrial buildings will have no notable effect, except where transmission towers are erected. Industrial areas are generally assigned medium value, since they usually have little value in the eyes of the public. A power line would not be incompatible in such surroundings. The environmental resistance of this component is therefore low.

Infrastructure component

Certain infrastructures in the study area are, by their nature, not incompatible with the presence of a power line, and the anticipated impact on them is low. These infrastructures are the existing power lines and substations, the gas pipeline, the railway, the dry waste disposal sites and the vehicle graveyards. They are assigned a low or medium value, since their conservation is not the subject of a consensus, or is of little concern to specialists and the general public. Their resistance to the project is therefore low.

C.4 Resistance of landscape units

The line route cuts through three types of landscape unit: hilly landscapes (1 unit), mountainous landscapes (7 units) and valley landscapes (9 units) (see Table C-3).

Very high resistance

Mountainous landscape unit MO4

This landscape unit (the summit of Mont Hereford) dominates the landscape and is a landmark of symbolic importance for the local population. The many outdoor activities, the beautiful views, its role as a landmark and its potential for residential development make this landscape unit an exceptional site for regional development. The value accorded to this unit is therefore high. The summit's dominance of the landscape results in a high level of visual exposure so that, despite the forest cover on the slopes, the mountain has a low capacity for visually absorbing the power transmission structures. In addition, the natural quality of this landscape offers little blending capacity, which contributes to a high anticipated impact. Its resistance to the construction of a power line is therefore very high.

Table C-3: Resistance of Landscape Units

Unit	Anticipated impact			Value			Resistance
	Absorption capacity	Blending capacity	Impact	Intrinsic quality	Interest according to land use	Value	
Hilly landscape							
CO7	Moderate	High 1 existing power line	Low	Medium	Low	Low	Low
Mountainous landscape							
MO3	High Forest cover	Low	Moderate	Medium	Medium	Medium	Moderate
MO4	Low Flanks exposed	Low Natural landscape	High	High Landmark Recognized panoramic site Scenic views	High Recreation/tourist activities Hiking and snowmobile trails Réserve naturelle Neil-et-Louise-Tillotson Residential development potential	High	Very high
MO5	High Forest cover	Low Natural landscape	Moderate	Medium	Medium	Medium	Moderate
MO6	High Forest cover	Low Natural landscape	Moderate	Medium	Medium	Medium	Moderate
MO7	High Forest cover	Medium Natural landscape	Moderate	Medium	Medium	Medium	Moderate
MO8	High Forest cover	Low Natural landscape	Low	Medium	Low	Low	Low
MO9	High Forest cover	Low Forest cover	Moderate	High Panoramic views	High	High	High
Valley landscape							
VA9	Moderate	High	Low	Medium	Low	Low	Low
VA10	Moderate	Low	Moderate	High	High Tourist attractions	High	High
VA11	High	Low	Moderate	Medium	High Bike circuit	Medium	Moderate
VA12	Moderate	Low	Moderate	High	High	High	High

Table C-3: Resistance of Landscape Units *(continued)*

Unit	Anticipated impact			Value			Resistance
	Absorption capacity	Blending capacity	Impact	Intrinsic quality	Interest according to land use	Value	
VA13	High	Low	Moderate	Medium	High Recreational trails	Medium	Moderate
VA14	High	Low	Moderate	Medium	Low	Low	Low
VA15	High	Low	Moderate	Medium	High Bike circuit	Medium	Moderate
VA16	High	Low	Moderate	Medium	Low	Low	Low
VA17	Moderate	Low	Moderate	Medium	High Village of Saint-Herménégilde	Medium	Moderate

High resistance

Mountainous landscape unit MO9

Here the forest cover reduces visibility and promotes the visual absorption of the structures, although blending capacity remains low. The anticipated impact is therefore moderate. The beauty of the panoramic views and their enhancement by managers confer a high value on this landscape. In light of these considerations, unit MO9 has been assigned a high level of resistance.

Valley landscape units VA10 and VA12

The incised character of these valleys, with their succession of forest cover and cropland, results in medium absorption capacity and a moderate anticipated impact. Views of the valleys framed by mountains are spectacular, and the intrinsic quality of the landscapes is high. Moreover, these landscapes are highly valued. Unit VA10 contains the village of East Hereford nestled among the mountains, along with various recreational and tourist attractions. Unit VA12 contains a scenic bike circuit. The resistance of these valleys is therefore high.

Moderate resistance

Landscape units MO3, MO5, MO6 and MO7

Visual screening by forest cover gives these landscape units a high absorption capacity. A moderate impact is nevertheless anticipated, since the dominant characteristics of this wooded area are not very compatible with those of the planned line. Because there are few inhabitants, the landscapes are almost all forest, which makes

for visual compositions of lower quality. The uniformity of the forest cover, the mountainous relief and the value placed on the mountainous landscapes by residents and land managers combine to justify the medium value assigned to these units. Their resistance is therefore moderate.

Valley landscape units VA11, VA13, VA15 and VA17

The anticipated impact on these landscape units is moderate, since the valleys' capacity to hide the line is high or medium but their blending capacity is low. Although the intrinsic quality of these units is only medium, they are valued by the communities, resulting in a value of high. Units VA11 and VA15 are crossed by a bike circuit, VA13 gives access to recreational trails, and VA17 contains the village of Saint-Herménégilde. These landscape units therefore have moderate resistance.

Low resistance

Hilly landscape unit CO7

This hilly landscape is already crossed by a power line, and it has good capacity to absorb a new line without degradation of its character. The anticipated impact is therefore low. It is an agroforest area with few signs of enhancement, and community interest in the landscape is low. Its resistance is low.

Valley landscape units VA9, VA14 and VA16

Like CO7, valley landscape unit VA9 is already crossed by a power line, and the anticipated impact is low. There are no signs of enhancement, and community interest is low. VA14 and VA16 consist of narrow valleys and woodlands, and they have a high capacity for hiding the facilities. In addition, there are very few access roads, so these units are not widely seen or valued. Their resistance is therefore low.

Mountainous landscape unit MO8

Landscape unit MO8 offers a high absorption capacity, as visual fields will be limited by forest cover. However, because the dominant natural characteristics have little compatibility with the planned line, the anticipated impact is moderate. There are few inhabitants here, so that the landscape unit is not particularly aesthetic and offers little in the way of interesting visual compositions, due to the homogeneous forest cover. In addition, there are very few access roads. For these reasons, unit MO8 is of low value and has low resistance to the construction of a power line.

D Public Participation

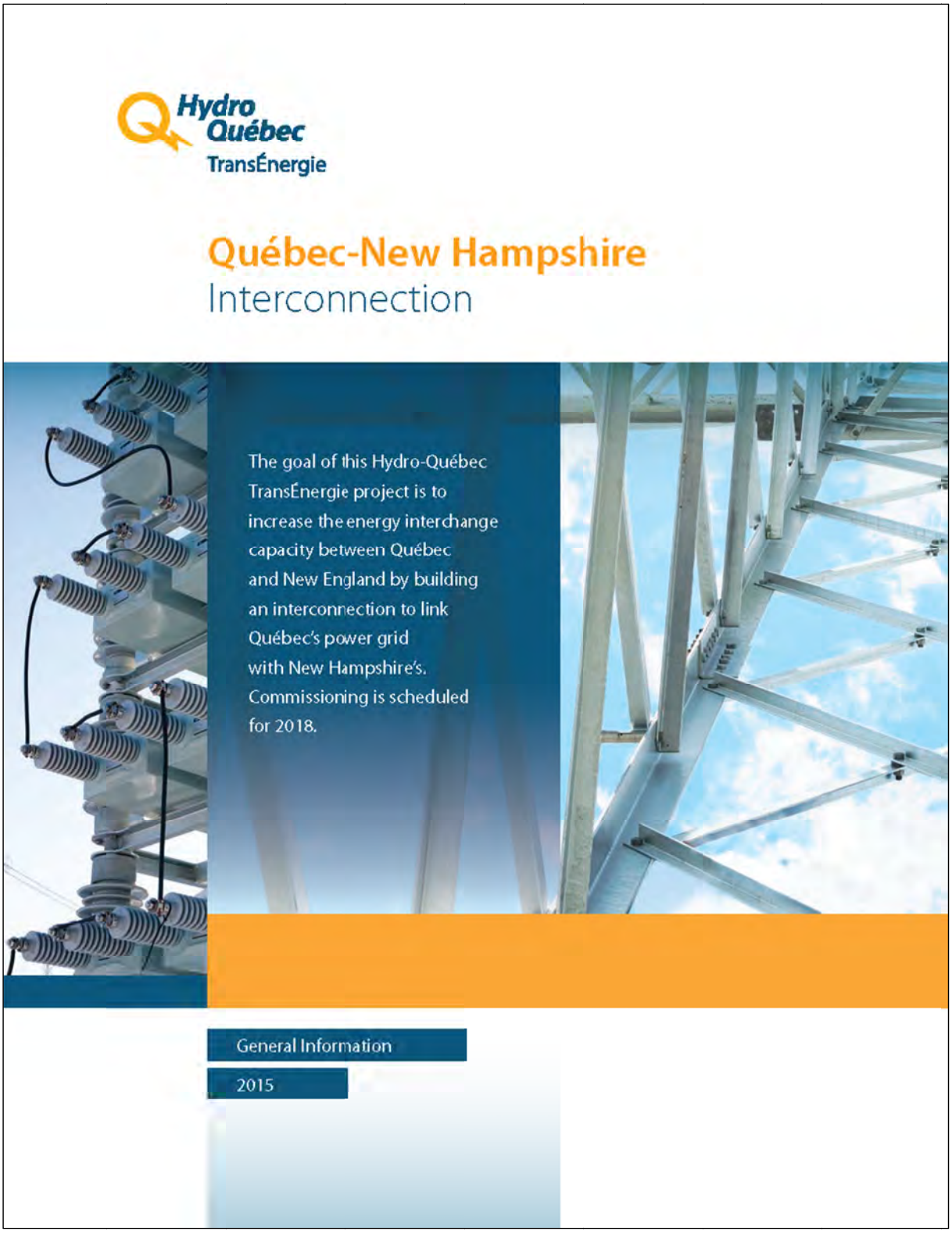
D.1 Meetings held

Date and location	Organizations met with (number of participants)
General Information	
January 6, 2015 Stoke Town Hall, Stoke	MRC du Val-Saint-François (3) Municipalité de Val-Joli (1) Municipalité de Stoke (1)
January 6, 2015 Offices of the MRC du Haut-Saint-François, Cookshire-Eaton	MRC du Haut-Saint-François (3) Municipalité d'Ascot Corner (1) Ville de Cookshire-Eaton (1)
January 6, 2015 Offices of the MRC de Coaticook, Coaticook	MRC de Coaticook (3) Municipalité de Martinville (1) Municipalité de Sainte-Edwidge-de-Clifton (1) Municipalité de Saint-Venant-de-Paquette (2) Municipalité de Saint-Herménégilde (2) Municipalité d'East Hereford (2) Forêt Hereford (1)
Public Consultation	
Working meetings	
February 17, 2015 MFFP, Québec	MAPAQ regional branch (1) MDDELCC regional branch (2) MFFP regional branch (1) MDDELCC (Québec) (3) MFFP (Québec) (4)
March 10, 2015 MDDELCC regional office, Sherbrooke	MDDELCC regional branch (1) MFFP regional branch (3)
April 17, 2015 MDDELCC regional office, Sherbrooke	MDDELCC regional branch (1) MFFP regional branch (2) MRC de Coaticook (1)
April 15, 2015 Fédération de l'UPA-Estrie, Sherbrooke	Fédération de l'UPA-Estrie (2)
April 15, 2015 Offices of the MRC de Coaticook, Coaticook	MRC de Coaticook (3) Municipalité de Sainte-Edwidge-de-Clifton (1) Municipalité de Saint-Herménégilde (2) Municipalité d'East Hereford (2) Forêt Hereford (1)
April 16, 2015 Offices of the MRC du Haut-Saint-François, Cookshire-Eaton	MRC du Val-Saint-François (1) MRC du Haut-Saint-François (2) Municipalité de Val-Joli (2) Municipalité de Stoke (1) Municipalité d'Ascot Corner (1) Ville de Cookshire-Eaton (1)

Date and location	**Organizations met with (number of participants)**
May 7, 2015 Offices of the MRC de Coaticook, Coaticook	Forêt Hereford (1) Nature Conservancy Canada (1)
July 23, 2015 MSSS regional office, Sherbrooke	MSSS regional branch (3)
Public consultation meetings	
May 26, 2015 Offices of the MRC du Haut-Saint-François, Cookshire-Eaton	MRC du Val-Saint-François (3) MRC du Haut-Saint-François (2) Municipalité de Val-Joli (1) Municipalité de Stoke (1) Municipalité d'Ascot Corner (2)
May 26, 2015 Offices of the MRC de Coaticook, Coaticook	MRC de Coaticook (4) Municipalité de Martinville (1) Municipalité de Sainte-Edwidge-de-Clifton (1) Municipalité de Saint-Venant-de-Paquette (1) Municipalité de Saint-Herménégilde (2) Municipalité d'East Hereford (2) Forêt Hereford (1)
May 26, 2015 Fédération de l'UPA-Estrie, Sherbrooke	Fédération de l'UPA-Estrie (1) Val-Saint-François and Sherbrooke local syndicates (2) Haut-Saint-François local syndicate (2) Coaticook local syndicate (2)
May 27, 2015 MAMOT regional office, Sherbrooke	Conférence régionale des élus de l'Estrie (1) MAMOT regional branch (1) MTQ regional branch (1)
May 27, 2015 Saint-François riding office, Sherbrooke	Provincial riding of Richmond (1) Provincial riding of Mégantic (1) Provincial riding of Saint-François (2) Provincial riding of Orford (1)
Open house	
June 2, 2015 Community Centre, Ascot Corner	Owners (52) MRC du Haut-Saint-François (1) Municipalité d'Ascot Corner (1) Haut-Saint-François UPA local syndicate (1)
June 3, 2015 Community Centre, Saint-Herménégilde	Owners (77) Citizens (15) Municipalité de Saint-Herménégilde (2) Municipalité d'East Hereford (2) Media (2)

Date and location	Organizations met with (number of participants)
Information on the Solution Selected	
Information meeting	
September 1, 2015 Offices of the MRC de Coaticook, Coaticook	MRC de Coaticook (3) Municipalité de Martinville (1) Municipalité de Sainte-Edwidge-de-Clifton (1) Municipalité de Saint-Herménégilde (2) Municipalité d'East Hereford (1) Forêt Hereford (1)
Open house	
September 3, 2015 Community Centre, Saint-Herménégilde	Private meeting with a group of property owners affected by the selected variant (5) Owners (24) Citizens (8) Municipalité de Saint-Herménégilde (2) Municipalité de Sainte-Edwidge-de-Clifton (1) Media (10)

D.2 Information bulletins



Connecting two networks

The project involves the construction of a direct-current transmission line in Québec, about 75 km long, with voltage capability of up to 320 kV. This line will be extended into the United States to connect Des Cantons substation to Franklin substation, in southern New Hampshire.

The project also includes adding equipment at Des Cantons substation to convert alternating current to direct current, to supply the planned transmission line.

Studies

In the coming months, Hydro-Québec Équipement will carry out environmental inventories and technical surveys to better understand the host environment of the planned line and to choose the line route that has the fewest social, environmental and technical impacts.

Project challenges

Identifying a route within the study area presents the following main challenges:

- Taking into account populated areas as well as farmlands and logging areas
- Visually integrating the new line into the region, which is valued for its scenic beauty
- Maintaining recreational and tourism activities in the study area

Defining the study area

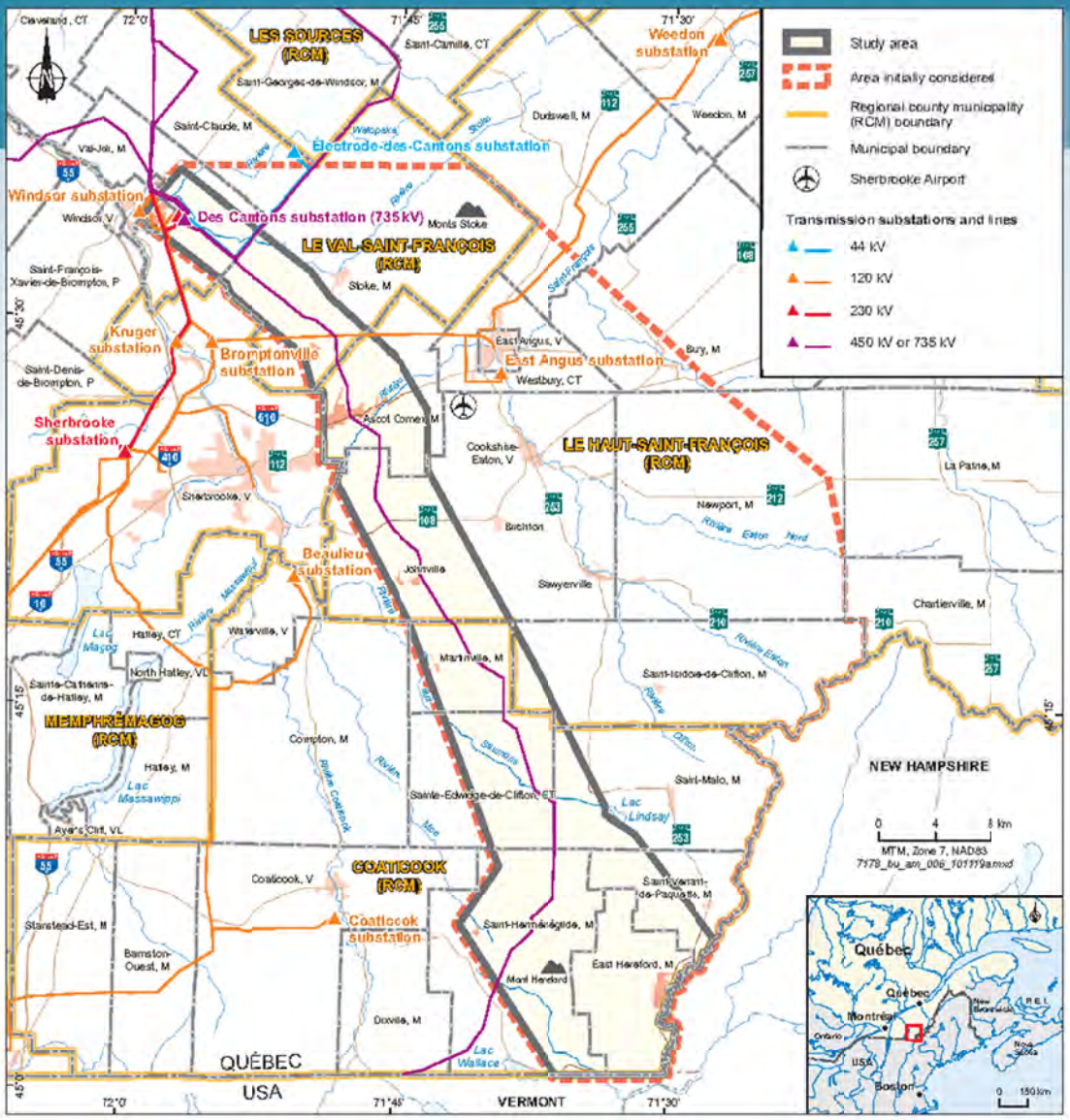
Hydro-Québec successively narrowed down the territory to come up with an area in which to evaluate possible line corridors. The **area initially considered** covers a large stretch from the starting point of the future line, Des Cantons substation, to the Québec–New Hampshire border.

The surveying and analysis of this area showed that there are few acceptable options for the creation of a new line corridor for this project. According to the analysis, the best solution would be to pair the new line with the 450-kV Des Cantons–New England line, which cuts through the area considered from north to south. The two lines would share the same line corridor to the extent possible.

Based on this analysis, Hydro-Québec defined a **study area** within which it will consider potential line routes. The study area is a 5- to 7-km wide band around the Des Cantons–New England line, stretching from Des Cantons substation south to the White Mountain foothills. Near the border with New Hampshire, the band widens to about 15 km so that different routes to the crossing point can be considered.

The study area covers parts of three regional county municipalities (RCMs): Val-Saint-François, Haut-Saint-François and Coaticook. Within these RCMs, the study area crosses a number of municipalities:

RCM of Val-Saint-François	RCM of Haut-Saint-François	RCM of Coaticook
Val-Joli	Ascot Corner	Marinville
Stoke	Cookshire-Eaton	Sainte-Edwidge-de-Clifton
	Saint-Isidore-de-Clifton	Saint-Malo
		Saint-Venant-de-Paquette
		East Hereford
		Saint-Herménégilde



Study area

The northern and central part of the study area, along the existing transmission line, is a mix of farmland and forest. Large farming operations are located along the concession roads around village hubs. There are also vast wooded areas that facilitate the integration of the existing line into the landscape. In the south, the mountains are covered in large part by forests. This part includes high-potential maple stands and many Christmas-tree farms. The entire study area falls within the Estrie federation of the UPA (Québec's farm producers' union).

Population density is relatively low in the study area except along Route 112 at Ascot Corner. The area's tourism and recreational development capitalizes on the region's natural features. The Johnville Bog & Forest Park is a place of interest, and the southern part of the study area, Mont Hereford in particular, has potential for recreational and tourism development. Part of the Chemin des Cantons (Townships Trail) crosses the study area near Birchton, via Route 108.

3

Stakeholder participation

Hydro-Québec will implement a communication program to maintain a dialogue with the community while the studies are being carried out. The company will thus be able to take the concerns and expectations expressed by the public and by key stakeholders into account so as to best adapt the project to local realities.

Project schedule

DRAFT DESIGN	
General information	Winter 2014–2015
Consultation on line routes	Spring 2015
Information about the route selected	Summer 2015

PROJECT	
Permitting	Fall 2015 to spring 2017
Construction	2017–2018
Commissioning	2018

For more information

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Hydro Québec

Hydro Québec TransÉnergie

Québec–New Hampshire Interconnection

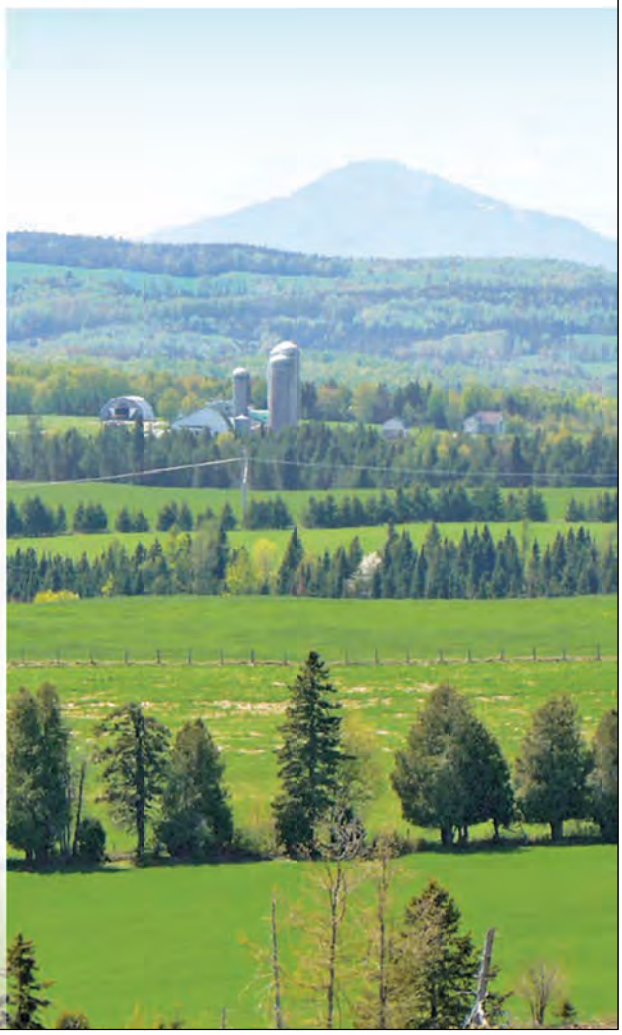
PUBLIC CONSULTATION • Spring 2015

The goal of this Hydro-Québec TransÉnergie project is to increase the energy interchange capacity between Québec and New England by building an interconnection to link Québec's power grid with New Hampshire's. Commissioning is scheduled for 2019.

Connecting the grids

The project involves the construction of a 320-kV direct-current transmission line, about 75 km long, in Québec. This line will be extended into the U.S.A. and will connect Des Cantons substation in Val-Joli to Franklin substation in southern New Hampshire.

To supply the planned transmission line, equipment that converts alternating current to direct current will be added to Des Cantons substation. The existing perimeter of Des Cantons substation will not be modified.



Study area characteristics

From the starting point of the planned line at Des Cantons substation in Val-Joli to the Québec/New Hampshire border, the study area covers 571 km². The north and central sections of the study area are on agroforest land in the Appalachian plateau, while the south section extends to the White Mountain foothills. Population density is greater in the Appalachian plateau than in the border area.

The study area covers parts of three regional county municipalities (MRCs): Val-Saint-François, Haut-Saint-François and Coaticook. Within these MRCs, it crosses through the following municipalities: Val-Joli, Stoke, Ascot Corner, Cookshire-Eaton, Saint-Isidore-de-Clifton, Martinville, Sainte-Edwidge- de-Clifton, Saint-Malo, Saint-Venant-de-Paquette, East Hereford and Saint-Herménégilde.

Main line routing criteria

In developing the various routes studied, the following criteria were taken into account:

- Run the line along the existing 450-kV line wherever possible.
- Avoid siting near isolated homes and avoid village hubs.
- As much as possible, avoid sensitive elements such as farmland, sugar bush operations, exceptional forest ecosystems, habitats of special-status plant and animal species, wetlands and recreational or tourist sites.
- Avoid the highlands of the Mont Hereford massif.
- Avoid open spaces and sites offering panoramic views.
- Optimize line design with a view to harmonious integration into the environment.

Line routes studied

Environmental studies have shown that the least-impact solution consists in running the planned line along the existing 450-kV Des Cantons–New England line. However, since this line goes into Vermont, the planned line will have to move away from it in the south section in order to reach the crossing point at the Québec/New Hampshire border.

The line route study therefore consists of two parts: a first section where the line is parallel to the existing 450-kV line, and a second section in which a number of line route variants are being studied. These variants lead to the border crossing point which Hydro-Québec has agreed on with its U.S. partner, Northern Pass Transmission (NPT).

Section where line is parallel to the 450-kV line

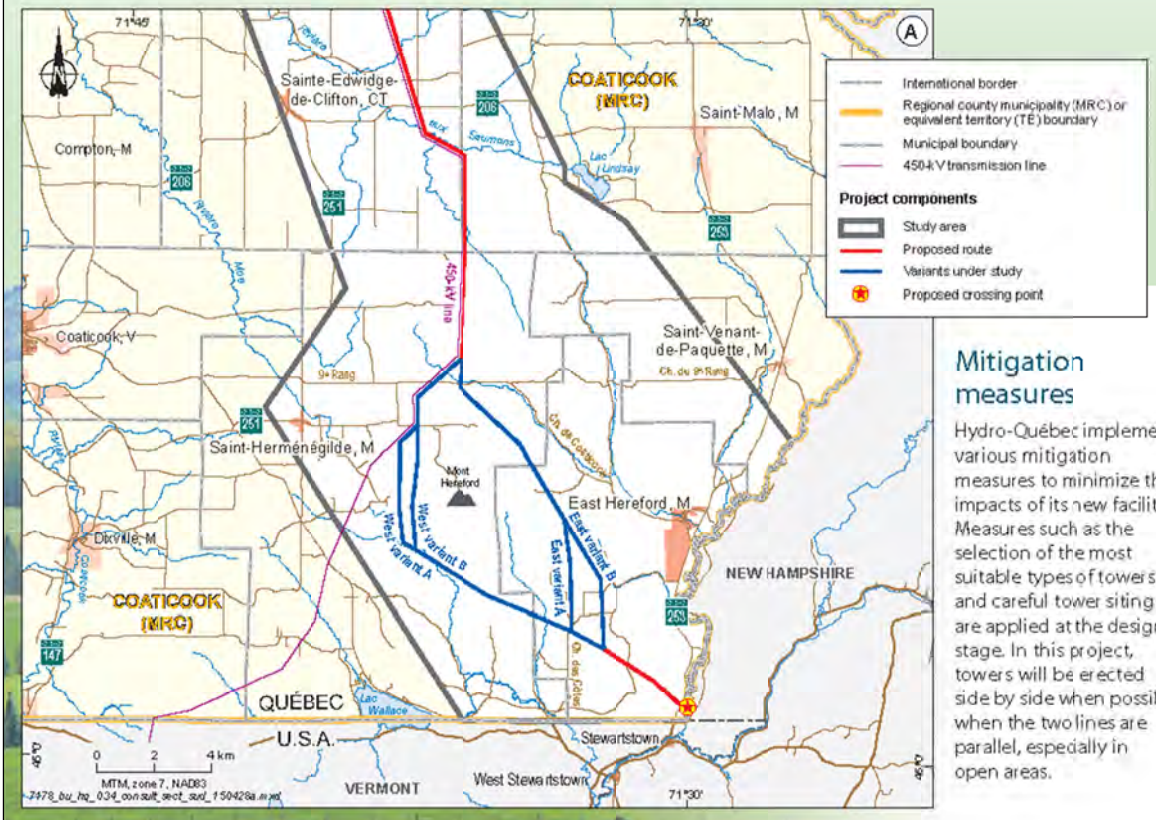
From Des Cantons substation to the municipality of Saint-Malo, the line will run along the east side of the 450-kV line, except for a short segment as it leaves Des Cantons substation. In this area, there are two 450-kV line segments stretching over 4 km; one of these (the west segment) will be dismantled and the other converted to 320 kV. The future 320-kV line will then run parallel to the existing line.

The option of running along the 450-kV line to the east was retained on the basis of technical and environmental criteria, including the number of homes located within the right-of-way of the future line. There are many more homes to the west of the existing line, including those at Ascot Corner and Johnville. Furthermore, the existing line runs through woodland over some 75% of its length, which will help integrate the future line into the landscape. The route crosses highways 216, 112, 108 and 206.

Section with various routes

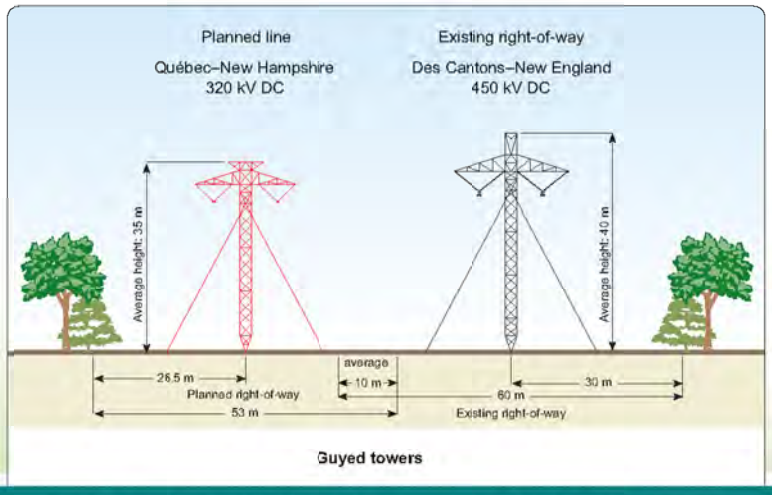
For this section, two feasible routes and several variants for reaching the border crossing point were studied. The west and east routes leave the existing line corridor some 15 kilometres from the crossing point. The west route variants measure 23 km (west variant A) and 22 km (west varian: B), but run along the 450-kV line for 4 km (west variant A) and 3 km (west variant B) of this distance. The new corridor that will have to be created for this route will measure approximately 15 km. The east variants are shorter (approximately 19 km) but also run along the 450-kV line for a smaller distance.

The route will not be chosen until Hydro-Québec has consulted the public.



Mitigation measures

Hydro-Québec implements various mitigation measures to minimize the impacts of its new facilities. Measures such as the selection of the most suitable types of towers and careful tower siting are applied at the design stage. In this project, towers will be erected side by side when possible when the two lines are parallel, especially in open areas.

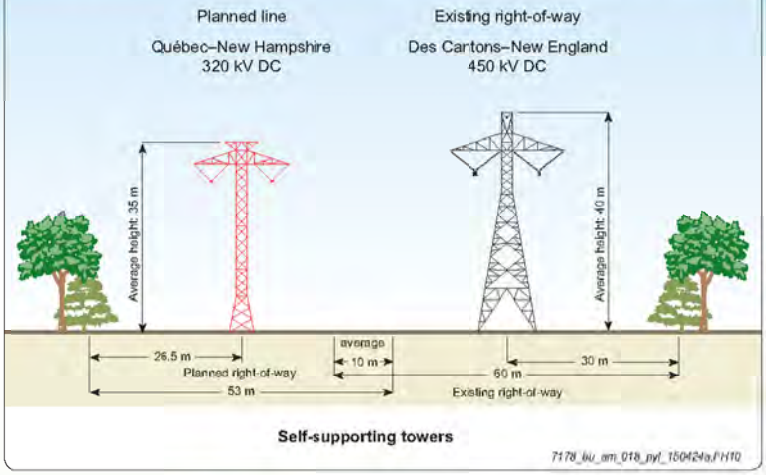


Guyed towers

Tower type and right-of-way

This will be the first 320-kV DC line built by Hydro-Québec, so a new family of steel towers will be used. The new towers will be designed to optimally integrate the planned line with the existing line.

Typical towers and rights-of-way when planned line is parallel to existing line



Self-supporting towers

7178_liu_am_018_pyl_150424a.FH10

Schedule

DRAFT DESIGN

General information	Winter 2014–2015
Public consultation on line routes	Spring 2015
Information on the selected route	Summer 2015

PROJECT

Permitting	Fall 2015 to spring 2017
Construction	2017-2019
Commissioning	2019

For more information

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Hydro Québec

Hydro Québec TransÉnergie

Québec–New Hampshire Interconnection

INFORMATION ON THE SOLUTION SELECTED • Summer 2015

The goal of this Hydro-Québec TransÉnergie project is to increase the energy interchange capacity between Québec and New England by building an interconnection to link Québec's power grid with New Hampshire's. Commissioning is scheduled for 2019.

Connecting the grids

The project involves the construction of a 320-kV direct-current transmission line, about 80 km long, in Québec. This line will be extended into the U.S.A. and will connect Des Cantons substation in Val-Joli to Franklin substation in southern New Hampshire. To supply the planned transmission line, equipment that converts alternating current to direct current will be added to Des Cantons substation. No expansion of the existing Des Cantons substation is required.

Environmental studies

From the start of the draft-design study, Hydro-Québec delineated a vast study area to expand its knowledge of the territory. Hydro-Québec confirmed that the route with the least impact consists in running the new 320-kV line near the existing 450-kV line over the longest possible distance.

The study area (571 km²) covers parts of three regional county municipalities (MRCs): Val-Saint-François, Haut-Saint-François and Coaticook. Within these MRCs, it crosses through the following municipalities: Val-Joli, Stoke, Ascot Corner, Cookshire-Eaton, Saint-Isidore-de-Clifton, Martinville, Sainte-Edwidge-de-Clifton, Saint-Malo, Saint-Venant-de-Paquette, East Hereford and Saint-Herménégilde.

Work completed in recent months

Environmental field surveys were carried out in spring and summer 2015.

Field crews recorded numerous components of the biophysical environment (rare plants, snakes, etc.) in the section of the new line route that runs parallel to the existing 450-kV line and along the path of the variants studied.

Each variant was evaluated based on its impacts on the region's landscape, as well as on the human and natural environments (noise, archeology, etc.).

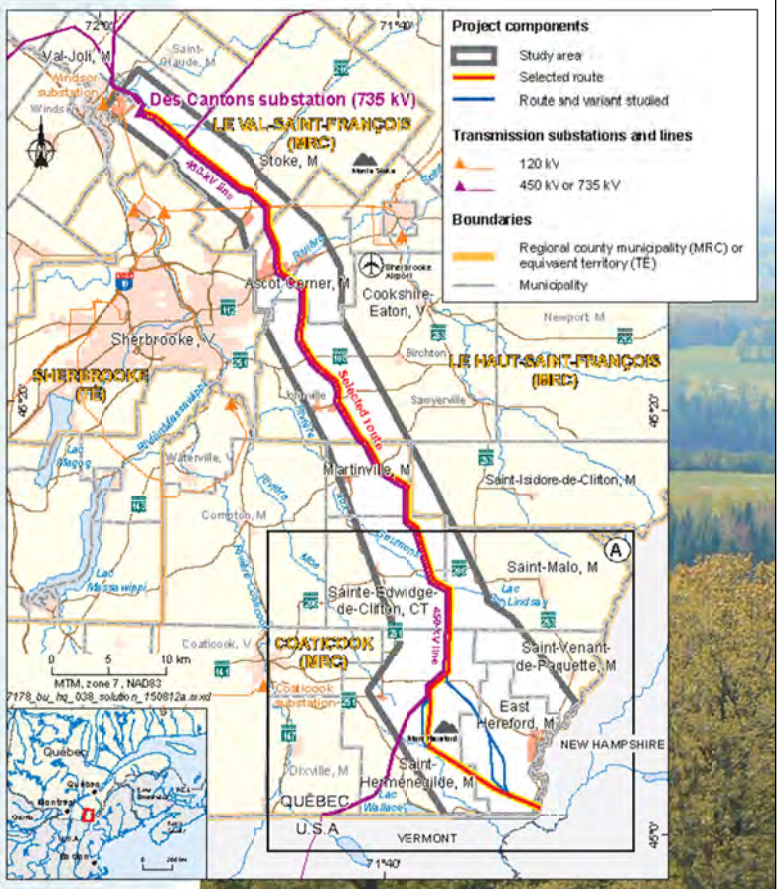
Key role of host community's comments

In recent months, Hydro-Québec has been working with local authorities to obtain information on the host community and gather their opinion on the route under study (i.e., the section that runs parallel to the 450-kV line and the four variants in the other section). In addition, last June, we held meetings with the host community to present the project and gather comments. The community's input had a decisive influence on the solution selected.

Location criteria for the line

In developing the line route, the following main criteria were taken into account:

- Run the line along the existing 450-kV line wherever possible.
- Avoid siting near homes as much as possible.
- As much as possible, avoid sensitive elements such as farmland, sugar bush operations, exceptional forest ecosystems, habitats of special-status plant and animal species, wetlands and recreational or tourist sites.
- Avoid the highlands of the Mont Hereford massif.
- Avoid open spaces and sites offering panoramic views.
- Optimize line design with a view to harmonious integration into the environment.



Selected line route

Based on the results of its studies and the comments from community representatives and the public, Hydro-Québec has opted for the route described below.

For 80% of its length, from Des Cantons substation to the municipality of Saint-Malo, the planned line will run along the east side of the 450-kV line.

In the southern section, Hydro-Québec studied four variants that took into account technical and environmental criteria and the community's suggestions and concerns. To reach the crossing point, the line will run west of the mountain, mainly because this side allows for a better integration into the landscape. By selecting this route, Hydro-Québec aims to bypass Mont Hereford and not interfere with outdoor activities, which are practiced more widely east of the mountain.

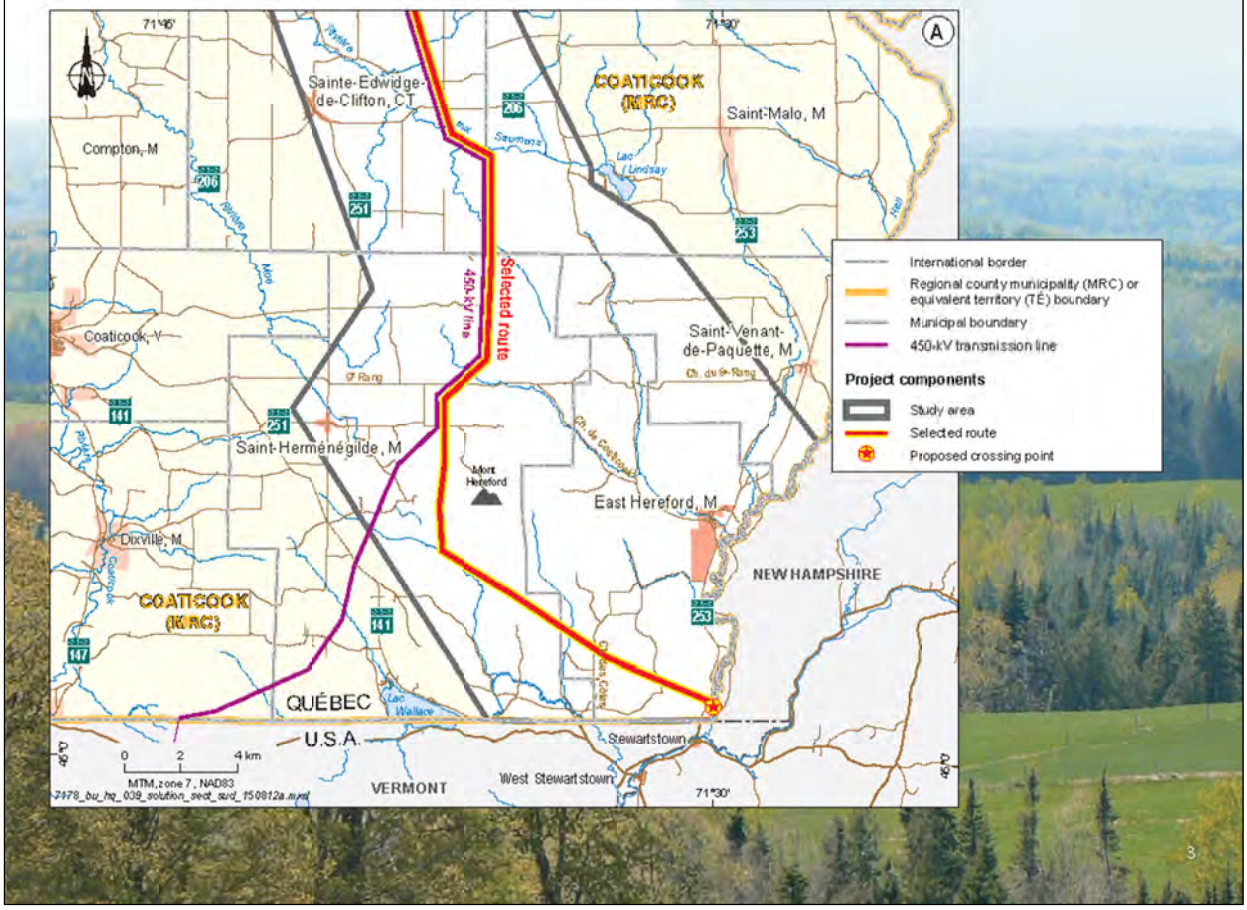
In addition, Hydro-Québec is currently working on optimizing the selected route by taking into account comments from residents and local authorities.

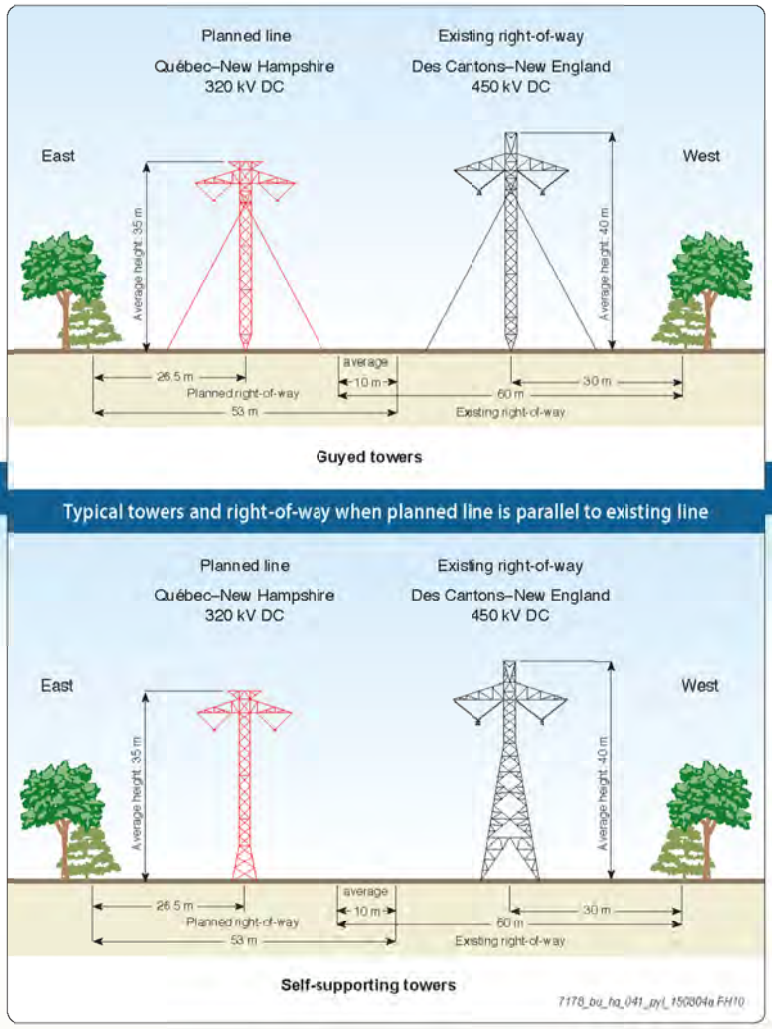
Tangible support for community development

Hydro-Québec sees its projects as an opportunity to participate in the development of host communities. With this in mind, it grants eligible organizations funding equivalent to 1% of the initially authorized value of the facilities covered by the Integrated Enhancement Program, to be used for local enhancement initiatives that improve the community.

Improved mitigation measures

Starting at the project design phase, Hydro-Québec implements a number of mitigation measures, including selecting the most suitable types of towers and careful tower siting. In this project, towers will be erected side by side when possible when the two lines are parallel, especially in open areas.





Tower types and right-of-way

This will be the first 320-kV DC line built by Hydro-Québec, so a new type of steel tower will be used.

These towers will be similar to the ones for the existing 450-kV line, but will be smaller. They will be installed near existing towers wherever possible.

Schedule

DRAFT DESIGN	
General information	Winter 2014-2015
Public consultation on line routes	Spring 2015
Information on the route selected	Summer 2015

PROJECT	
Permitting	Fall 2015 to spring 2017
Construction	2017–2019
Commissioning	2019

For more information

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Hydro Québec

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D.3 Concerns expressed during public participation

Concern	Publics
General Information	
Landscape preservation	All publics
Position of new line in relation to existing 450-kV line (east or west side)	MRC du Val-Saint-François MRC du Haut-Saint-François
Visual impact of structure where planned line crosses the existing 450-kV line	MRC du Val-Saint-François MRC du Haut-Saint-François
Compensation of affected property owners	All publics
Integrated Enhancement Program (IEP)	All publics
Public consultation	
Support and compensation for affected property owners	All publics
Integrated Enhancement Program (IEP)	MRCs and municipalities
Right-of-way clearing	All publics
Visual integration and landscape preservation	All publics
Protection of Réserve naturelle Neil-et-Louise-Tillotson	Forêt Hereford Nature Conservancy Canada MRC de Coaticook
Impact on natural areas and valued sites (e.g., Johnville Bog and Forest Park and Mont Hereford)	MRCs and municipalities Forêt Hereford Affected property owners Citizens concerned
Planting in right-of-way	UPA Affected property owners (agricultural producers)
Towers – Siting and types	All publics
Closeness of residential and farm buildings	MRCs and municipalities UPA A few affected property owners
ATV and snowmobile traffic in right-of-way	Forêt Hereford Nature Conservancy Canada Affected property owners
Electric and magnetic fields and stray voltage	A few affected property owners A few citizens concerned

Concern	Publics
Information on the Solution Selected	
Support and compensation for affected property owners	All publics
Integrated Enhancement Program (IEP)	MRCs and municipalities
Right-of-way clearing	All publics
Visual integration and landscape preservation	All publics
ATV and snowmobile traffic in right-of-way	Forêt Hereford Nature Conservancy Canada Affected property owners
Protection of Réserve naturelle Neil-et-Louise-Tillotson	Forêt Hereford Nature Conservancy Canada MRC de Coaticook
Impact on natural areas	Forêt Hereford Nature Conservancy Canada Affected property owners Citizens concerned
Route optimization	MRCs and municipalities Affected property owners

D.4 Press review

Date	Media	Title and topics
June 4, 2015	*La Tribune* Reporter: Maryse Carbonneau	"Hydro-Québec relance son projet de ligne reliant le Québec et le New Hampshire" Revival of the project, situation in the U.S., and an open house.
June 4, 2015	*La Tribune* Reporter: Maryse Carbonneau	"Des choix à faire dans la MRC de Coaticook" Description of the route variants.
June 4, 2015	*Le Progrès de Coaticook* Reporter: Vincent Cliche	"Quatre tracés à l'étude pour l'interconnexion Québec-New Hampshire" Project summary and description, open house and affected property owners.
July 12, 2015	*La Tribune* Reporter: Luc Larochelle	"Le tracé des redevances" Comparison of compensation and taxes paid in Québec and the U.S. by Hydro-Québec, TQM and NPT.
July 21 , 2015	*La Presse* Reporter: Kathy McCormack	"Un rapport se fait critique sur un projet américain impliquant Hydro" Description of the NPT project and various scenarios for the line route on the U.S. side.
August 31, 2015	*La Presse* Reporter: André Dubuc	"Hydro lorgne un gros contrat" New England states' request for proposals and steps in the process on the U.S. side.
August 31, 2015	RCI Web site Reporter: Carmel Kilkenny	"Hydro Quebec will supply energy to New England States" Announcement of the project and of the partnership between Hydro-Québec and Eversource at the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP).
August 31, 2015	Radio-Canada Web site Reporter: Hugo Lavallée	"Hydro-Québec en route vers le plus gros contrat de son histoire" Partnership between Hydro-Québec and Eversource; U.S. recognition of hydropower as green energy.
August 31, 2015	Radio-Canada Web site	"Hydro-Québec s'allie à une compagnie américaine pour décrocher le plus gros contrat de son histoire" Announcement of the project and of the partnership between Hydro-Québec and Eversource at the NEG/ECP Conference.
September 1, 2015	*La Tribune* Reporter: Sue Bailey	"Hydro précise son projet d'exportation de 1 000 MW" Announcement of the project at the NEG/ECP Conference; Hydro-Québec's competitive advantage in the RFP issued by three New England states.
September 1, 2015	*Le Devoir* Reporter: Sue Bailey	"Le Québec pourrait fournir encore plus d'électricité" Announcement of the project at the NEG/ECP Conference; Hydro-Québec's competitive advantage in the RFP issued by three New England states.
September 2, 2015	CKOY L'Estrie maintenant Presenter: Vincent Franche-Lombart	Open house and route variant selected on the basis of landscape integration, recreation and tourism. Interview with Ginette Cantin of Hydro-Québec.
September 2, 2015	CKOY Que l'Estrie se lève Reporter: Pierre Harvey	Summary of project announcement at the NEG/ECP Conference. Most New England homes and power plants burn natural gas. Will people want to convert to electricity?

Date	Media	Title and topics
September 2, 2015	CBF-FM-10 Écoutez l'Estrie CBF-FM-10 Regional news Presenter: Magali Paquette	Open house and description of the route variant selected. Interview with Ginette Cantin of Hydro-Québec, who explains that the variant selected is the one that will integrate the best into the landscape.
September 2, 2015	CKOY Midi actualité Host: Martin Pelletier	Interview with Ginette Cantin of Hydro-Québec: consultation of local representatives and affected property owners on the variants studied, selection of the route variant according to the preferences expressed, description of the route variant selected, integration into the landscape, possibility of adjustments (optimization) with affected property owners, financial compensation of affected property owners, and an open house.
September 3, 2015	CKSH Le Téléjournal Estrie Reporters: Jean Arel and Marie-Ève Lacas	Open house; majority of the population in favor of the project. Interview with Ginette Cantin of Hydro-Québec, who explains that the variant selected is the one that has the least impact, in particular on homes and the landscape. Interview with an East Hereford man who wonders what impact the line will have on his property value and his health.
September 3, 2015	CHLT Le TVA Nouvelles Reporter: Jean-François Desbiens	Open house; description of the route variant selected (i.e., the one with the least impact on the environment and the local population). Interviews with Ginette Cantin of Hydro-Québec, an affected property owner, residents of East Hereford and the Mayor of Saint-Herménégilde.
September 3, 2015	CBF-FM-10 Regional news Presenter: Mélissa Fauteux	Description of the route variant selected; open house. Interview with an East Hereford woman concerned about stray voltage. Interview with Ginette Cantin of Hydro-Québec, who explains that the variant selected is the one that will integrate the best into the landscape.
September 3, 2015	CBF-FM-10 Regional news Reporter: Isabelle Labranche	Interview with Ginette Cantin of Hydro-Québec: Description of the route variant selected (i.e., the one with the least impact), integration into the landscape and open house.
September 3, 2015	RDI Matin Reporter: Marie-Ève Lacas	Open house and selection of the route variant with the least impact on the landscape and on property. Interview with a resident of East Hereford.
September 3, 2015	Radio-Canada Web site Reporter: Geneviève Proulx	"Le tracé Northern Pass d'Hydro-Québec expliqué aux citoyens de la région de Coaticook" Description of project and route variant selected, consultation of property owners and open house.
September 3, 2015	*La Tribune* Reporter: Claude Plante	"Hydro a choisi le tracé de sa future ligne à 320 kV" Description of the project, the route variants studied and one selected, and public consultation.
September 3, 2015	CIMO News Presenter: Marc Toussaint	An open house described by Ginette Cantin of Hydro-Québec.
September 4, 2015	*La Tribune* Reporter: Maryse Carbonneau	"Des pylônes au pied du mont Hereford" Consensus in East Hereford and Saint-Herménégilde about the route variant selected; visual integration of the line and open house.
September 4, 2015	CBF-FM-10 Regional news Presenter: Mélissa Fauteux	Open house and description of the route variant selected.
September 4, 2015	*Le Progrès de Coaticook* Reporter: Dany Jacques	"Hydro-Québec précise son tracé" Description of the route variant selected, visual integration of the line, financial compensation of the affected property owners; little opposition to Hydro-Québec's project.

Date	Media	Title and topics
September 4, 2015	CKOY Que l'Estrie se lève Reporter: Luc Larochelle	Description of variants studied and the variant selected, which will be well integrated into the landscape, but longer and therefore more costly. Reaction to comments by Pierre Harvey (September 2, 2015): the project will go ahead.
September 14, 2015	*La Tribune* Reporter: Maryse Carbonneau	"Interconnexion Québec-New Hampshire : Forêt Hereford en attente" Protection of Réserve naturelle Neil-et-Louise Tillotson and clearing of the line right-of-way.
September 14, 2015	*La Tribune* Reporter: Maryse Carbonneau	"Interconnexion Québec-New Hampshire : Deux poids, deux mesures" Hydro-Québec–UPA agreement in farming communities and the IEP.
September 14, 2015	CKOY L'Estrie maintenant Host: Martin Pelletier	Interview with the Mayor of Ascot Corner: Affected property owners, the IEP and concerns about loss of potential municipal tax revenue.

E Impact Assessment Method

E.1 Introduction

The purpose of an environmental impact assessment is to measure the significance of impacts from building transmission or power transformation facilities in a given environment.

The impact assessment covers every component of the biophysical and human environments affected by one or more sources of project-related impact during the construction and operation phases.

E.2 Significance of impact

The significance of impact is a summary indicator whereby an overall judgment is made regarding the impact to which an environmental component may be subject due to the project. Assessing the significance of the project's impact on a component or element includes the following steps:

- Determine the sources of project-related impact on a given component.
- Describe the impact.
- Describe the environmental requirements and specific mitigation measures applicable.
- Describe the residual impact and assess its significance based on three criteria: its magnitude, scope and duration.

E.3 Sources of impact

The sources of impact are the aspects of the project that may affect the host environment.

Sources of impact related to the construction phase are distinguished from those during operation of the facilities. Sources of impact for a line project may differ from those for a substation project.

Constructing a power transmission line gives rise to the following sources of impact:

- Building access roads and construction camps
- Clearing
- Earthwork
- Installing towers and stringing conductors
- Transport and travel
- Presence of workers

Operating a line gives rise to the following sources of impact:

- Presence of the line and right-of-way
- Operating the line
- Vegetation control

E.4 Mitigation measures

There are two types of mitigation measures, i.e., those in the standard environmental clauses and specific mitigation measures.

The standard environmental clauses are environmental requirements that apply to all power transmission line or substation projects. Such environmental requirements are systematically incorporated into all tender documents prepared for Hydro-Québec TransÉnergie transmission projects. Appendix F contains the full set of standard environmental clauses.

The purpose of specific mitigation measures is to mitigate the impacts specific to a project in a given environment. Such measures are developed on a project-by-project basis, depending on the particular features of the host environment.

Mitigation measures affect the magnitude, scope or duration of an impact. They help reduce to a large extent the significance of the residual impact.

E.5 Assessing significance of the residual impact

The analyst's overall judgment involves assessing the *residual impact*, i.e., the impact that remains after standard environmental clauses and specific mitigation measures are implemented. The significance of the residual impact of a power transmission project is the result of combining three distinct factors, i.e., the impact's *magnitude*, *scope* and *duration*. The significance of impact applies to components of the biophysical and human environment, and to landscape units.

The significance of the residual impact is determined using the matrix in Table E-1 and factors in the mitigation measures incorporated into the project's design. An impact may be of major, moderate or minor significance. The assessment matrix is symmetrical (or balanced), i.e., there is an equal number of combinations (7) giving impacts of major and minor significance. It also has 13 combinations giving impacts of moderate significance. These three degrees of significance of impact are defined as follows:

- A *major* impact generally corresponds to a profound alteration of the nature or use of a component valued by the entire population or by a large proportion of the population living in or using the study area.

- A *moderate* impact generally corresponds to a partial alteration of the nature or use of a component valued by a limited proportion of the population living in or using the study area.
- A *minor* impact generally corresponds to a slight alteration of the nature or use of a component valued by a small group of people.

Table E-1: Assessment Matrix for Significance of Residual Impacts

Magnitude	Scope	Duration	Significance
High	Regional	Long	Major
		Medium	Major
		Short	Major
	Local	Long	Major
		Medium	Major
		Short	Moderate
	Limited	Long	Major
		Medium	Moderate
		Short	Moderate
Moderate	Regional	Long	Major
		Medium	Moderate
		Short	Moderate
	Local	Long	Moderate
		Medium	Moderate
		Short	Moderate
	Limited	Long	Moderate
		Medium	Moderate
		Short	Minor
Low	Regional	Long	Moderate
		Medium	Moderate
		Short	Minor
	Local	Long	Moderate
		Medium	Minor
		Short	Minor
	Limited	Long	Minor
		Medium	Minor
		Short	Minor

a. For landscape, regional scope corresponds to a high perception level, local scope corresponds to a moderate perception level and limited scope corresponds to a low perception level.

E.5.1 Magnitude of impact

For components of the biophysical and human environments, the magnitude of impact expresses the degree to which any such component is disturbed, either directly or through modifications to the physical environment. Assessing the magnitude takes into account the biophysical and human environment receiving the project component, and the value attributed to the component disturbed.

The magnitude of an impact on the biophysical or human environment falls into one of the following three distinct levels:

- The magnitude is *high* if the impact destroys the component affected, jeopardizes its integrity or use, or leads to a major change in its general distribution or use in the area.
- The magnitude is *moderate* if the impact modifies the component affected without jeopardizing its integrity or use, or leads to a limited change in its general distribution in the area.
- The magnitude is *low* if the impact slightly alters the component affected without really changing its quality, general distribution or use in the area.

For landscape, magnitude of impact expresses the degree of absorption and blending of facilities into the environment. The *absorption* level of facilities relates to their visibility. It considers the capability of the relief and forest cover to absorb and camouflage the structures. The *blending* level of facilities relates to how compatible facilities are in scale and character with landscape components.

The magnitude of an impact on landscape falls into one of the following three distinct levels:

- The magnitude is *high* if the facilities are totally visible (low absorption level) and the landscape has no features to render them compatible with it in scale and character (low blending level).
- The magnitude is *moderate* if the facilities are totally visible (low absorption level) and the landscape has some or many features to render them compatible with it in scale and character (moderate or high blending level). The magnitude is also moderate if the facilities are partially or scarcely visible (moderate or high absorption level) and the landscape has no or few features to render them compatible with it in scale and character (low or moderate blending level).
- The magnitude is *low* if the facilities are scarcely visible (high absorption level) and the landscape has some or many features to render them compatible with it in scale and character (moderate or high blending level).

E.5.2 Scope of impact

For components of the biophysical and human environments, the scope of an impact is an indication of the geographic area or portion of the population affected. The scope of an impact on such environments may be regional, local or limited.

- The scope is *regional* if the impact on a component is felt over a large portion of the study area or affects a large portion of its population.
- The scope is *local* if the impact on a component is felt over a small portion of the study area or a small portion of its population.
- The scope is *limited* if the impact on a component is felt over a small area or by a small number of people.

For landscape, scope of impact corresponds to the perception level of the facility in a given landscape by a group of observers. The scope of the visual impact is assessed based on three factors: *visual exposure level*, which relates to the configuration of visual fields and distance between the facility and viewpoints, *observer sensitivity* (for stationary/traveling and temporary/permanent observers) and the *number of observers affected*.

By combining these three factors, three perception levels or scopes for visual impact are distinguished:

- The perception level is *high* (large scope) if the visual exposure level of the facility is high, observer sensitivity to the components affected is high and the impact is felt by the entire study area population or a large portion of it.
- The perception level is *moderate* (moderate scope) if the visual exposure level and observer sensitivity are high, and a limited portion of the population can feel the impact. The perception level is also moderate if the visual exposure level and number of observers potentially feeling the impact are high, and observers have limited sensitivity. The perception level is again moderate if observer sensitivity and the number of observers potentially feeling the impact are high, but the visual exposure level of the facilities is low.
- The perception level is *low* (small scope) if the visual exposure level of the facilities is moderate or low, observer sensitivity ranges from low to high, and the visual impact is felt by a small group of observers.

E.5.3 Duration of impact

The duration of an impact relates to the period during which the effects will be felt in the area. It may be long, medium or short.

- The duration is *long* if the impact is constantly felt throughout the facility's service life, or at least over a much longer time than the construction phase. It is often a matter of a permanent and irreversible impact.
- The duration is *medium* if the impact is constantly felt, but over a shorter period of time than the facility's service life, or if the impact is felt during the construction phase (generally one to three years).
- The duration is short if the impact is felt during a limited part of the construction phase.

F Standard Environmental Clauses

Hydro Québec
Équipement et services partagés

Société d'énergie de la Baie James

STANDARD ENVIRONMENTAL CLAUSES

Environnement
Direction - Ingénierie de Production

October 2013

TABLE OF CONTENTS

1 GENERAL

1.1 Communication of environmental requirements

The Contractor shall take part in a site startup meeting to learn about the applicable environmental requirements. It must then organize an information session to brief its own personnel and its subcontractors' personnel on these requirements, and must also brief any new employee. Upon request by Hydro-Québec, the Contractor shall prove that these sessions have been organized.

The Contractor shall incorporate an environmental component into its health and safety breaks and upon request, must prove that it has done so.

1.2 Environment officer

The Contractor shall designate an on-site environment officer to ensure that all contractual standards and provisions are complied with throughout the term of the contract. The environment officer must have the necessary competence, autonomy and authority to carry out his/her functions.

1.3 Temporary facilities

Before installing its temporary facilities, the Contractor shall submit a file to Hydro-Québec for compliance verification, containing the plans for the facilities, copies of all required permits and any other relevant documents, including all correspondence concerning the facilities. The planned temporary facilities include wastewater treatment and drinking water supply systems, fuel depots, concrete plants, stone crushers and residual hazardous material (RHM) storage areas.

1.4 Exception request

Any request for an exception to these environmental clauses must be submitted sufficiently far in advance to enable Hydro-Québec to analyze it and, if need be, obtain the necessary government authorizations.

Acceptance or approval by Hydro-Québec of an exception to these clauses does not relieve the Contractor of its legal obligations concerning the environment.

1.5 Environmental non-compliance

Hydro-Québec shall notify the Contractor in writing when it finds evidence of a breach of the environmental causes. The non-compliance notice will indicate the nature of the breach, as well as the corrective work required and the time allowed to complete it. Should the contractor fail to carry out the corrective measures requested within the time allowed, Hydro-Québec reserves the right to perform the work itself, or to have the work carried out by a third party, at the Contractor's expense.

1.6 Use of biodegradable products

The Contractor shall use biodegradable maintenance products in the site buildings.

1.7 Correspondence with government authorities

The Contractor shall submit to Hydro-Québec all correspondence it has had with the government authorities.

2 NOISE

2.1 General principles

The Contractor shall comply with all municipal regulations. In all cases, the Contractor shall give priority to reducing noise at the source.

2.2 Plant maintenance

The Contractor shall ensure that pneumatic hammers, drills, compressors, pile drivers, crushers and any other plant that could constitute a substantial source of noise are maintained regularly. It shall also make sure that the exhaust mufflers of its plant and that of its subcontractors are always in good condition.

2.3 Construction site noise levels

The Contractor shall take all necessary measures to ensure that the site is quiet and that residents can sleep, both in the evening (between 7 and 10 p.m.) and at night (between 10 p.m. and 7 a.m.). Over a period of one hour, the noise level must be 45 dBA or less, or must be equivalent to the ambient noise level in the absence of the construction site, if the site's noise level is higher than 45 dBA. This noise limit shall be complied with at all locations used for residential or equivalent purposes (i.e., hospital, institution, school, etc.).

In the case of evening work (i.e., work carried out between 7 and 10 p.m.), should constraints be such that the Contractor cannot perform the work in compliance with the set noise limits, it must notify the Hydro-Québec representative on site to obtain an exception. No exceptions shall be granted for night work (between 10 p.m. and 7 a.m.), except in cases of emergency or absolute necessity.

3 QUARRIES AND SANDPITS

3.1 General principles

The Contractor shall take all necessary measures to comply with the *Regulation respecting pits and quarries* and, where required, with the *Regulation respecting standards of forest management for forests in the domain of the State (RNI)*. Before crushing or screening any materials in a quarry or increasing production in a quarry or sandpit, the Contractor shall obtain authorization from the Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs (MDDEFP) [Québec Department of Sustainable Development, Environment, Wildlife and Parks].

The Contractor shall operate existing quarries or sandpits that have been authorized by the MDDEFP, or quarries or sandpits whose opening is provided for in the Contract under a certificate of authorization granted by the MDDEFP. To open or expand a quarry or sandpit, the Contractor must submit a written request to Hydro-Québec. If it considers the request justified, Hydro-Québec will either take the necessary steps to obtain the required certificate or will ask the Contractor to do so. Hydro-Québec cannot be held responsible for the time taken to issue the certificate of authorization, or for any refusal on the part of the competent authorities to issue it.

The Contractor shall strip the quarries and sandpits in a progressive manner, in order to keep the area disturbed to a strict minimum.

During operation of a quarry or sandpit, the Contractor shall take measures to limit erosion caused by runoff and prevent sediment in runoff water from reaching a lake or watercourse.

3.2 Access to operating area

The Contractor may build one or two access roads per operating area, in accordance with the routes indicated by Hydro-Québec. The width of the access roads shall be no greater than 2.5 times the width of the largest vehicle used to transport materials. As far as possible, the road routes (curved, diagonal, etc.) must hide the presence of the operating.

3.3 Operating area boundaries

At the start of the work, the Contractor shall clearly indicate the boundaries of the operating area using markers (i.e., pegs, ribbons attached to trees or any other visual mark on trees). These markers shall remain in place and be visible until the site is restored.

In quarries and sandpits that will not be flooded, the Contractor shall preserve a strip of land around the periphery of the operating area (inside the authorized perimeter), or at any other location designated by Hydro-Québec, for the purpose of stockpiling stripped topsoil. The topsoil shall be used to restore the site. Dumping stripped soil in the wooded area around a quarry or sandpit is prohibited.

3.4 Site restoration

The Contractor is responsible for restoring quarries and sandpits after operation. Residual and unusable materials, machine parts and any other items brought to the site shall be removed. The land shall then be covered with the topsoil stockpiled at the site for this purpose. In addition, the worksite roads and machine-compacted areas shall be scarified to a minimum depth of 25 cm to encourage vegetation growth.

In sandpits that will be flooded, the Contractor shall grade the slopes at a maximum angle of 30° down to the pit's lowest operating level. The bottom of the sandpit shall be levelled only if it lies above the minimum level of the planned bay or reservoir or less than 1 m beneath it.

4 LAND CLEARING

4.1 General principles

On public lands, the Contractor must take all necessary measures to comply with the *Forest Occupancy Act* and related regulations, particularly the *Regulation respecting standards of forest management for forests in the domain of the State (RNI)*, the *Forest Protection Regulation* and the *Clean Air Regulation*. Moreover, the Contractor shall comply with the provisions set out in the forest management permit issued by the Ministère des Ressources naturelles [Québec Department of Natural Resources].

On private lands, the Contractor shall comply with section 1 of the *Tree Protection Act*. Consequently, the Contractor shall ask Hydro-Québec to obtain the consent of the owner before felling or pruning a tree, shrub, tall shrub or coppice. If it is unable to obtain the owner's consent, Hydro-Québec shall provide instructions to the Contractor.

Unless Hydro-Québec has already done so, the Contractor shall use markers to clearly delimit the areas to be cleared that are indicated in the Contract. It shall then request authorization from Hydro-Québec to begin felling trees.

Should it be necessary to secure the area to be cleared, the Contractor shall install temporary barriers and make sure they are maintained. It shall also take measures to protect sensitive element (i.e., wells, archaeological sites, etc.) that are indicated in the Contract or pointed out by Hydro-Québec.

During land clearing, the Contractor shall take care not to damage the edge of the forest and shall avoid felling trees outside the boundary of the clearing area or near a watercourse. Where necessary, the Contractor shall clear watercourses and riverbanks of cutting residues.

The Contractor is required to preserve one third of the treetops that must be pruned due to damage caused by its land-clearing work.

The Contractor shall not tear out or uproot trees, unless otherwise indicated in the Contract. Felled trees shall be laid on the ground and processed in accordance with the Contract provisions.

4.2 Reservoir clearing

When clearing a future reservoir, the Contractor shall comply with the special technical conditions set out in the Contract and with the applicable land-clearing plans, special plan and forest management permit.

4.3 Plant and traffic standards

For work outside flooding zones, the Contractor shall choose construction machinery suited to the characteristics of the land (i.e., type of soil, time of year, environmental sensitivity, etc.) in order to limit the impact on the environment.

The Contractor shall restrict traffic of its plant to the roads and work areas indicated in the Contract or authorized by Hydro-Québec.

Road construction is prohibited on erosion-prone ground with a slope in excess of 30°, unless prior authorization has been provided by Hydro-Québec.

The Contractor shall fill ruts as the work progresses.

4.4 Work near wooded areas on farmland or in urban areas

The Contractor must preserve the root system of trees and shrubs located in riparian strips and in approaches to watercourse crossings.

It is prohibited to compact soil, backfill or store heavy equipment directly under the dripline of the tree crowns.

If work requires the ground level to be raised or lowered, the Contractor shall do so outside the minimum 3-m strip surrounding the dripline of the tree crowns.

4.5 Recovery of merchantable timber

The Contractor shall recover all trees of merchantable dimensions where required under the Contract. A tree of merchantable dimensions is one that has a diameter at chest height (1.3 m above the ground) equal to or greater than 9.1 cm.

Trees shall be felled, skidded, lopped, polled and then stacked in the same direction, arranged on stringers, on sites that the Contractor has selected beforehand jointly with Hydro-Québec.

4.6 Management of wood waste

Unless Hydro-Québec specifies otherwise, wood waste shall not be buried on site or removed to anywhere other than a site authorized by the Ministère du Développement durable, de l'Environnement et des Parcs [Québec Department of Sustainable Development, Environment and Parks] and by Hydro-Québec.

In the rights-of-way of access and bypass roads, the Contractor shall dispose of trees of non-merchantable dimensions and cutting residues by one of the following methods approved beforehand by Hydro-Québec:

- Chipping or shredding
- Lopping, crosscutting into 1.2-m logs and storing in a location designated by Hydro-Québec
- Removal to burning areas authorized by Hydro-Québec

4.7 Burning of wood waste

If the Contract provides for the burning of wood waste, the Contractor must proceed in a manner that complies with municipal regulations, the *Forest Occupancy Act* and with the conditions imposed by Québec's forest fire prevention agency, the Société de protection des forêts contre le feu (SOPFEU). If it has to obtain a burning permit, the Contractor must submit it to Hydro-Québec before starting work.

Combustion of stacks of wood waste must be complete.

Under the *Clean Air Act*, the use of tires or oil to assist the combustion of wood waste is prohibited.

4.8 Chipping of wood waste

If the Contract provides for the chipping of wood waste, the Contractor must spread the chips uniformly over the site, without forming heaps, unless another use or disposal method is planned, such as the use of biomass for energy purposes or composting.

The spreading of chips inside the 20-metre-wide strip at the edge of permanent lakes and watercourses and inside the 15-metre-wide strip at the edge of intermittent watercourses is prohibited. The spreading of chips around the perimeter of a future reservoir or bay is also prohibited.

4.9 Vegetation clearing method

Vegetation shall be cleared in accordance with the following guidelines:

- The methods used shall allow for the preservation of topsoil and root systems.
- An area 5 m wide in the middle of the right-of-way shall be completely cleared to enable personnel and equipment to circulate freely within it. This strip shall be kept free of all residues to allow for the unreeling of cables and operation of the line.
- The height of tree stumps within the cleared area shall not exceed 10 cm above the highest root.
- All trees shall be felled so that they fall inside the boundaries of the area to be cleared and do not damage trees adjacent to the right-of-way.

During the work, ruts more than 20 cm deep caused by repeated machinery passes shall be levelled.

In addition, to minimize environmental impacts, vegetation clearing methods will be adapted to each type of environment encountered, especially in sensitive areas.

Method A

Clearing method A shall be used in areas with no sensitive components and on land where forestry equipment can operate without causing erosion. This method consists in the manual or mechanical cutting, for disposal or commercial or other purposes, of all trees, shrubs, tall shrubs and debris more than 30 cm high.

Method A with soil protection (WSP)

This clearing method shall be used to protect wetlands that have sufficient load-bearing capacity to withstand machinery traffic. Work at such sites shall comply with the following:

- Only machinery that exerts little pressure when in contact with the ground shall be used.
- The footprint of the machinery shall occupy no more than 25% of the area where this method is used, with the exception of the main clearing trail.
- All machinery shall use the same trails.
- The creation of ruts shall be strictly limited to the main trail.
- If ruts are forming in the clearing trails, the Contractor shall propose a method to avoid creating them. Should the chosen method fail to work, all machinery shall be stopped, the ruts shall be filled and vegetation shall be cleared using method B.
- No merchantable timber shall be stacked for recovery purposes, other than at sites indicated in the clearing plans, where applicable.

Methods B and B2

Method B is used to protect sensitive elements of the environment and minimize the risk of erosion during land-clearing work. This method consists in felling trees by hand only and recovering them for commercial or other purposes, or disposing of them. Shrubs and brush less than 2.5 m high at maturity shall be preserved, along with the stumps and root systems of felled trees. Method B applies to poor load-bearing terrain, steep slopes and areas near sensitive elements such as erodible soil, peatlands, swamps and other types of wetlands, the shores of lakes and watercourses, and special wildlife habitat areas and their protective vegetation strips.

Areas to be cleared using method B are also subject to the following special requirements:

- The layer of shrubs and tall shrubs made up of all species up to 2.5 m high at maturity shall be preserved within 20 m of permanent watercourses and 5 m of intermittent watercourses, as well as in erosion zones. Machinery traffic is prohibited within this riparian strip, except on a road to a river or stream crossing.
- No recovered merchantable timber shall be stacked inside the cleared areas, but logs to be used to make fascines may be stacked inside the cleared areas.
- Wood waste shall not be burned on site. However, in cases where moving wood waste is likely to cause more damage than burning it on site, Hydro-Québec may mark out burning areas inside the clearing zone.
- Machinery may only be used if Hydro-Québec deems it to have no significant impact on the environment.
- Should mechanical skidding be required, it shall be done using machinery that exerts little pressure when in contact with the ground. Where bearing capacity permits, the machinery shall operate on a single trail no more than 5 m wide.
- Wood waste may be removed by burning or chipping. If the latter method is used, the chips must be spread evenly, without forming heaps.
- In areas with erodible soil and in peatlands and swamps (wetlands), wood waste may be left inside the cleared area, as long as Hydro-Québec considers that there is no disadvantage in doing so. The trees may be felled, crosscut into logs up to 1.2 m long, lopped and left in place. An area 5 m wide in the centre of the right-of-way shall be kept clear of all residues. This variant of method B is also referred to as **method B2**.

Method C

Clearing method C applies to sensitive areas. It is used only where conductor clearance over vegetation so permits, along the edges of watercourses and main roads, on steep slopes, or near sensitive elements.

This method consists in the manual cutting of trees that hamper grid operations and the total clearing of a strip 5 m wide to allow for conductor stringing and machinery traffic.

Areas cleared using method C are also subject to the following special requirements:

- Machinery is prohibited in the clearing area, except inside the 5-m-wide centre strip.
- Felled trees shall be recovered or crosscut into logs up to 1.2 m long, lopped and left in place without forming piles.
- A strip 5 m wide in the centre of the right-of-way shall remain clear of all residues.

5 SNOW REMOVAL

5.1 General principles

The Contractor shall take all necessary measures to comply with the *Regulation respecting snow elimination sites* and the *Politique sur l'élimination des neiges* uses [policy on snow disposal].

The Contractor shall use a minimum amount of de-icing materials and abrasives to ensure worker and public safety. However, abrasives must not be spread on private property, farmland or in any sensitive area designated by Hydro-Québec.

The Contractor shall ensure that its snow removal machinery does not strip the soil.

5.2 Snow dumping sites

The Contractor shall submit its choice of snow dumping sites to Hydro-Québec. As needed, Hydro-Québec will request the necessary authorizations from the regional branch of the Ministère du Développement durable, de l'Environnement et des Parcs.

All snow dumping sites shall be located at least 30 m from any watercourse and any source of drinking water.

The Contractor shall clean up snow dumping sites, either at the end of the work or at snowmelt, as instructed by Hydro-Québec.

5.3 Snow disposal

The Contractor shall use a disposal site authorized by the Ministère du Développement durable, de l'Environnement et des Parcs whenever it is required to remove snow outside the site.

6 ACCIDENTAL CONTAMINANT SPILLS

6.1 Response plan

At the start of work, Hydro-Québec will provide a response plan that the Contractor is required to implement in the event of accidental contaminant spills. The Contractor shall display the response plan in a place where it can be seen by all its employees.

The Contractor shall inform its employees of what they must do in the event of a spill and make them aware of the importance of rapid action that complies with the response plan.

6.2 Spill kit

From the start of work, the Contractor shall ensure that it has at least one spill kit available at the worksite. The kit must contain products suited to the worksite characteristics. The number and content of spill kits must be approved by Hydro-Québec. As a minimum, a spill kit must contain the following items:

- 1 barrel or 1 sealed box to store the spill response equipment
- 10 absorbent polypropylene pads (430-cm^3)
- 200 absorbent polypropylene sheets
- 10 absorbent polypropylene socks
- 2 neoprene lids (1 m^2) for sewer manholes
- 5 ten-litre bags of treated peat fibre to absorb hydrocarbons
- 10 polythene bags 6 mm thick with a capacity of 205 litres for storing contaminated absorbent materials

6.3 Report and procedure

The Contractor shall immediately notify Hydro-Québec of any spill of contaminants, regardless of the quantities spilled.

In the event of an accidental contaminant spill, the Contractor shall immediately take the following measures at its own expense:

- Launch the alert procedure
- Secure the area
- Identify the contaminant and take the necessary protection measures before initiating intervention
- Stop the leak
- Assess the extent of the spill
- Contain the contaminant
- Recover the contaminant
- Excavate any contaminated soil
- Manage the contaminated soil in accordance with the provisions of the Contaminated soils clause
- Manage contaminated waste in accordance with the provisions of the Hazardous materials clause
- Before filling in the excavation, take samples of the soil, if necessary, to ensure that all contaminated materials have been removed and submit the analysis results to Hydro-Québec
- Prepare a spill report and submit it to Hydro-Québec within 24 hours

If the Contractor does not have the required expertise to intervene effectively in cases of contaminant spills, it shall contract a company specialized in this type of operation to do so.

If Hydro-Québec considers that the measures implemented by the Contractor are insufficient or inappropriate, it may take management of the spill out of the hands of the Contractor, in accordance with the Default – Cancellation section of the general conditions.

7 DRAINAGE

7.1 General principles

During the work, the Contractor shall take the area's natural drainage into account and take all measures necessary to allow for normal water runoff in order to prevent water from accumulating and forming ponds.

If it must build a road, the Contractor shall install a sufficient number of culverts to allow water to flow normally.

If it must create a temporary ditch, the Contractor shall reduce the slope as needed by placing obstacles at regular intervals to prevent erosion.

Where soil drainage risks carrying sediment into a watercourse, the Contractor shall implement measures to contain or divert the sediment.

7.2 Underground drainage

In areas where there is underground drainage, the Contractor shall comply with the provisions of the Farmland clause.

8 RAW WATER AND DRINKING WATER

8.1 General principles

The contractor responsible for water supply on a site must comply with the *Environment Quality Act*, the *Regulation respecting the quality of drinking water*, the *Regulation respecting bottled water*, the *Groundwater Catchment Act* and the *Regulation respecting occupational health and safety*.

Before installing a groundwater catchment facility, the Contractor shall obtain the necessary authorizations from the competent authorities.

8.2 Drinking water quality control

The Contractor shall periodically test the quality of drinking water to ensure that it complies with the standards set out in Schedule I of the *Regulation respecting the quality of drinking water*. The Contractor shall have these tests carried out by qualified or trained personnel and shall forward the analysis results to Hydro-Québec.

In the event of non-compliance with quality standards applicable to drinking water, the Contractor shall notify users and take the necessary steps to correct the situation. The Contractor shall also immediately notify the Hydro-Québec representative, the representatives of the Ministère du Développement durable, de l'Environnement et des Parcs, and the Directeur de la Santé publique [director of public safety] of the region concerned.

The Contractor may post temporary "non-potable water" notices. These notices must be removed once the water becomes fit for drinking again.

9 WASTEWATER

9.1 General principles

The Contractor shall recover wastewater from drilling, rock or overburden excavation, stripping, sawing, grinding, machining, spraying, cleaning, demolition, torch-cutting or welding work. The wastewater shall be filtered, clarified, or treated using any other method approved by Hydro-Québec to ensure its quality.

The Contractor shall also manage the water pumped to dry out the work area.

Before starting work, the Contractor shall inform Hydro-Québec of the wastewater management method it intends to use (i.e., transportation, disposal or treatment of wastewater), indicating the locations of the discharge outlets and storage sites and the name of the companies contracted.

As required, the Contractor shall obtain the necessary authorizations for water treatment or disposal.

9.2 Wastewater management

The Contractor may discharge wastewater into a municipal sewer system, provided that the discharge standards for the municipality concerned are met. It may also discharge wastewater into the river system, provided that the discharge standards for the municipality concerned regarding stormwater drainage are met. In the absence of municipal standards or regulations, the Contractor shall comply with the provisions set out in the Contract, or obtain information from Hydro-Québec concerning the standards to be met.

At the request of Hydro-Québec, the Contractor shall implement a sampling program, indicating sampling frequency, duration, parameters and locations, to demonstrate that wastewater discharges comply with the applicable discharge standards. Sampling shall be conducted by qualified personnel and approved by Hydro-Québec.

If the quality of wastewater does not meet the applicable discharge standards, the Contractor shall either modify its wastewater treatment procedure or its work methods, or discharge the water into a treatment or disposal site authorized by the Ministère du Développement durable, de l'Environnement et des Parcs. In the latter case, the Contractor shall provide proof that wastewater has been discharged into an authorized treatment or disposal site.

In the case of properties belonging to Hydro-Québec, the Contractor may discharge wastewater directly onto the property, to be filtered by the soil. The Contractor may discharge the wastewater into a watercourse directly or by runoff, if it has proven that the quality of the water meets applicable discharge standards.

10 EXCAVATION AND EARTHWORK

10.1 General principles

The Contractor shall keep stripping, clearing, excavation, filling and levelling of the work areas to a strict minimum to mitigate the impact on the environment. As much as possible, the Contractor shall conform to the terrain's natural topography and prevent erosion.

The Contractor shall ask for and comply with instructions from Hydro-Québec regarding the management of excavated material.

10.2 Service and storage areas

The Contractor shall strip a sufficient surface area of the service and storage sites of fill and excavated material. It shall set the topsoil layer aside and use it to restore the site at the end of the work. The thickness of the topsoil layer to be stripped shall either be stipulated in the Contract or determined on site by Hydro-Québec. The Contractor shall not carry out any earthwork or excavation within a 3-m-wide strip around the dripline of a tree or within a 30-m-wide strip along lakes and watercourses.

After the work, the Contractor shall level service and storage sites in accordance with the topography of the surrounding terrain. In addition, the Contractor shall re-establish drainage and stabilize soil that is sensitive to erosion.

If the Contractor discovers archaeological remains at the site, it shall suspend work and notify Hydro-Québec without delay. The Contractor shall avoid any intervention that could compromise the integrity of the remains discovered.

11 DRILLING AND BORING

11.1 General principles

The Contractor shall set aside the topsoil covering drilling or boring points and put it back in place at the end of the work.

For drilling and boring in wooded areas, the Contractor shall limit the surface area affected by the work as much as possible. The Contractor shall clear the land, crosscut the felled trees into logs 1.2 m longand stack them at the edge of the site, taking care to protect the topsoil.

At the end of the work, if drilling has reached the water table, the Contractor shall fill the hole with gravel or clean sand and plug it with impermeable material to prevent the infiltration of contaminants.

The Contractor shall notify Hydro-Québec without delay if it detects signs of contamination (odor, color, etc.) in a drill hole or borehole.

At the end of the work, the Contractor shall fill bore holes with excavated material, taking care to reconstitute the original geological conditions.

11.2 Drilling residues

If Hydro-Québec determines that drilling residues (drill cores, mud, etc.) are contaminated, the Contractor shall dispose of such residues in accordance with the conditions stipulated for their level of contamination (see the Management options for excavated contaminated soil clause).

The Contractor shall confine the drilling mud discharge area and take the necessary measures to ensure that runoff water is dispersed into the soil or is filtered before reaching a drainage structure, watercourse or lake.

11.3 Work in water

During work in water, the Contractor shall continuously monitor the contaminating products it uses. These products shall be kept in sealed containers or, failing this, in a place approved by Hydro-Québec. The Contractor shall make containers or absorbent pads available at the drilling site for the purpose of collecting any leakage of oil or other contaminants.

All lubricants used shall be biodegradable, even at low temperatures. In addition, all casings used for drilling in water must be removed or cut level with the bed of the watercourse.

12 WATERCOURSE CROSSINGS

The Contractor shall comply with the *Politique de protection des rives, du littoral et des plaines inondables* [protection policy for lakeshores, riverbanks, littoral zones and floodplains], the *Forest Occupancy Act*, the *Regulation respecting standards of forest management for forests in the domain of the State (RNI)* and the *Regulation respecting wildlife habitats*.

12.1 Fording

Fording is prohibited unless Hydro-Québec has obtained the required authorizations from the competent government departments.

12.2 Bridges and culverts

The Contractor shall use existing bridges and culverts, making improvements at its own expense if necessary, or build new ones in compliance with the Contract and with applicable laws and relations.

If the Contractor must install a new bridge or culvert, the location and type of structure shall be determined jointly with Hydro-Québec.

The Contractor shall ensure that the installation of its bridges and culverts creates no ponds, waterfalls or substantial changes in elevation, does not cause flooding and does not hinder the movement of fish.

The Contractor is required to restrict increases in water turbidity when it installs abutments, jetties and foundations for its bridges and culverts. Its working method must be submitted to Hydro-Québec for approval.

12.3 Modification of the bed and banks of a watercourse

Modifying the topography of the banks of a watercourse without prior authorization from Hydro-Québec is prohibited. Backfilling of permanent or intermittent watercourses is prohibited.

If there is a risk that the banks will be damaged by the work, the Contractor shall install protection using logs or planks, or use any other protection method approved by Hydro-Québec. The Contractor shall ask Hydro-Québec whether it may use trees cut down near the site to make log protection structures.

Any work requiring intervention in the bed of a watercourse must be carried out as quickly as possible.

12.4 Removal of bridges and culverts

All bridges and culverts used to create temporary access roads shall be removed, unless otherwise specified by Hydro-Québec.

After removal of the bridges and culverts, the Contractor shall re-establish the original profile of the bed and banks of watercourses, stabilize damaged banks in order to counteract erosion and drain water from the mires created by its machinery into areas of vegetation.

13 HALOCARBONS

13.1 General principles

The Contractor shall comply with provincial and federal regulations governing halocarbons when working with equipment containing halocarbons such as refrigeration, air conditioning and fire protection systems.

It is prohibited to release halocarbons (CFCs, HCFCs, halon, HFCs, etc.) into the air or to allow or cause such a release, either directly or indirectly. The Contractor shall not put a halocarbon into a container that is defective or is past the end of its service life.

Installing refrigeration or air conditioning equipment containing a CFC or filling such equipment with a CFC is prohibited. Installing or refilling a halon fire extinguisher is also prohibited.

The Contractor shall store recovered halocarbons in appropriate, clearly-labelled containers. The label shall indicate the type and quantity of halocarbons in the container, the name of the service company and its representative, and the date the halocarbon was recovered.

13.2 Equipment inventory and maintenance log

Any Contractor who owns, supplies or uses equipment containing halocarbons shall provide Hydro-Québec with a list indicating the type of equipment used and the quantity of halocarbon used in each piece of equipment.

Whenever the Contractor works on (i.e., installs, repairs or dismantles) equipment containing halocarbons, it shall provide Hydro-Québec with a maintenance log detailing the following: description and location of the work performed, type of halocarbon used, quantity of halocarbon recovered, lost or put back into the equipment, name of the person who performed the work, leak tightness test results and date the work was performed. The log shall be kept and maintained in compliance with regulations.

13.3 Accidental release

Hydro-Québec shall be notified without delay of any accidental release of halocarbons into the air.

14 SULPHUR HEXAFLUORIDE (SF_6) AND CARBON TETRAFLUORIDE (CF_4)

14.1 Installation of new equipment

The Contractor shall be responsible for installing new sealed or unsealed equipment (circuit breakers, etc.). Unsealed equipment shall be filled with SF_6 or CF_4 by a specialized supplier.

14.2 Dismantling of equipment

The Contractor shall be responsible for dismantling sealed or unsealed equipment.

In the case of unsealed equipment, the Contractor shall notify Hydro-Québec two weeks in advance of the planned start of dismantling. Hydro-Québec or a specialized company shall collect the gas in orange-colored bottles.

The Contractor shall keep the number of each piece of equipment for shipping identification purposes and shall ship the equipment no later than one month after dismantling it. The Contractor shall ask the Hydro-Québec representative about shipping requirements (identification by serial number, packaging, etc.) and comply with them.

The Contractor shall then supply the labor and materials required to transport the dismantled equipment and bottles to the residual hazardous materials recycling centre in Saint-Hyacinthe (CRMD Saint-Hyacinthe).

14.3 SF_6 or CF_4 leaks

It is prohibited to release SF_6 or CF_4, or any mixture of these gases contained in the equipment and bottles. In the event of the accidental release of these gases, the Contractor shall follow the communication flowchart provided by Hydro-Québec for cases of accidental spills.

15 PLANT AND TRAFFIC

15.1 Plant selection and maintenance

To avoid creating ruts, the Contractor shall choose site plant based on the nature of the terrain. If it is unable to comply with this guideline for technical reasons, the Contractor shall prepare a plan for the restoration of the soil specific to the work area and submit it to Hydro-Québec.

The Contractor shall maintain its plant in perfect working order and must be able to demonstrate this on request from Hydro-Québec. The Contractor must inspect its plant every day in order to ensure that there is no leak of contaminants. If a leak is detected, the necessary repairs shall be carried out immediately.

The handling (refuelling, transfer, etc.) of fuel, oil or other contaminants must be carried out farther than 60 m from any watercourse and other sensitive elements indicated in the Contract. However, if the Contractor is unable to respect this 60-m distance, it must prepare a spill prevention plan and submit it to Hydro-Québec.

If it is located less than 60 m from a watercourse or other sensitive elements, stationary plant that contains hydrocarbons shall be fitted with a leak-tight recovery system that has received prior approval from Hydro-Québec. The recovery system shall be inspected and emptied on a regular basis to prevent overflow.

At the worksite, fuel cans with a capacity of about 20 litres shall be fitted with a non-return valve.

The Contractor shall carry out all maintenance work on its plant in a location where contaminants can be contained in the event of a spill and make the necessary emergency response equipment available on site.

The Contractor shall equip its plant with the absorbents necessary to respond effectively in the event of an accidental contaminant spill.

If there is a risk of water contamination, the Contractor shall store its contaminating products and plant containing hydrocarbons or other contaminants in leak-tight containers. These containers must be placed in a location that is laid out and maintained in such a way that it remains accessible to emergency teams at all times.

Any plant used by divers under water shall operate with biodegradable oil and its use must receive prior approval from Hydro-Québec.

Hydro-Québec recommends using biodegradable oil throughout the worksite.

15.2 Cleaning of plant

The Contractor shall wash plant used for transporting and laying concrete in an area set aside for this purpose and must ensure that overflows are prevented. The location of the washing area shall be approved by Hydro-Québec. The washing area may consist of a settling pond dug out of the ground. If required, the Contractor shall remove solid segmented residues at the end of the work and place them in a container of dry materials or at an authorized site. It must then fill the settling pond with the original soil, taking care to replace the topsoil layer.

The Contractor shall clean its plant at a site specifically designed for the recovery of hydrocarbons. The washing area shall be located at least 60 m from any water body. The Contractor shall be responsible for recovering all cleaning materials (water, rags, etc.) soiled by hydrocarbons and disposing of them in accordance with the provisions of the Hazardous materials clause. The Contractor shall have its washing area and work method approved by Hydro-Québec.

15.3 Traffic

The use of any road not indicated in the Contract without prior authorization from Hydro-Québec is prohibited.

When building a road on public land, the Contractor shall comply with the *Regulation respecting standards of forest management for forests in the domain of the State (RNI).*

The Contractor shall ensure that there is no traffic beneath tree crowns. The Contractor may protect certain trees or shrubs using snow fences, collars of planks, or any other means considered effective by Hydro-Québec.

To reduce the risk of erosion on sloping ground, the Contractor shall use methods such as building retaining embankments, berms, trenches or diversion ditches perpendicular to the gradient.

Upon request from Hydro-Québec, the Contractor shall stop heavy plant traffic in areas such as those sensitive to erosion during periods of heavy rainfall, or those with poor load-bearing capacity during periods of light frost or thaw.

15.4 Traffic in the right-of-way of a power line

To operate its plant in the right-of-way of a power line, the Contractor shall use an existing road or build a roadway no more than 8 metres wide. Any deviation from this procedure must be authorized by Hydro-Québec.

At the start of work, the Contractor shall determine the path of a worksite road in the power line right-of-way and establish a baseline for the public and private roads it plans to use during the work, with the understanding that it shall be responsible for maintaining these roads.

Unless prior authorization has been obtained from Hydro-Québec, it is prohibited to modify the path of an access or bypass road indicated in the Contract, or a worksite road built within the right-of-way of a power line.

The Contractor shall request authorization from Hydro-Québec at least ten days before using any access road in the right-of-way of a power line that is not indicated in the Contract.

The Contractor's worksite road must not prevent landowners in the area from accessing neighboring fields.

If its plant is creating ruts more than 20 cm deep or causing erosion, the Contractor shall propose mitigation measures to Hydro-Québec and restore damaged soil.

The Contractor shall maintain an efficient drainage system on either side of the roads crossed by its worksite road. If required, the Contractor shall install culverts to prevent blockage of the drainage system, leaching, erosion, or any other deterioration of the roads crossed.

The Contractor shall protect the edges and surfaces of paved roads and keep them clean.

The Contractor shall use access roads during regular working hours only, unless it has obtained special authorization from Hydro-Québec.

Unless otherwise indicated by the Hydro-Québec representative, the Contractor shall restore the terrain to its original condition after the work. For example, the Contractor shall level the ground and fill ruts and excavations using materials other than the topsoil stripped on site. The Contractor shall also restore the roads it has used to their original condition or better. In addition, the Contractor shall scarify the worksite roads, work areas, heavy equipment parking areas and any other area designated by Hydro-Québec to a depth of at least 25 cm to encourage vegetation growth.

15.5 Roadway maintenance and protection

Throughout the work, the Contractor shall ensure that the roadways it uses are maintained and kept clean and shall take the necessary measures to avoid hindering other traffic.

The Contractor shall take measures to protect paved or concreted roadways during operation of its tracked vehicles. The Contractor shall minimize airborne dust generated by its plant traffic, using dust-control agents that comply with the BNQ's NQ 2410-300 standard. If it is unable to use a product that meets this standard, the Contractor shall request instructions from the Hydro-Québec representative.

16 HAZARDOUS MATERIALS

16.1 General principles

Depositing, releasing or discharging a hazardous substance into the natural environment or a sewer system is prohibited.

The Contractor shall store hazardous materials in a place approved by Hydro-Québec. This storage site must be located far from any roadway and at a reasonable distance from drainage ditches, sumps and any other sensitive element indicated by Hydro-Québec.

The Contractor shall have the emergency equipment necessary to deal with contaminant spills available on site, in accordance with the Accidental contaminant spills clause.

The Contractor shall not mix or dilute residual hazardous materials (RHM) with other substances, whether hazardous or not, unless they are compatible substances and the result of the mixture is a hazardous substance.

When transporting RHM and any other hazardous substance, the Contractor shall comply with the *Transportation of Dangerous Goods Regulations* and the *Transportation of Dangerous Substances Regulation*. As needed, the Contractor shall supply signs to identify substances (plates or labels warning of danger).

16.2 Residual hazardous materials (RHM)

RHM shall be managed in accordance with the *Regulation respecting hazardous materials*. The Contractor shall be responsible for the recovery, storage and transport of RHM generated in the execution of its Contract.

The temporary storage site installed by the Contractor shall include a shelter with roof, closed on at least three sides and fitted with a liquid-tight floor forming a basin with a retention capacity equal to the higher of the following volumes: 125% of the largest container or 25% of the total volume of all containers filled with liquid RHM. The Contractor shall provide the liquid-tight containers and identify each of them with the name of the material and the last date the container was filled. Absorbents shall be kept near all liquid material storage sites.

The Contractor shall, at its own expense, remove RHM to a place authorized by the Ministère du Développement durable, de l'Environnement et des Parcs and shall inform Hydro-Québec of this location at the site startup meeting. The Contractor shall provide the Hydro-Québec representative with proof that RHM have been eliminated for every shipment to the disposal site.

16.3 Residual hazardous materials belonging to Hydro-Québec

Residual hazardous materials belonging to Hydro-Québec constitute all materials or equipment present at the site before the arrival of the Contractor.

If the Contractor suspects that solid waste not covered by the Contract and belonging to Hydro-Québec may be contaminated, it shall immediately notify Hydro-Québec, which shall identify these substances.

RHM belonging to Hydro-Québec shall be stored in an RHM recovery area that has been delineated, identified and previously approved by Hydro-Québec. As an example, a recovery area might consist of a series of liquid-tight containers covered by a shelter, construction site trailer or maritime container.

The Contractor shall provide the labor and materials required to set up the recovery area, recover the RHM belonging to Hydro-Québec and transport them to the Hydro-Québec staging area nearest the worksite.

Hydro-Québec shall supply the recovery containers (i.e., barrels), the labels to identify the container contents, the posters to identify the RHM categories and the merchandise shipping orders.

17 WASTE MATERIALS

17.1 General principles

The Contractor shall collect site waste on a daily basis and sort it into recyclable residual materials and residual materials for disposal, as defined in the *Regulation respecting the landfilling and incineration of residual materials*.

17.2 Recyclable waste

Recyclables include construction lumber, paper, cardboard, plastic and glass. The Contractor shall recover and sort all recyclable waste if the site is equipped with a sorting centre.

If there is no sorting centre on site, Hydro-Québec recommends that contractors recover all recyclables and transport them to the nearest sorting centre or use the community's recycling services [http://www.recyc-quebec.gouv.qc.ca/client/fr/repertoires/rep-recuperateurs.asp].

Metals and tires shall be stored at a site approved by Hydro-Québec pending their removal to a recovery or recycling centre. The Contractor shall deposit iron, copper, aluminum and other metals belonging to Hydro-Québec in containers provided by Hydro-Québec so that the latter can recover them.

17.3 Concrete, brick and asphalt waste

The Contractor shall encourage the reclamation of concrete, brick and asphalt waste by complying with the *Lignes directrices relatives à la gestion de béton, de brique et d'asphalte issus des travaux de construction et de démolition et des résidus du secteur de la pierre de taille* [guidelines on the management of concrete, brick and asphalt waste from construction and demolition work and of stone rubble from quarry operations] from the Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs.

Before the start of work, the Contractor shall present the options it has chosen for the management of concrete waste and supply a list of proposed sites for disposal or recovery. The Contractor shall support waste reclamation. If there are no facilities for this purpose at or near the site, the Contractor shall remove concrete waste to authorized sites.

When the Contractor must remove concrete that shows signs of contamination (e.g., an oily surface), it shall first clean or scarify it. Soiled absorbent fabric must then be disposed of in accordance with the methods applicable to hazardous materials.

If the Contractor scarifies the concrete, it must dispose of flakes with oily surfaces in accordance with the methods applicable to hazardous materials.

Once the cleaning or scarification work has been completed to Hydro-Québec's satisfaction, the concrete may be broken up and loaded for removal.

17.4 Blasting waste

The Contractor shall recover all blasting waste such as rust, paint, coatings, slag and abrasive along with wastewater by immediate vacuum suction, or by carrying out the work under a shelter, or by using any system that meets current applicable efficiency standards and requirements. The recovery facilities shall be approved by Hydro-Québec.

Hydro-Québec shall analyze the blasting waste and dispose of the portion defined as hazardous material under the *Regulation respecting hazardous materials*. The Contractor shall remove the rest of the waste to a site authorized by the MDDEFP and provide Hydro-Québec with proof that this has been done.

If needed, the Contractor shall place dry and wet waste in sealed, covered containers to prevent any release of residues into the air.

When performing waterblasting work, the Contractor shall recover residues and wastewater in order to prevent any contaminants from being released into the environment. Its recovery system must have undergone a prior inspection by Hydro-Québec.

The use of abrasives containing silica is prohibited. The Contractor shall transmit the datasheet for the abrasive it uses to Hydro-Québec.

17.5 Waste destined for disposal

The Contractor shall be responsible for collecting, storing, transporting and disposing of waste generated by its activities. Such waste shall be disposed of at the Contractor's expense, in a location authorized by the MDDEFP. At Hydro-Québec's request, the Contractor shall provide proof that the waste has been removed to an authorized site.

18 FARMLAND

18.1 Underground drainage

At the start of work, the Contractor and Hydro-Québec shall jointly survey drained areas and if possible, install markers to identify the locations of the drains.

Worksite roads running parallel to the underground drainage system shall be built between the drains. These worksite roads shall not hinder the proper functioning of the drains.

If the Contractor damages a drain, it shall take the necessary measures to ensure that water flows freely through the drain upstream of the excavation and shall plug the drain downstream of the excavation, install a marker at the site of the drain to be repaired and notify Hydro-Québec.

The Contractor shall hire a specialized company to repair a damaged drain and shall submit all plans to modify or repair an underground drain to Hydro-Québec prior to final backfilling.

18.2 Surface drainage

At the start of work, the Contractor and Hydro-Québec shall jointly verify the condition of the bridges or culverts the Contractor intends to use and shall establish the locations where it plans to cross drainage structures and install bridges or culverts.

The Contractor shall maintain the bridges and culverts it uses in good working order and shall take the necessary measures to stabilize the banks.

Any modifications to the surface drainage system shall be approved by Hydro-Québec throughout the duration of the work.

The Contractor and Hydro-Québec shall jointly mark out the locations of the wells and any other drinking-water supply sources that could be affected by the Contractor's work. The Contractor shall inform Hydro-Québec of the measures it plans to take to protect water catchment structures.

Upon completion of the work or upon notice from Hydro-Québec, the Contractor shall remove any equipment it has installed. In addition, the Contractor shall re-establish the profile of the affected banks and drainage structures before stabilizing them.

18.3 Barriers and fences

At the start of work, the Contractor and Hydro-Québec shall jointly verify the condition of any fences present in the right-of-way and shall establish the types of barriers to be installed and their locations.

When building a rigid or temporary barrier or an arcade for an electric fence, the Contractor shall do the following:

- Shore up the posts on either side of the gap to maintain mechanical tension in the rest of the fence.
- Use the same type of pin and the same number of strands as in the adjacent fence.
- Ensure that the strands are taut enough to keep livestock in.

When taking down stone or pole fences to allow for plant traffic, the Contractor shall store the materials from the dismantled fences in such a way as to be able to rebuild them when the work is completed.

The Contractor shall install and maintain all temporary fences and any other structure required to protect crops, livestock and property.

The Contractor shall ensure that fence gates are closed immediately after the passage of vehicles or site plant.

Any barrier or fence cut, damaged or destroyed by the Contractor shall be repaired using materials of equal or better quality, or shall be replaced with a product of equal or better quality.

Upon completion of the work, the Contractor shall remove any temporary barriers it has installed, unless otherwise indicated by Hydro-Québec. The Contractor shall restore any fences it has modified to good working order using materials of original or better quality. Lastly, the Contractor shall strengthen the props of the posts planted on either side of the closed gap.

18.4 Traffic

Depending on the season and the nature of the soil, Hydro-Québec shall restrict access by vehicles and machinery that may disturb the soil. The Contractor shall take care to avoid mixing topsoil with mineral soil.

Whenever the ground cannot bear the weight of machinery or vehicles due to the season or the nature of the soil, the Contractor shall strip and set aside the topsoil, which shall be used to restore the site at the end of the work. If granular material has been added to the site, the Contractor shall deposit it on geotextile. When the site is restored, the Contractor shall remove the granular material and geotextile and replace the topsoil.

18.5 Performance of work

All excavation areas, stockpiling areas for excavated material and fill, and all areas requiring leveling shall be stripped. The Contractor shall store stripped topsoil for reuse during site restoration. The thickness of the layer to be stripped shall either be stipulated in the Contract or indicated by Hydro-Québec. In all cases, the layer to be stripped shall be no more than 30 cm thick.

If the stripped layer consists of a mixture of inert soil and topsoil, the Contractor shall replace it with topsoil from an area approved by Hydro-Québec.

All excess fill shall be removed from the site. The fill shall not be spread on the surface of the soil.

Spreading gravel on farmland is prohibited without prior authorization from Hydro-Québec.

The Contractor shall fence off all unsupervised excavation areas, in accordance with the terms of the compliance verification carried out by Hydro-Québec.

The Contractor shall take the necessary measures to avoid frightening livestock during the work.

In winter, the Contractor shall clear the area of snow before performing any backfilling or using any work or storage areas. The Contractor shall strip the soil in order to deposit granular material on geotextile.

Burying or leaving metallic or other debris at the worksite is prohibited.

Discharging sediment from pumping in excavation areas into watercourses or nearby ditches is prohibited.

In the event of an accidental contaminant spill, the Contractor shall fence off the contaminated site if it is left unsupervised and shall initiate emergency spill response in accordance with the Accidental contaminant spills clause.

The Contractor shall clean all plant used to transport and lay concrete in an area set aside for this purpose. The location of the washing area shall be determined by Hydro-Québec. The washing area may consist of a settling pond dug out of the ground and lined with a geotextile membrane. Upon completion of the work, the Contractor shall remove solid segmented residues and the geotextile membrane, place them in a container of dry materials and provide proof that they have been removed to a suitable storage site. The Contractor shall then fill the settling pond with the original soil, taking care to replace the topsoil layer on the surface.

When backfilling an excavation or dismantling a power line, the Contractor shall restore the terrain to its original profile. To do so, the Contractor shall use the excavated material stockpiled on site and, if there is not enough material, shall obtain material that is similar to the original soil. Stripping the surrounding land to compensate for the lack of material is prohibited.

The Contractor set up arrange areas for unreeling cables in locations that have the least impact and have been previously approved by Hydro-Québec.

If the Contractor leaves any of its plant on site after work hours, it shall install the necessary protective structures to prevent farm machinery or animals from coming into contact with the plant.

The Contractor shall be responsible for minimizing airborne dust generated by its plant traffic, using only dust-control agents approved by Hydro-Québec.

19 HERITAGE AND ARCHAEOLOGY

19.1 Heritage

It is prohibited to dismantle equipment that bears a plaque or any other sign indicating its heritage value before obtaining instructions from Hydro-Québec regarding the conditions governing its dismantling and management.

A Hydro-Québec representative shall be present to record the dismantling operations and recover the identification plaque, if applicable.

19.2 Archaeology

If the Contractor discovers archaeological remains on the site, it shall suspend work and notify Hydro-Québec without delay. The Contractor shall avoid any intervention liable to compromise the integrity of the site or the remains discovered.

20 AIR QUALITY

20.1 General principles

The Contractor shall comply with the provisions of the *Clean Air Act*, the *Forest Occupancy Act*, the *Regulation respecting pits and quarries* and applicable municipal regulations regarding airborne dust and air pollutants.

Before carrying out work liable to cause the dispersion of dust or fine contaminant particles, the Contractor shall submit its work method and the planned measures to protect air quality to Hydro-Québec for approval.

20.2 Open-air burning

The burning of waste in the open air is prohibited except for branches, dead leaves, explosives and empty explosives containers. This prohibition does not cover northern landfill sites as defined in the *Regulation respecting the landfilling and incineration of residual materials*.

Between April 1 and November 15, lighting a fire in or near a forest is prohibited unless a permit has been issued by SOPFEU. If the Contractor wishes to burn explosives or empty explosives containers, it shall have its burning method approved by Hydro-Québec and, if necessary, provide proof that it holds the required permit.

G High-Voltage 320-kV Direct Current Line and Human Health

High-Voltage 320-kV Direct Current Line and Human Health

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1 Introduction

A direct-current (DC) line produces a static magnetic field, which results from current in the conductors, and a static electric field, which results from the line voltage. A DC line may also ionize air at the surface of the conductors, depending on weather conditions. Resulting ions are repulsed by the electric field and move away from the conductors. When this occurs, the ions increase the static electric field strength measured near the line and create a measurable ground-level ion current.

The electric and magnetic fields (EMFs) produced by a DC line are static, while those produced by an alternating-current (AC) line alternate, i.e., their strength varies at a frequency of 60 cycles per second. This distinction is important with respect to effects on the human body. Given the currents that an alternating magnetic field induces in the body, its effects are felt at much lower levels than when the body is exposed to a static field. The following text only covers static fields.

2 EMF Profile Calculations

Profiles of the electric and magnetic fields of the 320-kV DC line were made using CEMEC software. Figure 1 is a schema of the 320- and 450-kV lines. All parameters needed to compute the fields are shown, except those for the conductor bundles. The 320-kV line is comprised of bundles of two conductors 5 cm in diameter and 40.6 cm apart. The 450-kV line is comprised of bundles of four conductors 3.51 cm in diameter and 45.7 cm apart. The 320-kV line has two ground wires 2.29 and 1.63 cm in diameter. The ground wire of the 450-kV line is comprised of a bundle of two conductors 3.16 cm in diameter and 41 cm apart. The amperages used to compute the magnetic field are 1,770 A for the 320-kV line and 2,222 A for the 450-kV line. These represent the peak loads given the capacity of the AC-DC converters. EMF profiles were calculated for both project scenarios: the 320-kV line alone and the 320- and 450-kV lines side by side in the same corridor. Calculations were made using the average height of the conductors between two towers (Turgeon, 2015).

The width of the 320-kV line right-of-way is 50 m, i.e., 25 m to either side of the middle of the line. For both lines side by side, the right-of-way is 97 m wide: -25 m on the 320-kV side (left) and 72 m on the 450-kV side (right), taking the middle of the 320-kV line as reference.

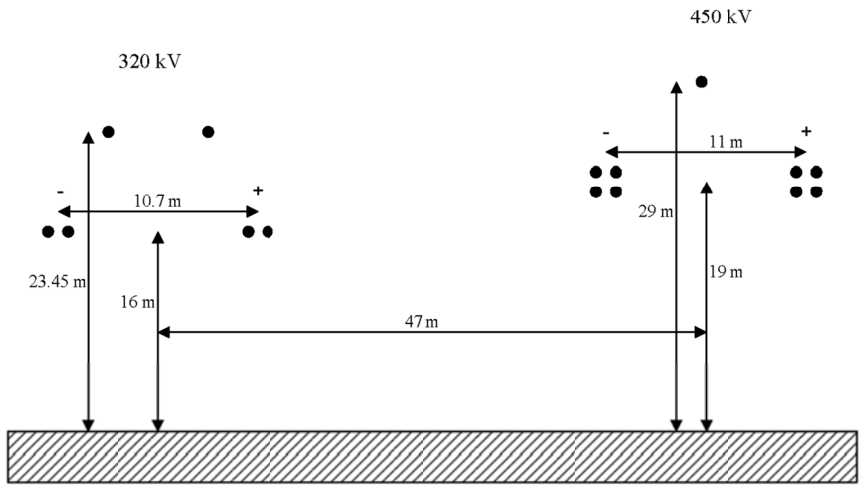

Figure 1 – Schema of the 320- and 450-kV DC Lines

3 Static Magnetic Fields

3.1 Natural magnetic field

The unit of measurement of magnetic fields is amperes per metre (A/m) but the tesla (T) is the unit generally used to express the strength of magnetic fields. The Earth is surrounded by a permanent static magnetic field, which can be detected with a compass. That field, to which we are all exposed, ranges in strength from 35 microteslas[1] (µT) at the Equator to 70 µT in polar regions. Its strength is 54 µT in the area crossed by the 320-kV line. It is a static field pointing toward the magnetic north with a constant strength at a given location.

3.2 Magnetic field produced by the 320-kV line

Figure 2 shows the profile of the magnetic field produced by the 320-kV line alone, excluding the Earth's magnetic field. The magnetic field reaches a value of 14.9 µT at the middle of the line, while it is 4.5 µT at the edge of the right-of-way.

Figure 3 shows the combined profile of both lines. The maximum magnetic field, 13.6 µT, is again located beneath the 320-kV line, and the values at the edges of the shared right-of-way are 5.3 µT on the 320-kV side and 5.7 µT on the 450-kV side.

[1] A microtesla is one millionth of a tesla.

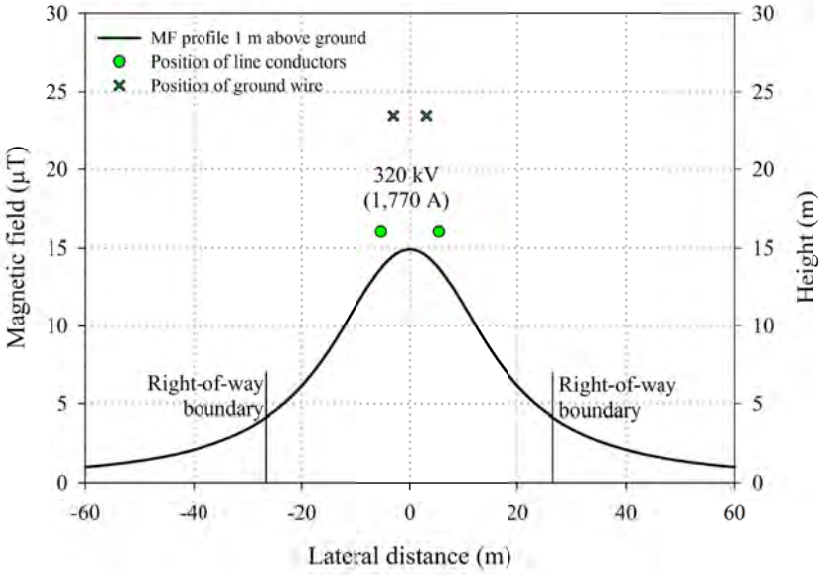

Figure 2 – Magnetic Field Profile for the 320-kV DC Line

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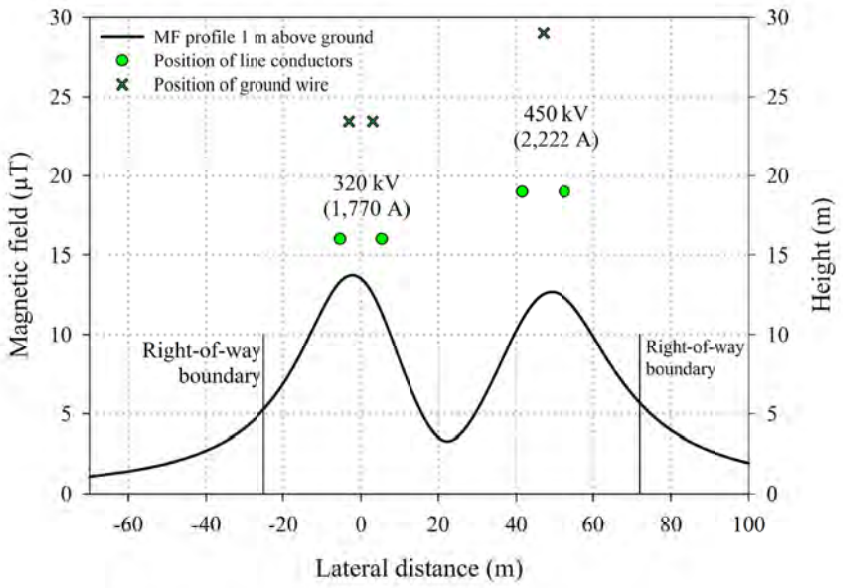

Figure 3 – Magnetic Field Profile for the 320- and 450-kV DC Lines

3.3 Total magnetic field for the 320-kV line

The magnetic field profiles above were calculated ignoring the Earth's magnetic field. In fact, the ground-level field beneath the DC line will be the vector sum of the Earth's magnetic field and the field produced by the line. The total magnetic field is higher than the natural field when both components point in the same direction and lower when they are in opposite directions. Since the line generally runs north-south, the magnetic field produced by the line and perpendicular to it will be east-west. For the purposes of this report, the magnetic field produced by the line is assumed to be perpendicular to the natural field, which approximates the actual situation over most of the line. The profile of the total magnetic field is shown for the line alone in Figure 4 and for both lines in Figure 5.

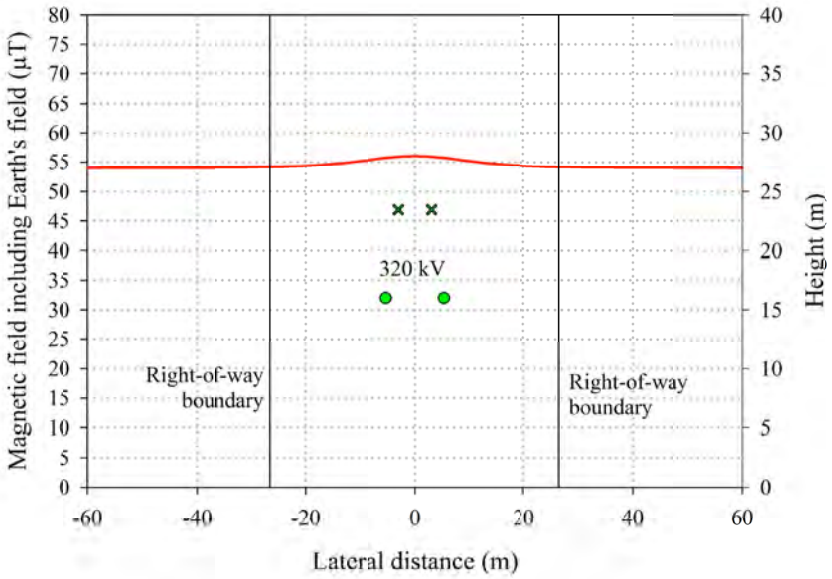

Figure 4 – Total Magnetic Field for the 320-kV Line

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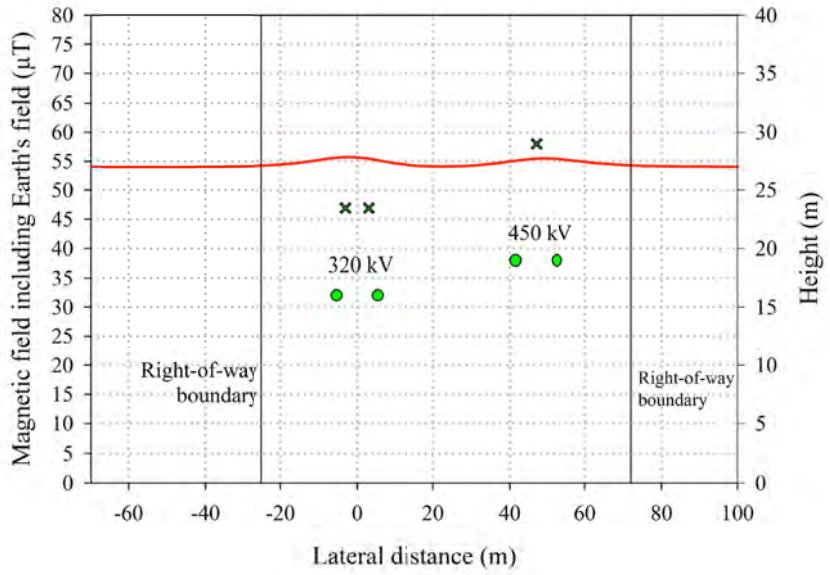

Figure 5 – Total Magnetic Field for the 320- and 450-kV Lines

Directly beneath the conductors of the 320-kV line alone, the maximum magnetic field increases from 54 to 55 μT. This increase diminishes with distance and becomes negligible before reaching the edge of the right-of-way. In conclusion, the DC line's area of influence on the Earth's magnetic field does not extend beyond the width of the right-of-way and the Earth's field changes in magnitude by less than 2%. The same conclusion applies to the total magnetic field profiles of both DC lines side by side, where the maximum field reaches 55.1 μT (Figure 5).

3.4 Static magnetic field and human health

The human body is quite transparent to magnetic fields since it contains nothing metallic in a significant amount reacting with such fields. The body can be exposed to very high levels of static magnetic fields with no harmful effects. Fairly high static magnetic fields are generated by some common technologies, e.g., electric railways and subways. Medical imaging equipment produces static magnetic fields of roughly 2 T, which is 40,000 times stronger than the Earth's magnetic field. Test devices have used fields up to 8 T strong (ICNIRP, 2009). Widespread use of imaging equipment over the past three decades and research to ensure their safety have not revealed any harmful effects. Experimental studies have reported minor physiological changes in fields of 2 T or more. Transient symptoms occasionally occur during magnetic resonance imaging tests. They arise from too rapid movement of the body in the magnetic field. During such movement, current is induced in the body and may be strong enough to lead to transient effects such as vertigo,

dizziness or a metallic taste in the mouth. By avoiding such movement, the symptoms are generally avoided.

Québec and Canadian regulations set no exposure limits for workers or the public. The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a body associated with the World Health Organization, issues recommendations on safe exposure levels for workers and the public. Those recommendations are the authoritative scientific basis to which many countries around the world refer in adopting exposure standards. The recommended values do include a safety margin and thus are not the threshold above which harmful affects may appear. The recommended limits for worker exposure are 2 T for the head and torso, and 8 T for arms and legs. The recommended limit for the public is 0.4 T regardless of the part of the body exposed (ICNIRP, 2009).

Another international organization, the International Committee for Electromagnetic Safety (ICES), under the oversight of the Institute of Electrical and Electronics Engineers, has developed guidelines for exposure to static magnetic fields (IEEE, 2002). On the basis of experimental studies on humans, ICES estimates that the average threshold for detectable physiological effects is about 1.5 T. Given the individual variability anticipated at that threshold and an extra safety factor of 3, the recommended exposure level for workers is 0.353 T. A further safety factor of 3 is applied for the public, giving a recommended limit of 0.118 T (118,000 µT).

Since the levels of the Earth's magnetic field will be changed very slightly by the presence of the DC line and the resulting magnetic field is about 2,100 times weaker than the most restrictive exposure limit for the public (55 µT vs. 118,000 µT), no impact on human health is anticipated.

4 Static Electric Fields

4.1 Natural electric field

A static electric field with a strength of about 100 V/m exists everywhere on the surface of the Earth. There are daily and seasonal fluctuations in field strength over a range of 50 to 300 V/m nearly 90% of the time (Bennett, 2007). An approaching storm raises the strength of the electric field to much higher values, roughly 10 to 20 kV/m at ground level (Yu, 2005). The Earth's surface is negatively charged and the upper atmosphere is positively charged. For the purposes of this report, the size of the area of influence of the planned line was estimated assuming a value of 100 V/m.

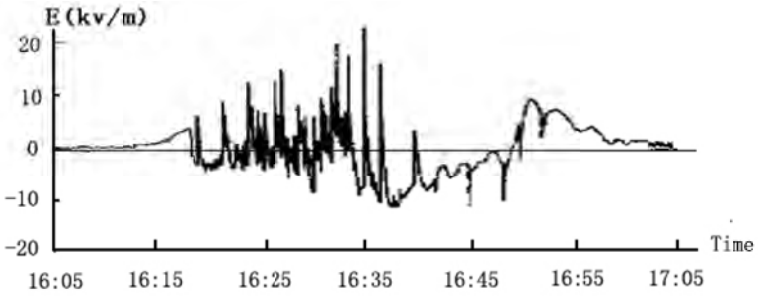

Figure 6 – Electric Field Strength at Ground Level during a Storm (Yu, 2005)

4.2 Electric field and ion current produced by the 320-kV line

Figure 7 shows the electric field profile calculated for the 320-kV line alone and Figure 8 shows the profile for both lines. The electrostatic field is calculated with no corona effect. Both profiles are shown at 1 m above ground and at ground level.

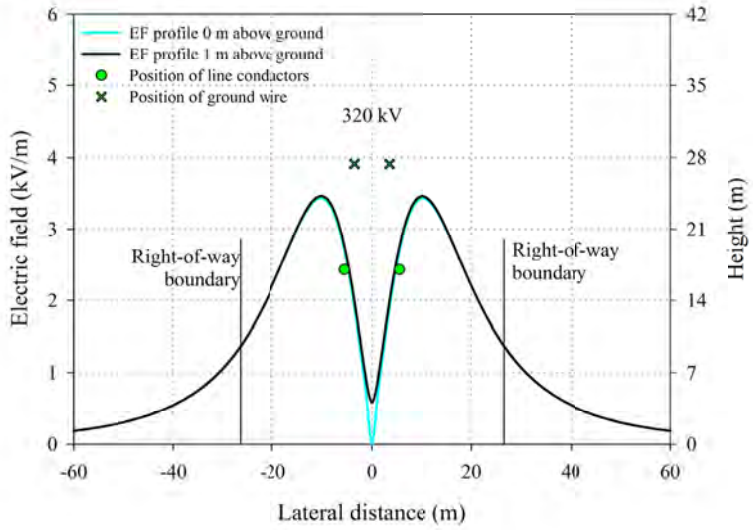

Figure 7 – Electric Field Profile for the 320-kV DC Line

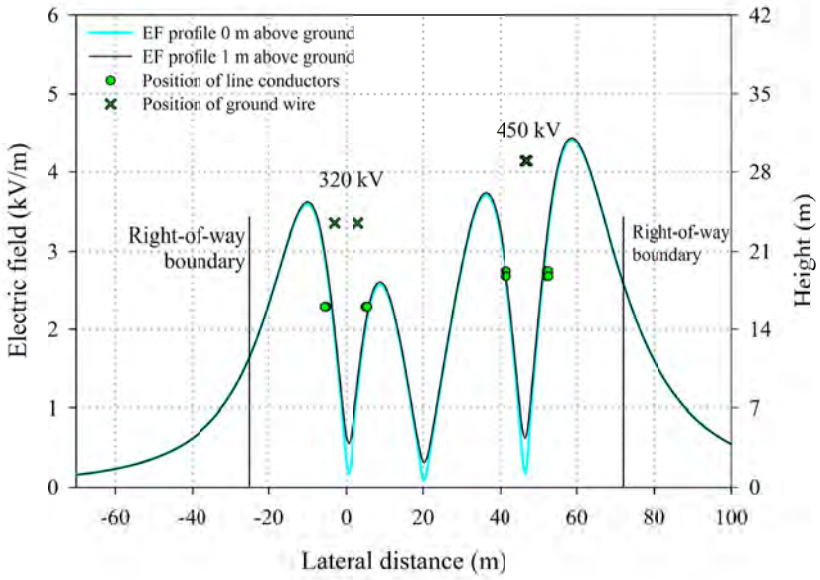

Figure 8 – Electric Field Profile for the 320- and 450-kV DC Lines

The maximum field beneath the 320-kV line alone is 3.47 kV/m. It is 1.5 kV/m at the edge of the right-of-way. With both lines, the strongest field is 4.4 kV/m and is found beneath the 450-kV line. The value is 1.6 kV/m at the edge of the 320-kV side of the right-of-way and 2.59 kV/m at the edge of the 450-kV side. The electric field strength diminishes with distance. It falls to the value of the Earth's natural field (100 V/m) at a distance of 75 m to either side of the 320-kV line alone.

If the electric field strength on the surface of conductors exceeds a threshold, spontaneous micro-discharges occur there. This is the corona effect. The micro-discharges ionize air molecules into negatively charged and positively charged ions. Ions with a polarity unlike that of the conductor are immediately attracted to the conductor by the electrostatic force. Ions of like polarity are repelled following the electric field lines and the wind. The moving ions produce a current that appropriate instruments can measure at ground level. At ground level beneath the positive and negative poles of the line, currents respectively of positive charges and negative charges can be measured. The wind can push the ions several tens of metres to either side, depending on its direction. Negative ions may end up beneath the positive pole. Another consequence of the corona effect is a strengthened electric field beneath the conductors due to the presence of electric charges (ions) there.

The electric field at the surface of the conductors determines whether or not the corona effect is present. It primarily results from set parameters, including the nominal line voltage, number of conductors per phase, conductor diameter, distance between phases, and distance between the conductor and the ground. High-voltage lines are designed to minimize the corona effect. Under poor atmospheric conditions, however, water droplets on the conductor's surface increase the strength of the local electric field above the electric field threshold and the corona effect becomes more probable.

To estimate the ion current density and increase in nominal electric field strength produced by the corona effect beneath the 320-kV line, data collected in a long-term study beneath an existing 450-kV line under actual operating conditions was used (IREQ, 1989).

The data was collected over a 20-month period by measuring instruments installed on the ground. That data shows that the mean ion current measured directly beneath the conductors was 1.9 nanoamperes per square metre (nA/m^2) beneath the positive pole and -4 nA/m^2 beneath the negative pole. The average value at the edge of the right-of-way was 1.1 nA/m^2 on the positive side and -4.5 nA/m^2 on the negative side. The current density 99% of the time was less than 39.3 nA/m^2. The asymmetry is primarily due to the direction of the prevailing winds, which push the airborne ions (Table 1).

Table 1

Environmental Monitoring of the 450-kV Line

Ion Current Measurements

(height of conductors: 16.7 m)

Location	Average (nA/m^2)	L5* (nA/m^2)	L1* (nA/m^2)
Edge of right-of-way, positive pole	1.1	-0.3/7.3	-0.7/13.9
Beneath conductors, positive pole	1.9	-2.9/14.1	-9.8/24.1
Beneath conductors, negative pole	-4.0	-20.7/1.2	-31.3/4.0
Edge of right-of-way, negative pole	-4.5	-20/0.9	-39.3/4.2

* Upper values observed respectively 95% and 99% of the time.

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Table 2 gives electric field strengths observed under the same conditions. The electric field strength is the combined result of the electric field produced by the conductors and the presence of electric charges between the conductors and the ground.

Table 2

Environmental Monitoring of the 450-kV Line

Electric Field Measured at Ground Level

(height of conductors: 16.7 m)

Location	Average (kV/m)	L5* (kV/m)	L1* (kV/m)
Edge of right-of-way, positive pole	3.3	0.6/11	-0.3/14.7
Beneath conductors, positive pole	5.8	0.4/14.6	-0.5/18.7
Beneath conductors, negative pole	-7.9	016.2/-1.1	-19.4/5.0
Edge of right-of-way, negative pole	-7.3	-17.5/-0.5	-22.8/0.5

* Upper values observed respectively 95% and 99% of the time.

Observations show that the average electric field is 5.8 kV/m beneath the positive pole and -7.9 kV/m beneath the negative pole. The electric field was less than 22.8 kV/m more than 99% of the time. For the 320-kV line, the electric field diminishes gradually with distance to reach the natural strength of 100 V/m at a distance of 75 m from the middle of the line.

Using this data and data collected along two other DC lines (500 kV and 600 kV), a theoretical model was devised to predict ion production beneath various high-voltage line configurations (Maruvada, 2012). The model predicts that ion currents from the 320-kV line will be weaker than those from the 450-kV line (Figure 9).

It may be concluded that the actual electric field and ion currents from the new line will be substantially weaker than those measured beneath the 450-kV line.

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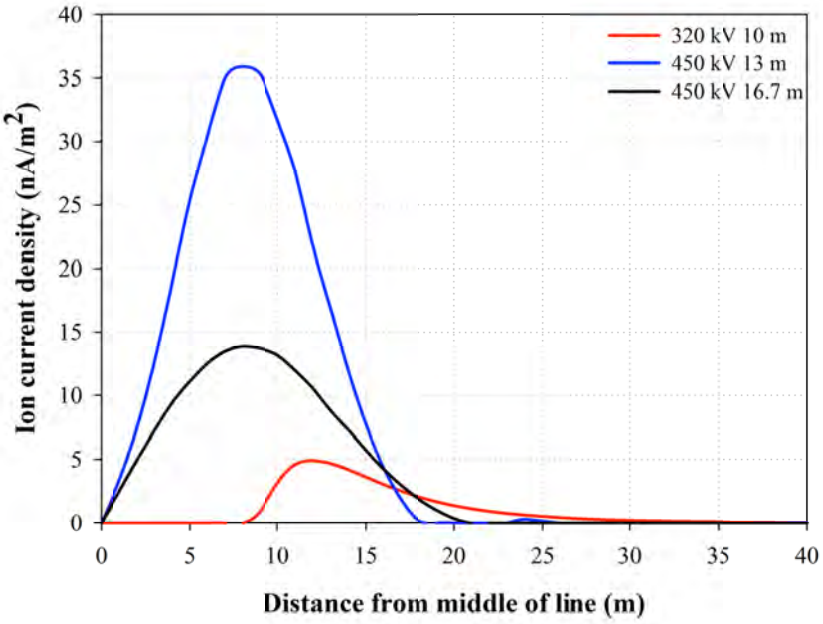

Figure 9 – Predicted Ion Current beneath the 320-kV Line

4.3 Effect of static electric fields on humans

No harmful effect is known related to exposure to static electric fields. If a person's body is exposed to a static field and that person is well grounded, e.g., barefoot on moist ground, the body cannot accumulate electric charges and remains at the same electric potential as the ground. If the same person is well isolated from the ground, e.g., footwear with insulating soles, electric charges can accumulate and lead to a rise in the electric potential of the body. This rise is slow since the air only contains minute amounts of electric charges that can be accumulated. Due to electrostatic repulsion between like electric charges, the accumulation of charges is strictly confined to the surface of the skin and hair. The electric field within the body is nil. It is thus possible to subject the human body to an electric potential of several hundreds of thousands of volts with no harmful effect. If the accumulated charge is sufficient, hairs will tend to stand on end and push away from one another. Many scientific museums use a Van de Graff generator so the public can enjoy, in complete safety, a hair-raising experience as their body potential rises.

The static electric field perception threshold was investigated in a test study with 48 subjects (Blondin, 1996). The data shows that the average threshold at which the static electric field is perceived by humans is 45 kV/m. The electric field is only perceived on the skin, subjects describing a discrete tactile sensation, most on the scalp but some also on facial skin. Most subjects considered the sensation neutral and none qualified it as painful. No statistically

significant correlation was found in the study between the detection threshold of subjects and the abundance and characteristics of their hair.

A later study (Chapman, 2005) focused on local perception, on the forearm, of a static electric field of up to 65 kV/m. None of the 16 subjects was able to detect the presence of the electric field under these conditions.

If the electric potential of the body exceeds 500 V, the person will feel a small electric discharge when touching a grounded object. The reverse can occur if a well-grounded person touches a charged conductive object that is electrically isolated from the ground. There is a small likelihood that this may happen beneath the DC line. If it does happen, the individual is surprised but not in any danger.

4.4 Effect of ion currents on the human body

The effects of ion currents in a static electric field were studied among 48 subjects (Blondin, 1996). The study was designed to check whether the ion current could affect the subjects' electric field detection threshold. Subjects were exposed to two current strengths: 60 and 120 nA/m^2. Observations showed that the 60 nA/m^2 current did not affect the electric field detection threshold of most subjects. At a current density of 120 mA/m^2, however, the detection threshold was substantially lower for most subjects.

5 Standards for Human Exposure to Static Electric Fields

There are no Canadian or Québec standards in this area. Nor do international recommendations exist.

Since the current density and electric field strength beneath the 450-kV line are very far below the human perception thresholds (respectively 45 kV/m and 60 nA/m^2), and since strengths beneath the 320-kV line are lower than those of the 450-kV line, it is unlikely that the electric field of the 320-kV line will be perceivable by people moving beneath the line, even under maximum corona effect conditions.

6 Cardiac Pacemakers and Implanted Defibrillators

Limits that the static field must not exceed may vary, depending on the manufacturer. Lacking a specific limit, it is recommended that someone with a pacemaker or defibrillator not be exposed to more than 500 µT. This field strength is never reached beneath the DC line.

No limits are prescribed for the static electric field. We are unaware of any reported cases casting doubt on the immunity of such devices in the Earth's natural electric field, which may reach several tens of kV/m during storms.

7 Conclusion

The magnetic field produced by the 320-kV DC line will very slightly modify the natural magnetic field strength already present. This effect becomes negligible at the edge of the right-of-way. It is a field strength far too weak to produce any kind of effect on the human body.

The electric field produced by the line will remain imperceptible almost all of the time, even for the most sensitive individuals. The area of influence will be 75 m to either side of the line. Beyond that distance, the strength of the electric field will be less than that of the natural electric field.

It is unlikely that someone beneath the line and in contact with a conductive object would be subject to a micro-discharge. If this occurs, the individual is surprised but not in any danger. Indeed, there are no known adverse effects due to static electric fields.

Consequently, the electric and magnetic fields produced by the planned 320-kV line present no health risk.

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