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Un nouveau **pont** pour le Saint-Laurent

COMPENSATION PROJECTS FOR THE LOSS OF WETLANDS AND FISH HABITATS

CONCEPTS DEVELOPMENT



Prepared on behalf of
Public Works and Government Services Canada

Final Report

January 9, 2015

Ref No.: J020160-E1

CJB Environnement inc.

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Acronyms

2D:	Two-dimensional
C.A.:	Certificate of authorization
CDPNQ:	Centre de données sur le patrimoine naturel du Québec [Quebec Natural Heritage Data Centre]
CMM:	Communauté métropolitaine de Montréal [Montreal Metropolitan Community]
COSEWIC:	Committee on the Status of Endangered Wildlife in Canada
CPUE:	Catch per unit of effort
DFO:	Department of Fisheries and Oceans
DUC:	Ducks Unlimited Canada
EA:	Environmental assessment
EC:	Environment Canada
ELF:	Engineered landfill
ESA:	Environmental site assessment
FCSI:	Federal Contaminated Sites Inventory
GPS:	Global positioning system
HEC-RAS:	Hydrologic Engineering Centers - River Analysis Systemic
INFC:	Infrastructure Canada
LEMV:	Quebec <i>Act respecting threatened or vulnerable species</i>
LQE:	Quebec <i>Environment Quality: Act</i>
MAH:	Monocyclic aromatic hydrocarbons
MCC:	Quebec Department of Culture and Communications

MDDELCC:	Quebec Department of Sustainable Development, the Environment and the Fight Against Climate Change
MDDEP:	Quebec Department of Sustainable Development, the Environment and Parks
MENV:	Quebec Department of the Environment
MFFP:	Quebec Department of Forests, Wildlife and Parks
MRN:	Quebec Department of Natural Resources
NBSL:	New Bridge for the St. Lawrence
PAH:	Polycyclic aromatic hydrocarbons
PWGSC:	Public Works and Government Services Canada
SARA:	<i>Species at Risk Act</i>
SEG permit:	Special permit issued by the Quebec government for the capture of animals for scientific, educational or wildlife management purposes
ZIP:	Zones d'intervention prioritaire [areas of prime concern]

Note: This report has been modified from its original version; redacting all information not related to the retained compensation projects. The project(s) described herein have been selected out of five projects assessed in the original report.

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1. INTRODUCTION

The impacts of the deconstruction of the Champlain Bridge, the construction of the New Bridge for the St. Lawrence (NBSL) and the deconstruction and reconstruction of the Nuns' Island Bridge will include losses of aquatic habitats and wetlands as well as area losses of a migratory bird sanctuary.

The initial assessment conducted during the environmental assessment (EA) process estimates the losses of ecological and socioeconomic functions of wetlands at 6,300 m². Following discussions with the expert departments, these functions must be compensated in a ratio of 3:1. A total compensation area of 18,900 m² is therefore proposed.

Permanent and temporary losses of fish habitat total approximately 5,865 m² and 45,495 m² respectively, for a total of 51,360 m², or approximately 5 ha. Of this area, 9,950 m² of still water habitat and 41,410 m² of habitat in fast-flowing water must be compensated. These areas must be compensated in a ratio of 1.1.

As part of the EA process, a compensation plan for fish habitat and wetland functions was developed in accordance with the requirements of the *Federal Policy on Wetland Conservation* and the *Fisheries Act*.

The maximum area of the sites affected by the project depends on factors such as the configuration of the bridge and the construction methods. In the event that the area of compensation provided by one of the proposed compensation projects proves to be less than the compensation needs, other compensation projects will be developed.

Public Works and Government Services Canada (PWGSC), mandated by Infrastructure Canada (INFC), retained the services of CJB Environnement inc. to develop the detailed concept of the four compensation projects identified during the EA, develop the preliminary and detailed concept of the Lapierre Island project, evaluate all five projects, describe the additional studies necessary to develop the plans and specifications, and estimate the implementation costs of each project.

2. DESCRIPTION OF THE PROJECTS

2.1 THÉORET POINT ISOLATED MARSH

The Théoret Point sector is owned by the City of Montreal. There is an interior marsh in this sector which is surrounded by multiple areas of fill which interfere with the free circulation of water during the seasonal variations in the water level of the Rivière des Prairies. More specifically, an access road leading to the Cap-Saint-Jacques Nature Park obstructs the supply channel which supplies water to the marsh in high-water periods. However, water exchanges with the Rivière des Prairies appear to be possible since there is a considerable amount of debris in the interior marsh, which indicates that a connection exists. The confirmed presence of herons in the marsh could indicate the presence of fish that are trapped when the water level falls.

2.1.1 Location

Forming part of the Cap-Saint-Jacques Nature Park, Théoret Point is located to the south of Bizard Island and is owned by the City of Montreal. Bizard Island is located to the southwest of Laval Island and to the northwest of Montreal Island, between Lac des Deux-Montagnes and the Rivière des Prairies (Figure 1).

The excavation work will be carried out in the sector that separates the marsh from the Rivière des Prairies over an area of approximately 25 m by 10 m. Vegetation will be planted on a 10 m wide strip around the periphery of the interior marsh.

2.1.2 Description of the project

The compensation project includes a few simple operations intended to facilitate access to fish habitats in still water and wetlands located in the interior marsh of Théoret Point. This work mainly involves:

- Clearing and widening the supply channel over an area of approximately 250 m².
- Installing a culvert under the access road.
- Restoring adequate vegetation cover around the periphery of the marsh.

The following sections describe in detail each stage of this work. Table 1 presents a description of the project. It should be noted that the work methods described to carry out the project work must be considered as one possible option for project implementation. In our planning process, they were used to estimate project costs. The work methods will be developed further at the plans and specifications stage and must be approved by the federal organizations.

2.1.3 Clearing and widening of the supply channel

First, a hydraulic study will be conducted to determine the dimensions of the channel necessary to facilitate water flow. An excavator will be used to widen the supply channel to facilitate water inflows and outflows in keeping with the water level variations of the Rivière des Prairies. The additional width will also reduce the risks of jams and obstruction by small debris. At the same time, the depth and slopes of the channel will be modified in order to facilitate water flow (Figure 2). However, the current project does not include any modification of the shoreline profile of the interior marsh.

Figure 1 Flood plain and isolated marsh of Théoret Point

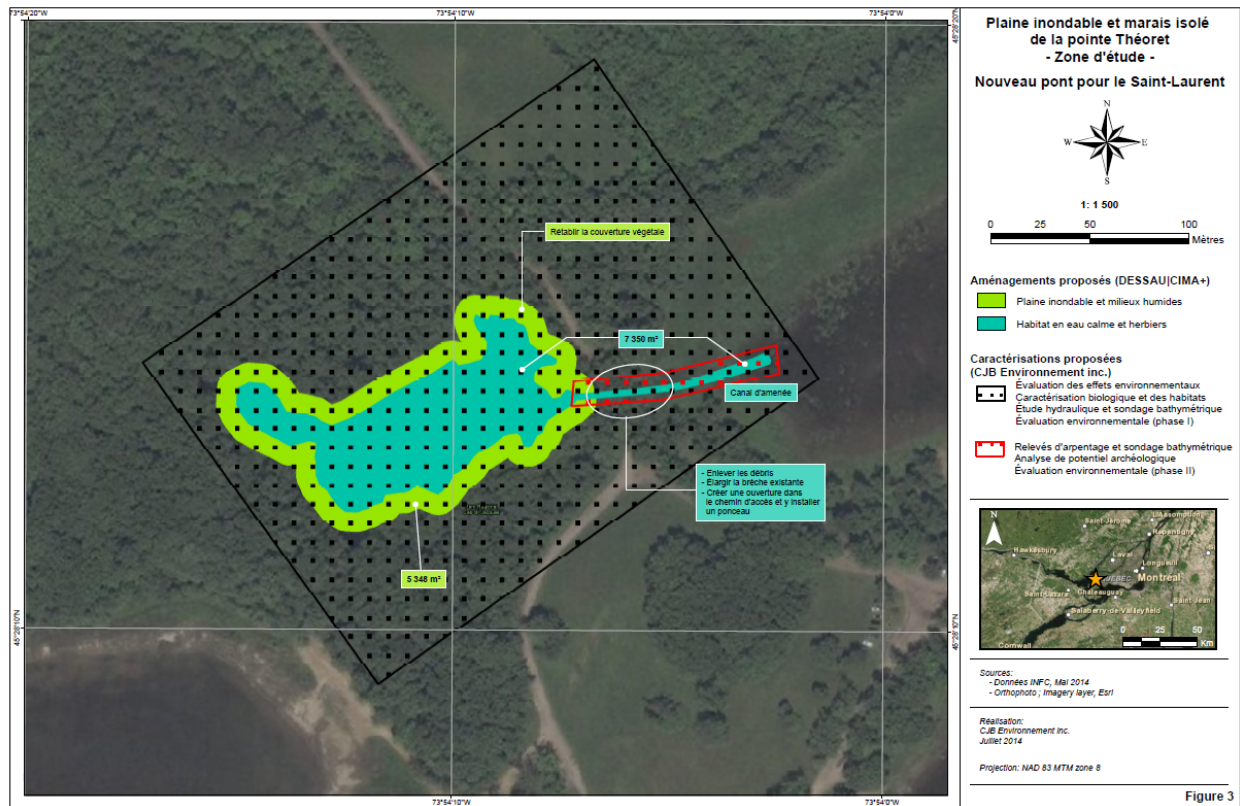
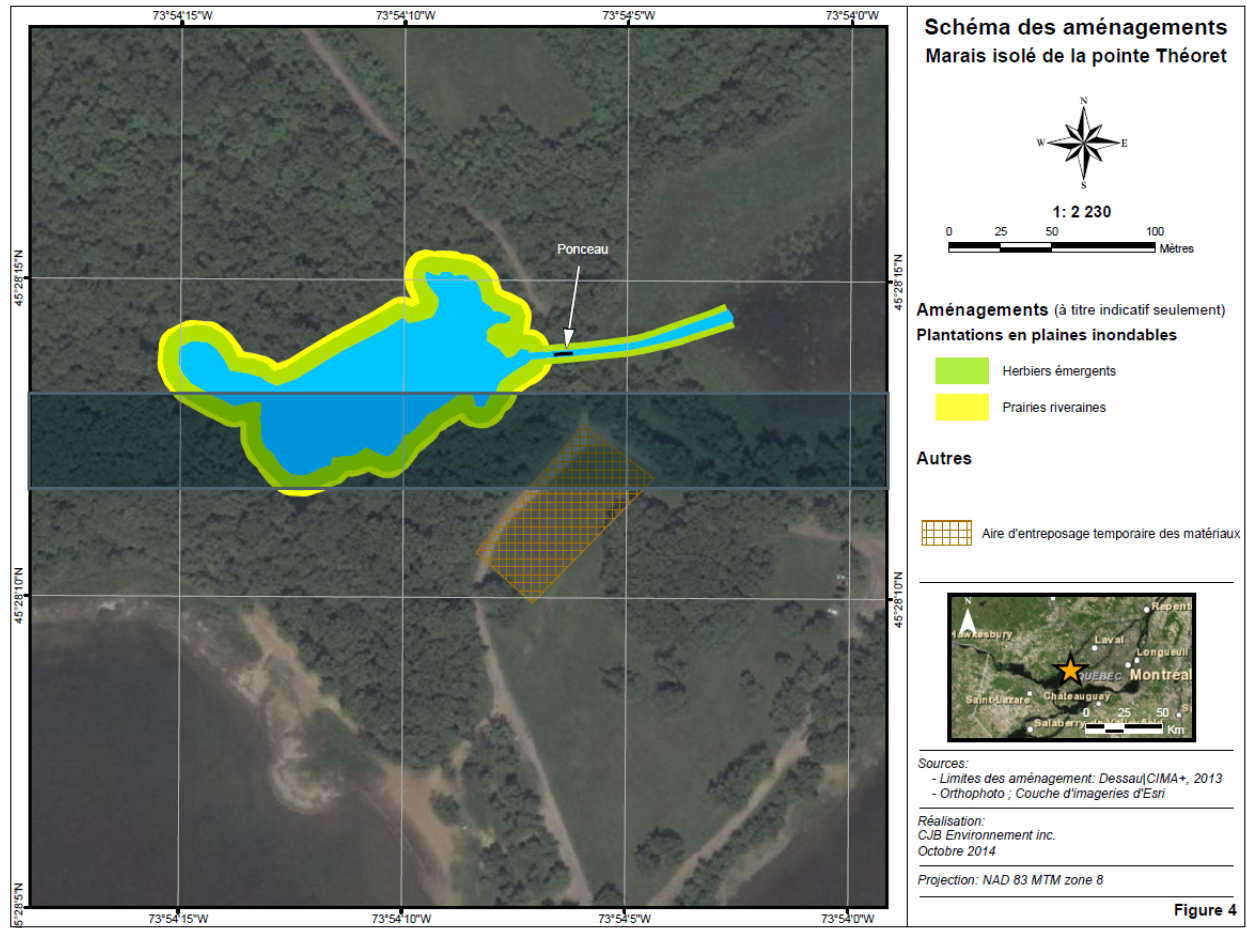


Figure 2 Diagram of the habitat enhancements – Théoret Point isolated marsh



Secondly, the land surveys carried out during the hydraulic study will also serve to determine whether excavation work needs to be carried out in the marsh itself to facilitate water flow and avoid creating pools that would trap fish.

The excavated materials will be stored temporarily on site and allowed to drain before being loaded onto trucks and then shipped to an engineered landfill authorized to receive the materials based on their physicochemical characteristics.

The soils will be managed according to the MDDELCC's management grid for excavated contaminated soils set out in the *Soil Protection and Contaminated Sites Rehabilitation Policy* and in the *Regulation respecting the burial of contaminated soils* (R.S.Q., c. Q-2, r. 6.01).

The decision as to how to manage the excavated materials in the terrestrial environment will be based on the physicochemical quality of the materials (which are classified according to three decreasing levels of quality: A, B and C) and based on the rules set out in the MDDELCC's *Soil Protection and Contaminated Sites Rehabilitation Policy*. The materials must be managed in such a way as to ensure that they do not constitute a new source of environmental contamination.

The closest authorized landfill that can receive non-contaminated soils is 60 km from the site and the closest authorized landfill that can receive contaminated soils is 65 km from the site.

2.1.3.1 Installation of a culvert under the access road

The access road to Théoret Point, which is built on a layer of fill, is the main obstacle to water flow. In order to facilitate water inflows and outflows to and from the interior marsh, some of the fill will be removed and a culvert installed. The diameter of the culvert must permit the free passage of a large volume of water, in high-water periods, and the free movement of fish.

2.1.3.2 Vegetation of the flood plains and channel banks

In the present context of fish habitat compensation, the revegetation of barren areas is very important, first, because the plant species planted will be used by fish fauna to lay their eggs, and secondly because the root system of the plants holds the substrates in place and helps to mitigate shoreline erosion. There is currently vegetation around the periphery of the interior marsh. This vegetation will be improved over a 10 m wide strip with a range of native plants (trees, shrubs and herbaceous vegetation and rooted, submerged, floating or emergent aquatic plants) and locally adapted plants based on their affinity with hydromorphic soils. Vegetation will also be planted on a 3.0 m strip on the banks of the supply channel.

The choice of plant species and density will be determined when the plans and specifications are drawn up since the tolerance of the plants is dictated by the dimensions of the supply channel.

2.1.4 Objectives

The objective of the Théoret Point compensation project is to increase the availability of spawning habitat in flood plains and wetlands over a proposed area of 1.3 ha. Currently, a certain volume of water remains trapped within the marsh in low-water periods. The dimensions of the new channel and the construction of the culvert will ensure the free passage of water to avoid trapping fish in the marsh. The land surveys carried out during the hydraulic study will also serve to determine whether excavation work needs to be carried out in the marsh itself to facilitate water flow and avoid creating pools that would trap fish.

Section 5 of Sheet 134 of the St. Lawrence Shoreline Restoration Atlas lists the eight fish species targeted by the restoration of spawning, nursery, rearing and feeding habitats. More specifically, the spawning habitats target the following species:

- Brown bullhead
- Rock bass
- Pumpkinseed
- Cyprinids (minnows) (*Cyprinids* spp.)
- Northern pike
- Black crappie
- Yellow perch

The completed habitat enhancements must be stable and able to withstand the variations in the hydraulic conditions of the Rivière des Prairies. More specifically, the chosen substrate must be conducive to spawning, but also remain in place under heavy flow conditions during high-water periods.

It should be noted that the kind of work being considered by INFC must be self-sustaining and require no further maintenance following completion of the work.

2.1.5 Description of the ecological functions restored or enhanced

The following section describes the ecological functions restored or enhanced through the work carried out as part of the Théoret Point isolated marsh project. Table 2 presents a summary of the compensation of ecological functions and also describes the socioeconomic functions that are restored or enhanced.

It should be noted that the gains for still water habitats are calculated based on a two-year return period. For this reason, work that will be affected by water levels must be carefully planned. The wetting time, emptying dynamics, profile of the modified habitats and vegetation strata are also aspects that must be considered during the project development process.

Biogeochemical cycle

The restored interior marsh will constitute a gain in terms of biogeochemical functions since its filtering capacity will be increased. Indeed, since it will be more exposed to the water level variations of the river, the marsh will capture the minerals, particles and contaminants of a larger volume of water.

Fish habitats

The clearing and widening of the supply channel constitutes the creation of a new watercourse with permanent grassbeds, thereby restoring the hydraulic connection between the Rivière des Prairies and the interior marsh which was previously isolated for fish fauna.

These modifications will be beneficial from an ecological standpoint since they will create large areas of permanent fish habitat and will improve access to existing habitats. In addition, the grassbeds will play an important role in the reproduction of phytophilous species since they constitute new spawning habitats for the development of fish larvae and juveniles.

Other wildlife habitats

The project will also restore and enhance habitat for mammals and herpetofauna as well as for avifauna and more specifically for the great blue heron (*Ardea herodias*). According to Sheet 134 of the St. Lawrence Shoreline Restoration Atlas, waterbirds and waterfowl would benefit from these improvements.

2.1.6 Monitoring program

In the course of implementation of compensation projects, an environmental monitoring program as well as a work site monitoring program will be carried out in order to ensure compliance with environmental standards during the work.

The purpose of the monitoring programs is to ensure the application and effectiveness of the mitigation measures recommended during the implementation of the work. The proponent or a person mandated by the proponent is responsible for carrying out the monitoring. In addition to verifying the application of the mitigation measures and environmental protection provisions, the person responsible for the monitoring will recommend any necessary corrective action, identify areas of non-compliance and provide advice on decision-making on environmental issues.

A worksite log is generally completed on a daily basis and all the observations are compiled in a monitoring report which is submitted to the department concerned.

Table 1 Description of the Théoret Point isolated marsh project

Théoret Point isolated marsh			
Description of the project	Location	Objectives	Description of the ecological functions restored or enhanced
<p>The compensation project includes a few simple operations intended to facilitate access to fish habitats in still water, flood plains and wetlands located in the interior marsh of Théoret Point. This work mainly involves:</p> <ul style="list-style-type: none"> • Clearing and widening the supply channel over an area of approximately 250 m². • Installing a culvert under the access road. • Restoring adequate vegetation cover around the periphery of the marsh. 	<ul style="list-style-type: none"> • To the south of Bizard Island (Montreal) within the boundaries of the Cap-Saint-Jacques Nature Park (Figure 1). • The excavation work will be carried out in the sector that separates the marsh from the Rivière des Prairies over an area of approximately 25 m by 10 m. Vegetation will be planted on a 10 m wide strip around the periphery of the interior marsh. 	<ul style="list-style-type: none"> • Increase the availability of spawning habitat in flood plains and wetlands over a proposed area of 1.3 ha. • The dimensions of the new channel and the construction of the culvert will ensure the free passage of water to avoid trapping fish in the marsh. • Stability of the habitat enhancements • Create self-sustaining habitat enhancements that require no further maintenance following completion of the work. • Target species for spawning habitat enhancement: <ul style="list-style-type: none"> • Brown bullhead • Rock bass • Pumpkinseed • Cyprinids (minnows) • Northern pike • Black crappie • Yellow perch 	<ul style="list-style-type: none"> • Improvement of the filtering capacity (biogeochemical functions) of the marsh. • Restoration of the hydraulic connection of the channel with the Rivière des Prairies. • Creation of a new watercourse with permanent grassbeds. • Creation of large areas of habitat. • Improved access to previously isolated habitats. • Creation of new spawning habitats for the development of phytophilous fish larvae and juveniles. • Restoration and improvement of habitat for avifauna (great blue heron, waterfowl, waterbirds), herpetofauna and mammals.

Table 2 Summary of compensation measures for the Théoret Point isolated marsh project

Environment type	Area lost, degraded or disturbed	Degraded ecological and socioeconomic functions	Anticipated area gained through compensation	Anticipated gains in and socioeconomic functions	Net change in area
Aquatic environments					
Still water habitat	8,150 m ²	<ul style="list-style-type: none">• Spawning of lithophilous fish species in still water	7,350 m ² (including the possibility of half in aquatic grassbeds)	<ul style="list-style-type: none">• Overall improvement in the state of existing environments• Creation of large areas of permanent fish habitat• New access to existing but previously isolated habitats• Creation of a new habitat for the development of fish larvae and juveniles• New fishing sites• Interpretation sites	Deficit of 2,600 m ² (ratio of 0.7:1)
Grassbeds	1,800 m ²	<ul style="list-style-type: none">• Spawning of phytophilous species in still water, nursery and feeding of fish		<ul style="list-style-type: none">• Creation of a new watercourse with permanent grassbeds• Creation of a new habitat for the development of fish larvae and juveniles	
Wetlands					
Emergent riparian marshes	2,000 m ²	<ul style="list-style-type: none">• Spawning of phytophilous fish species• Biochemical cycle (runoff filtration)• Wildlife habitat	5,348 m ²	<ul style="list-style-type: none">• Restoration of the hydraulic connection of the marsh with the Rivière des Prairies• Stabilization of habitat for heron• Creation of new fish spawning habitats• New access to an existing habitat• New fishing sites	Deficit of 952 m ² (ratio of 0.85:1)
Reed marshes	4,300 m ²	<ul style="list-style-type: none">• Biochemical cycle (runoff filtration)• Wildlife habitat			

2.2 DEVELOPMENT OF LAPIERRE ISLAND

Lapierre Island has been owned by the City of Montreal since 2008, but there is a conservation easement in perpetuity recorded in the name of DUC (**Figure 3**). The previous owners had planned to develop a residential project on the island, but the project never materialized. At the time, the eastern part of Lapierre Island was occupied by a riparian marsh. Between 1980 and 1983, clearing work was carried out and a large amount of fill, from Montreal Island, was deposited in the central and eastern sections of the island, filling in the marsh. The wooded portion, the western section of the island, received legal protection in 1994 under the City of Montreal master plan.

The island on the cadastre has an area of 53,245 m². However, considering the submerged parts, including the part not on the cadastre, the island is estimated to have an area of approximately 66,400 m². As noted above, the eastern section of the island was originally an interior riparian marsh, whose water level fluctuated based on the level of the Rivière des Prairies. A channel, located in the northern part of the island, allowed water inflows and outflows.

Currently, more than two thirds of the total area of the island is covered by fill, composed of brick and wood debris and chunks of concrete and asphalt, surrounded by a wooded strip. According to the Lapierre Island soil characterization report (Inspecsol, 2007), the thickness of the fill ranges from 1.5 m to 2.8 m (average depth: 2.28 m).

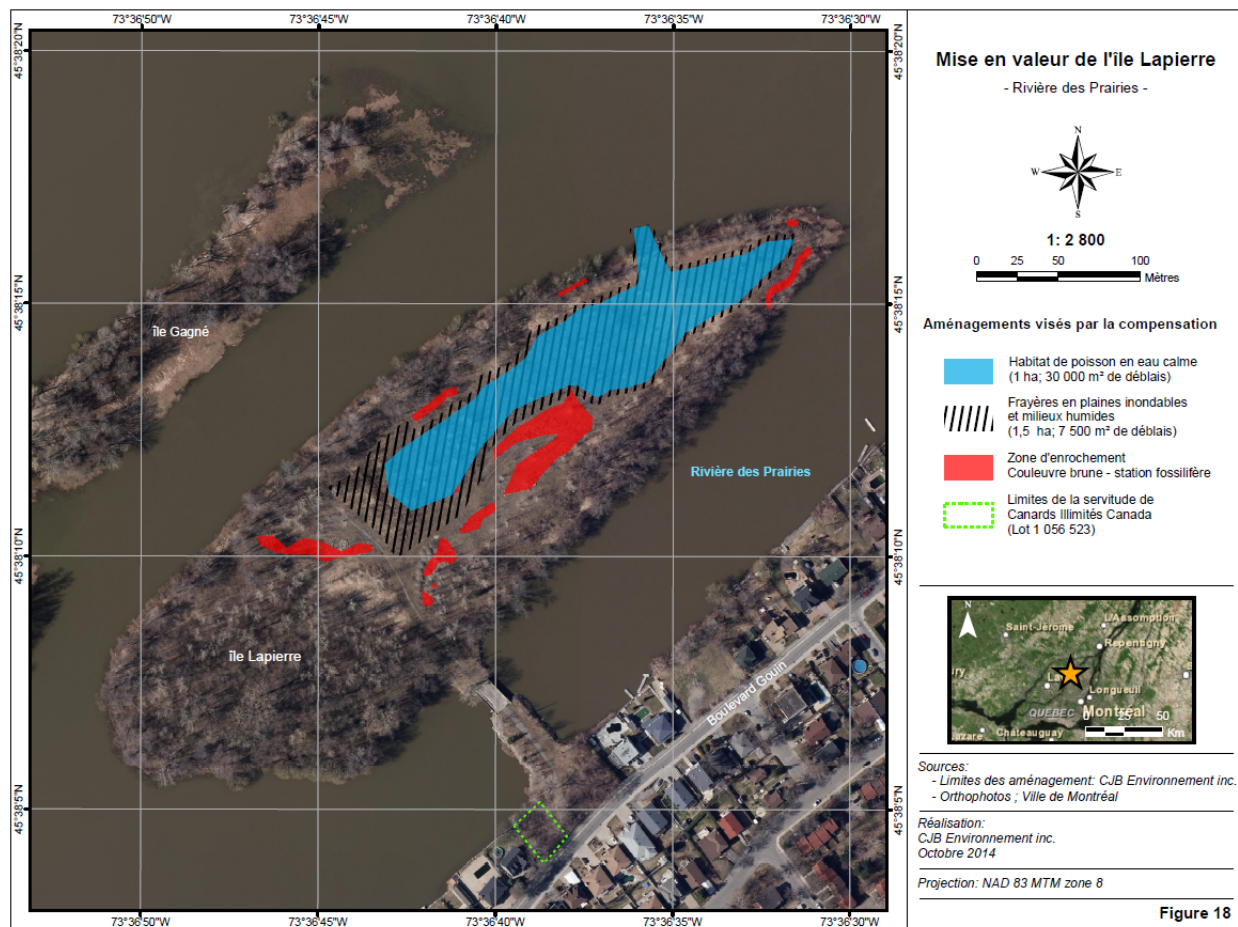
The same characterization report estimated a volume of 60 m³ of soils meeting criterion “B-C”, and 22 m³ of soils exceeding criterion “C” of the MDDELCC’s *Soil Protection and Contaminated Sites Rehabilitation Policy*. However, these volumes will have to be reconfirmed during the work, particularly since the analyses performed during the soil characterization of the fill (Inspecsol, 2007) did not include asbestos. This parameter will have to be taken into account during the soil assessment.

Lapierre Island is linked to the north shore of Montreal Island by a road bridge. Although access to the bridge is currently closed to the public, there is evidence of illegal incursions (campfire sites, discarded furniture, large volume of debris, etc.). Certain problems have been identified with the road bridge (Lyse Renaud, personal communication) which will have to be corrected before trucks start using the bridge, so that the structure is able to support the repeated passage of dump trucks.

The work currently required to ensure the stability of the structure, includes, but is not limited to, the following:

- Remedial work on the fill is necessary over the entire width of the bridge under the concrete slope protection.
- Remedial work on the fill is necessary at the approaches.
- Stabilization of the fill is required near the bridge abutments.
- The openings in the backwall must be sealed off to prevent any potential loss of fill.
- Concrete New Jersey barriers must be installed in order to delimit the traffic lane to a width of 5 metres, approximately in the middle of the bridge (specific location to be determined).

Figure 3 Development of Lapierre Island



The deficiencies will be identified by means of a joint inspection (INFC and City of Montreal), and an inspection plan will have to be drawn up based on the volume of truck traffic on the bridge.

Even after refurbishment work is completed, some traffic restrictions will have to be applied for safety reasons, such as: the use of only one lane in the middle of the bridge, the passage of only one truck at a time, ban on overloaded trucks, speed on the bridge will be restricted to 20 km/h.

In the event that the compensation work is carried out in winter, the spreading of salt on the bridge will be prohibited. Only the use of sand will be authorized.

2.2.1 Location

Lapierre Island lies to the north of Montreal Island in the Rivière des Prairies, in the Borough of Rivière-des-Prairies-Pointe-aux-Trembles. It is located approximately 200 m downstream of the Olivier-Charbonneau Bridge. The habitat enhancement work will be carried out in the central and eastern sections of the island.

2.2.2 Description of the project

The Lapierre Island compensation project is being developed jointly with INFC, the City of Montreal and DUC. This project involves the compensation of fish habitat in still water and wetlands.

The planned habitat enhancements require carrying out various types of work at the site, including the removal of a large volume of fill, which will restore the original interior marsh and possibly expand it by extending it into the central part of the island. The ecological functions targeted by the restoration of this marsh are:

- the creation of still water fish habitats (including increasing the area of spawning habitats in the flood plain); and
- the creation of the wetlands area.

These improvements will result in increased availability of still water fish habitats, as well as an increase in the area of spawning habitats in the flood plain and in the area of wetlands.

The Lapierre Island compensation project comprises three main phases:

- Removal of approximately 37,500 m³ of fill to restore the former marsh as well as construct a supply channel which will permit water inflows and outflows. This site is currently occupied by fill in the terrestrial environment.
- Reprofiling of the marsh and the channel so that permanent habitats and specifically spawning habitats can be created. The choice of substrate must be able to withstand the sector's hydraulic conditions.
- Planting of vegetation on the banks and the flood plains with species locally adapted to emergent and submerged areas.

Sections 2.2.2.1 to 2.2.2.3 describe in detail each of these phases. The work methods described to carry out the planned habitat enhancements must be considered as one possible option for project implementation. In our planning process, they were used to estimate project costs. The work methods will be developed further at the plans and specifications stage and must be approved by the federal organizations.

In addition to the compensation project presented here, which deals exclusively with environmental aspects, the overall approach to the revitalization of Lapierre Island also includes a recreational and educational component. In fact, the City of Montreal's development plan for Lapierre Island (Ville de Montréal, 2013) includes the following amenities:

- The construction of non-invasive hiking trails and a fossil interpretation station around the edge of the marsh, in order to highlight the natural environment.
- The conservation and protection of brown snake (*Storeria dekayi*) hibernation sites.
- The construction of a sunbathing site for the map turtle located on the south shore of the island, near the west pier of the bridge providing access to the island.
- The construction of a family relaxation and picnic area.
- The construction of a bird observatory.
- The construction of a fishing platform.

No buildings are currently present on or proposed for the island.

It should be noted that the amenities listed above are not part of this compensation project; however, they will be considered in order to guide the actions carried out under this project and to ensure that there is no conflict between the city's plans and this project.

It should also be noted that the objective of the City of Montreal is to consolidate the Lapierre Island development project with the facilities of the Ruisseau-De Montigny Nature Park. A visitor information centre will be built on Gouin Boulevard, approximately 800 m from the island, to provide visitor information and create a link with the Ruisseau-De Montigny Nature Park. A pathway on Gouin Boulevard will allow pedestrians, cyclists and public transit users to easily reach Lapierre Island.

Based on the aerial photographs of 1964, the City of Montreal and DUC estimated the area of fill within the boundaries of the original marsh at 1.42 ha and the fill in the terrestrial environment at 1.43 ha (**Figure 4**). However, although the objective of the compensation project is to restore the original marsh, the entire area of the marsh will not be used here.

In fact, work along the banks and in the riparian buffer strip (which was created after the fill was deposited) should be avoided in order to maintain the new ecological features that have developed in this area (planting of vegetation to prevent erosion, presence of mature trees, etc.). Part of the fill along the periphery of the island will therefore be left in place.

Based on the observations made during a site visit on July 24, 2014, and also considering the additional modifications planned as part of the city's development plan for Lapierre Island (Ville de Montréal, 2013) (e.g. fossil interpretation station, hiking trails, presence of mature trees), the habitat enhancements will occupy an area of 15,000 m² (1.50 ha) in the flood plain and wetlands as well as 10,000 m² (1.0 ha) in aquatic environments for still water fish habitat (which is included in the 1.50 ha) (**Erreur ! Source du renvoi introuvable.**). This recommendation entails expanding the original marsh as well as encroaching on an area heavily used by the brown snake.

Figure 4 Removal and modification of fill on Lapierre Island



Very specific management measures will therefore have to taken, such as the preservation of the boulder piles which serve as hibernation sites for the brown snake (Figure 3) and the creation of new ones.

The area of still water habitat is included in the area of wetlands. Approximately half (0.5 ha) of the area of the still water habitat would be a grassbed.

Table 3 Area currently occupied by fill and proposed habitat enhancements

	Area currently occupied by fill (hectares)	Area of planned habitat enhancements (hectares)
Terrestrial environment	1.42	-
Wetland (marsh)	1.43	1.50
Aquatic environment	-	1.00*

* Included in the wetland area

The habitat enhancements will be designed to allow the water level of the marsh to fall in summer, so that the aquatic portion evolves toward a wetland, preventing fish from being trapped in the marsh.

Table 5 presents a description of the project.

2.2.2.1 Excavation of the fill material

Assuming that there is on average 2.28 m of fill (InspecSol, 2007) on top of the natural ground level, an average depth of excavation of 1.5 m was estimated for the flood plains and the wetlands, while an average depth of excavation of 3.0 m was estimated for the aquatic environments. The planned work at this site as a whole will encompass a total area of 1.50 ha and the excavation of 37,500 m³ of materials. Of this volume, 30,000 m³ of fill will be removed for the creation of fish habitats in still water and 7,500 m³ in order to create flood plains and wetlands.

A supply channel will be dug in the northeast sector to create a link between the new marsh and the Rivière des Prairies. It should be noted that this channel, with an area of 560 m², would require the excavation of approximately 1,100 m³ of material. This volume is already included in the previous volumes since it serves as a hydrological link for the project. However, these volumes must be re-evaluated following the hydraulic study based on the optimal conditions desired for the channel (slopes, angles, depth, width, etc.).

According to the plans and specifications, the fill will be removed using excavators. The excavated materials will be stored temporarily on site and allowed to drain before being loaded onto trucks and then shipped to an engineered landfill authorized to receive the materials based on their physicochemical characteristics. The soils will be managed according to the MDDELCC's management grid for excavated contaminated soils set out in the *Soil Protection and Contaminated Sites Rehabilitation Policy* and in the *Regulation respecting the burial of contaminated soils* (R.S.Q., c. Q-2, r. 6.01). The decision as to how to manage the excavated materials in the terrestrial environment will be based on the physicochemical quality of the materials (which are classified according to three decreasing levels of quality: A, B and C) and based on the rules set out in the MDDELCC's *Soil Protection and Contaminated Sites Rehabilitation Policy*. The materials must be managed in such a way as to ensure that they do not constitute a new source of environmental contamination.

Non-contaminated residual fill material could be re-used during various work connected with the NBSL if the material is compatible from a geotechnical standpoint. Contaminated soils, meeting criterion "B-C" and exceeding criterion "C", will be managed offsite in accordance with the provisions of the MDDELCC management grid and of the *Soil Protection and Contaminated Sites Rehabilitation Policy*. The closest engineered landfill that can receive these non-contaminated soils is 20 km from the site and the closest authorized landfill that can receive contaminated soils is 30 km from the site.

Table 4 provides an estimate of the volumes of soils which must be excavated. These volumes are distributed based on the MDDELCC generic criteria for soils.

The other materials (construction debris, wood, concrete, etc.) will be shipped to landfill sites authorized by the MDDELCC, depending on the nature of the materials.

Table 4 Estimates of the volumes of soil to be excavated based on the MDDELCC generic criteria for soils

Estimates of the volumes of soil to be excavated (m ³)			
<A and A-B	B-C	> C	Total
37,418	60	22	37,500

2.2.2.2 Profiling of the marsh, flood plains and channel

In order to attain the objectives and thereby create permanent spawning habitats and wetlands, the profile of the marsh and of the supply channel must meet a series of criteria (depth, slopes, substrate, etc.) which will be determined by a hydraulic study based on data for the last 20 years, targeting a minimum flood of at least 80% of the area of the flood plains, four years out of five. This recommendation may be modified depending on the requirements of the analysts of the government entities concerned by the project. The profiling work will be carried out using machinery.

The flood plains, which will be designed with a shallow depth, will serve as buffer areas intended to receive the surplus water during floods. They may also be used by several fish species as spawning and nursery habitats in late spring and early summer. A suitable substrate (type, quantity, particle size distribution) will also be laid down in order to withstand the variations in current and to meet the spawning requirements of the targeted fish species.

The habitat enhancements must be designed so that fish are not trapped in the marsh during low-water periods (slope and depth of the marsh, dimensions of the access). The depth of the site must also prevent its colonization by invasive plant species. Work on the banks, highly fragile habitats, must be minimized insofar as possible in order to help keep the substrate in place and preserve the forest buffer around the periphery of the island composed mainly of silver maple stands and a white willow stand.

The location of the access channel was determined based on the low tree density in this sector as well as the presence of common reeds (*Phragmites australis*), which may be removed during the work. Particular precautions must therefore be applied in order to prevent any propagation of invasive species (common reed, purple loosestrife (*Lythrum salicaria*), European buckthorn (*Rhamnus cathartica*), reed phalaris (*Phalaris arundinacea*), flowering rush (*Butomus umbellatus*), Japanese knotweed (*Fallopia japonica* var. *japonica*), etc.).

It should be noted that hydraulic and geomorphological studies will be required in order to determine the most appropriate position of the opening of the bay on the Rivière des Prairies. It will be necessary to ensure that the linking channel is not affected by sedimentation, which would obstruct it after a certain number of years.

2.2.2.3 Vegetation of the banks and flood plains

In the present context of fish habitat compensation, the vegetation of the areas is very important, first, because the plant species planted will be used by fish fauna to lay their eggs, and secondly because the root system of the plants holds the substrates in place and helps to mitigate shoreline erosion. A wide range of native plants (trees, shrubs and herbaceous vegetation and rooted,

submerged, floating or emergent aquatic plants) and locally adapted plants will be planted along the banks based on their tolerance and their affinity with the aquatic environment.

Permanent submerged and emergent grassbeds will be established in aquatic environments, while the plant cover in the new wetlands will be mainly herbaceous and shrub (Figure 5). The choice of plant species and density will be determined when the plans and specifications are drawn up since the tolerance of the plants is dictated by the dimensions of the marsh and the channel.

2.2.3 Objectives

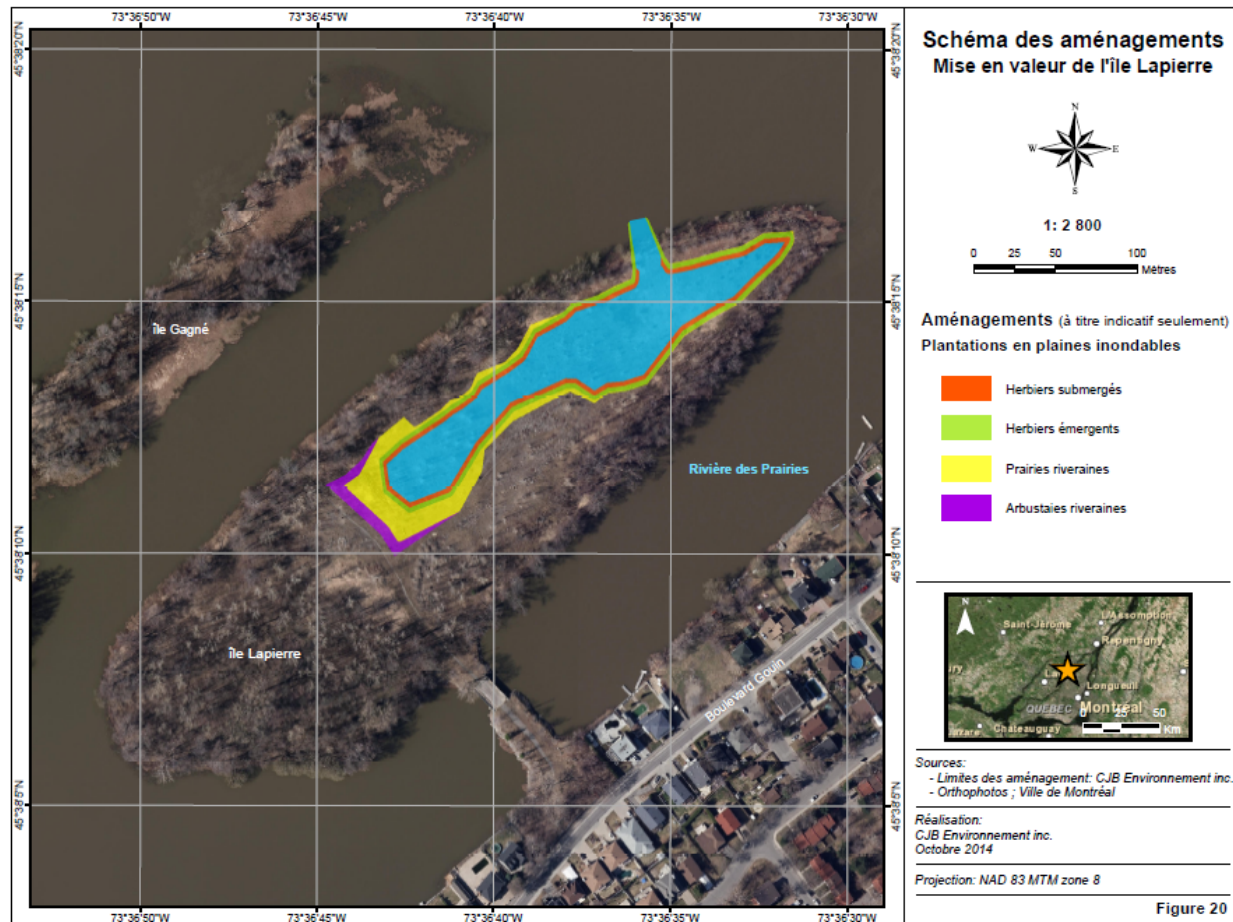
The objective of the Lapierre Island compensation project is to increase the availability of spawning habitat in flood plains and wetlands over a proposed area of 1.5 ha. The free passage of water must therefore be assured at all times to avoid trapping fish.

It should be noted that the kind of work being considered by INFC must be self-sustaining and require no further maintenance following completion of the work.

More specifically, the spawning habitats are targeted at the following species:

- Brown bullhead (*Ameiurus nebulosus*)
- Channel catfish (*Ictalurus punctatus*)
- Rock bass (*Ambloplites rupestris*)
- Pumpkinseed (*Lepomis gibbosus*)
- Northern pike (*Esox lucius*)
- Black crappie (*Pomoxis nigromaculatus*)
- Yellow perch (*Perca flavescens*)

Figure 5 Diagram of the planned work – Removal of fill on Lapierre Island



The completed habitat enhancements must be stable and able to withstand the variations in the hydraulic conditions of the Rivière des Prairies. More specifically, the chosen substrate must be conducive to spawning, but also remain in place under heavy flow conditions during high-water periods.

2.2.4 Description of the ecological functions restored or enhanced

The following section describes the ecological functions restored or enhanced through the work carried out as part of the Development of Lapierre Island Project. Table 6 provides a summary of the compensation of the ecological functions and also describes the socioeconomic functions that are restored or enhanced.

It should be noted that the gains for still water habitats are calculated based on a two-year return period. For this reason, work that will be affected by water levels must be carefully planned. The wetting time, emptying dynamics, profile of the modified habitats and vegetation strata are also aspects that must be considered during the project development process.

Biogeochemical cycle

The restored wetlands (banks and flood plains) will constitute a gain in terms of biogeochemical functions since their filtering capacity will be increased. Indeed, since the large areas of these

wetlands will be exposed to the variations in the water level of the river, they will be better able to filter minerals, particles and contaminants.

Fish habitats

The planned restoration of the hydraulic connection of the channel with the Rivière des Prairies will create a new watercourse with permanent grassbeds. These modifications will be beneficial from an ecological standpoint since they will create permanent fish habitats. In addition, the grassbeds will play an important role in the reproduction of phytophilous species since they will constitute new spawning habitats and habitats for the development of fish larvae and juveniles.

Other wildlife habitats

The project will also restore and enhance habitat for mammals, particularly for muskrat (*Ondatra zibethicus*) and herpetofauna including the brown snake (*Storeria dekayi*) and amphibians. Waterbirds and landbirds as well as waterfowl may also benefit from the new facilities during the nesting and migration periods.

Special status species

The existing areas of fill appear to offer good hibernation sites, particularly for a population of brown snakes. This species is considered likely to be designated threatened or vulnerable under the Quebec *Act respecting threatened or vulnerable species* (LEMV). The site visit made it possible to identify the sectors most conducive to these habitats (**Figure 3**). The location of the compensation project takes this reality into account by minimizing the impacts on the best habitats. Lost or disturbed habitats must be compensated by the establishment of hibernation sites elsewhere on the island. The principles of the management plan for the brown snake, drafted in the context of the NBSL project, must be respected.

In addition, particular attention must be paid to the following species (Ville de Montréal, 2013):

- Red-headed woodpecker (*Melanerpes erythrocephalus*) (threatened according to Schedule 1 of the *Species at Risk Act* (SARA) as well as according to the LEMV)
- Green dragon (*Arisaema dracontium*) (special concern according to Schedule 1 of SARA and special concern according to the LEMV)
- Branched bur-reed (*Sparganium angrocladum*) (likely to be designated threatened or vulnerable according to the LEMV)
- Large-flowered bellwort (*Uvularia grandiflora*) (species vulnerable to harvest according to the LEMV).

With respect to the plant component, a characterization of the stands carried out by Groupe Hemisphères (2013) highlighted the diversity of habitats on the island, dominated by silver maple stands on floodplains, an eastern cottonwood stand as well as old fields colonized by eastern cottonwood. The rest of the island is occupied by an eastern cottonwood stand (centre-west of the island), old fields and fields (centre-east of the island).

Invasive plants

Removal of the fill will eliminate invasive plants already established. This step is very important and must be carried out with caution in order to prevent any subsequent re-establishment of invasive plants. In fact, all possible measures must be taken in order to eradicate even the smallest parts of these plants since they have high regeneration capacity.

As mentioned in section 0, the location of the access channel was determined based on the low tree density in this sector, but also owing to the presence of common reeds. The excavation work will result in the elimination of the colony of common reeds in this sector. However, it will be important that precautions be applied in order to prevent any propagation of the plants of this invasive species, as well as of its seeds and their germination. In August, the stem of the reed produces more than 300 seeds. These seeds will be dispersed by the wind until the following spring, particularly since the stems remain erect above the snow cover in winter. A seed can therefore travel up to 10 km, propagating new colonies. For example, the following are some examples of measures that could be applied:

- Conduct an annual survey to detect the presence of this species.
- Specifically identify its location.
- Eradicate the colonies identified by means of complete excavation, making sure to eliminate their entire root system on the work site.
- Appropriately manage the excavated materials, since they may contain plant fragments.
- Thoroughly clean the machinery used in order to prevent propagation to other construction sites.
- Plant vegetation, if possible, on exposed soil.
- Monitor for any regrowth and treat with a registered herbicide, where regulations permit.

With respect to the other invasive species (purple loosestrife, European buckthorn, reed phalaris, flowering rush, Japanese knotweed, etc.), monitoring must also be carried out to prevent their propagation in the sector. The measures outlined above are also useful for preventing the proliferation of these species and limiting their spread.

2.2.5 Monitoring program

In the course of implementation of compensation projects, an environmental monitoring program as well as a work site monitoring program will be carried out in order to ensure compliance with environmental standards during the work.

The purpose of the monitoring programs is to ensure the application and effectiveness of the mitigation measures recommended during the implementation of the work. The proponent or a person mandated by the proponent is responsible for carrying out the monitoring. In addition to verifying the application of the mitigation measures and environmental protection provisions, the person responsible for the monitoring will recommend any necessary corrective action, identify areas of non-compliance and provide advice on decision-making on environmental issues.

A worksite log is generally completed on a daily basis and all the observations are compiled in a monitoring report which is submitted to the department concerned.

Table 5 Description of the Development of Lapierre Island Project

Development of Lapierre Island			
Description of the project	Location	Objectives	Description of the ecological functions restored or enhanced
<ul style="list-style-type: none"> • Carry out the refurbishment work on the access bridge to Lapierre Island. • Restore the marsh in order to create fish habitats in still water (1.0 ha) and increase the area of flood plains and wetlands (1.5 ha). • Remove approximately 37,500m³ of fill to recreate the former marsh and a supply channel. • Profile the marsh, the flood plains and a channel so as to create spawning habitats. Choose a substrate that will withstand the hydraulic conditions of the sector. • Plant vegetation in the marsh and the flood plains with species locally adapted to emergent and submerged areas. • The habitat enhancements also have a recreational and educational dimension, as mentioned in the Development of Lapierre Island plan (Ville de Montréal, 2012). 	<ul style="list-style-type: none"> • Lapierre Island is located to the north of Montreal Island in the Rivière des Prairies, in the Borough of Rivière des Prairies-Pointe-aux-Trembles. The island is located approximately 200 m downstream of the Olivier-Charbonneau Bridge. • The work will take place in the central and eastern portion of the island (Figure 5). 	<ul style="list-style-type: none"> • Increase the availability of aquatic habitats over a proposed area of 1.0 ha. • Increase the availability of spawning habitat in flood plains and wetlands over a proposed area of 1.5 ha. • Ensure the free circulation of water at all times to avoid trapping fish in the marsh. • Prevent the establishment and propagation of invasive plants. • Create self-sustaining habitat enhancements that require no further maintenance following completion of the work. • Target species for spawning habitat enhancement: <ul style="list-style-type: none"> • Brown bullhead • Cyprinids (minnows) • Rock bass • Pumpkinseed • Northern pike • Black crappie • Yellow perch • Stability of the habitat enhancements. 	<ul style="list-style-type: none"> • Partial restoration of the island's natural habitats. • Improvement of the filtering capacity (biogeochemical functions) of the marsh. • Restoration of the hydraulic connection of the channel with the Rivière des Prairies. • Creation of a new watercourse with permanent grassbeds. • Creation of permanent fish habitats • Creation of new spawning habitats and habitats for the development of phytophilous fish larvae and juveniles. • Conservation and protection of brown snake wintering habitats. • Restoration and improvement of habitat for avifauna, herpetofauna (brown snake and amphibians) and mammals (muskrat). • Removal of established invasive plants and reduction of the establishment of new colonies.

Table 6 Summary of the compensation measures of the Development of Lapierre Island Project

Environment type	Area lost, degraded or disturbed	Degraded ecological and socioeconomic functions	Anticipated area gained through compensation	Anticipated gains in and socioeconomic functions	Net change in area
Aquatic environments					
Still water habitat	8,150 m²	<ul style="list-style-type: none">• Spawning of lithophilous fish species in still water.	10,000 m² (including the possibility of half in aquatic grassbeds)	<ul style="list-style-type: none">• Partial restoration of the island's natural habitats.• Creation of permanent fish habitats.• Improved access to existing habitats.• Creation of a new habitat for the development of fish larvae and juveniles.• New fishing sites.• Interpretation sites.	Approximate gain of 50 m² (1:1 ratio)
Grassbeds	1,800 m²	<ul style="list-style-type: none">• Spawning of phytophilous species in still water, nursery and feeding of fish.		<ul style="list-style-type: none">• Creation of a new watercourse with permanent grassbeds.• Creation of a new habitat for the development of fish larvae and juveniles.	
Wetlands					
Emergent riparian marshes	2,000 m²	<ul style="list-style-type: none">• Spawning of phytophilous fish species.• Biochemical cycle (runoff filtration).• Wildlife habitat.	15,000 m²	<ul style="list-style-type: none">• Restoration of the hydraulic connection of the marsh with the St. Lawrence River.• Creation of new spawning habitats.• Improved access to existing habitats.• Control of invasive species.• Restoration and improvement of habitat for avifauna, herpetofauna, aquatic mammals and small wildlife species.	Gain of 8,700 m² (ratio of 2.4:1)
Reed marshes	4,300 m²	<ul style="list-style-type: none">• Biochemical cycle (runoff filtration).• Wildlife habitat.			

3. ADDITIONAL STUDIES REQUIRED FOR THE DEVELOPMENT OF THE PLANS AND SPECIFICATIONS

Carrying out these studies will generate information essential to the development of the plans and specifications. For each project, the studies deemed essential were evaluated and a justification provided for their choice. In addition, the objectives to be attained were detailed, as well as the data that must be collected to attain those objectives. The various methods that will be proposed to attain these objectives were described briefly.

The additional studies for each compensation project are compiled in a table which is presented in Appendix 1. This table presents the objectives, the method or methods used to attain the objectives and the estimated cost of each study.

Description	Théoret Point isolated marsh	Development of Lapierre Island
Hydraulic study and bathymetric surveys	♦	♦
Biological and habitat characterization	♦	♦
Analysis of archeological potential and archeological study	♦	
Phase I environmental site assessment	♦	
Phase II environmental site assessment (depending on the results of Phase I)	♦	♦
Federal, provincial and municipal authorizations, including the C.A. application.	♦	♦

4. DEVELOPMENT OF THE MONITORING AND FOLLOW-UP PROGRAMS

The elements necessary for the implementation of a monitoring and follow-up program on the effectiveness of the habitat enhancements are presented in this section. This information is adapted for each project. Therefore, the parameters to be measured, the duration of the monitoring and follow-up, the frequency of the visits and the justification for these elements will also be specified.

It should be noted that the nature, duration and frequency of the monitoring and follow-up measures specified in this study were chosen for the purpose of estimating costs. They will be reviewed and refined in a subsequent phase by the competent organizations in relation with the objectives of the compensation project and in light of the issues and risks associated with the compensation project.

Hence, for the purposes of this study, all the projects will be subject to a monitoring and follow-up program for three years, spread over a five-year period, or longer, if the project represents a higher risk. Depending on the project, there could be six visits during a five-year period. This frequency will be reviewed in a subsequent phase and it is possible that it may be modified based on the recommendations of the various departments concerned.

Additional amounts must be reserved in the total budget in the event that, after the initial follow-up, additional corrective action proves necessary to ensure the effectiveness of the compensation project.

4.1 THÉORET POINT ISOLATED MARSH

4.1.1 Parameters to be measured

In order to verify the attainment of the objectives of the compensation project, the following habitat enhancements will be evaluated during the spring high-water period and in the low-water period for:

1. Wetlands

- ▶ Stabilization of the restoration of the hydraulic connection of the marsh with the Rivière des Prairies.
 - Observation of areas of erosion or sediment accumulation using photography and an underwater camera, if necessary.
- ▶ Creation of new spawning habitats.
 - Fisheries (note the fishing gear used, species caught, area sampled, count, total length, etc.).
- ▶ Improved access to existing habitats.
 - Verify the condition of the culverts under the access road to the island.

- ▶ Control of invasive species.
 - Direct observation on the site.
- ▶ Restoration and improvement of habitat for avifauna, herpetofauna, aquatic mammals and small wildlife species.
 - Multi-species inventories.

2. Aquatic environments

- ▶ Stabilization of the restoration of the hydraulic connection of the marsh with the St. Lawrence River.
 - Observation of areas of erosion or sediment accumulation using photography and an underwater camera, if necessary.
- ▶ Creation of new permanent habitats and improved access to existing habitats.
 - Direct observation of spawning habitats, feeding sites, migration routes, shelters and nursery areas.
 - Fisheries (note the fishing gear used, species caught, area sampled, count, total length, etc.).
- ▶ Installation of culverts.
 - Verify the condition of the culverts under the access road to the island.
- ▶ Creation of new fishing sites.
 - Compilation of data on fishing success at the site.
- ▶ Creation of a new watercourse with permanent grassbeds.
 - Biophysical characterization of the grassbeds (substrate, condition of the vegetation, herbaceous, shrub and tree species planted, density of the vegetation cover, length and width of the grassbed, etc.) and direct observation of fry instead of characterization. The use of photography and of an underwater camera will be necessary.

4.1.2 Monitoring periods and frequency

For example, for calculation purposes, monitoring and follow-up of the effectiveness of the compensatory habitat enhancement could be carried out, in the high-water and low-water period (two visits/year), three times over a five-year period after the date of completion of the work, i.e. in years 1, 3 and 5, in order to validate attainment of the planned objectives for the aquatic and wetland environments. Therefore, six visits will be required in total. This frequency will be reviewed in a subsequent phase and may be modified based on the recommendations of the various departments concerned.

4.1.3 Projected costs

A bi-annual monitoring and follow-up program would cost approximately \$23,000. If monitoring is carried out for three years (first, third and fifth year), the total cost of the program, including an inflation rate of 2% a year, would be \$72,000. The details of the cost estimate are provided in the table below.

Table 7 Cost estimate of the annual monitoring program for the Théoret Point isolated marsh project spread over five years

Description	Amounts (\$)
Monitoring of habitat enhancements – year 1: Planning and application for SEG permit <ul style="list-style-type: none">- Field visit 1: observation points and various surveys of wetland and aquatic environments- Field visit 2: observation points and various surveys of wetland and aquatic environments Data entry + progress report	23,000
Monitoring of habitat enhancements – year 3: Planning and application for SEG permit <ul style="list-style-type: none">- Field visit 1: observation points and various surveys of wetland and aquatic environments- Field visit 2: observation points and various surveys of wetland and aquatic environments Data entry + progress report	24,000
Monitoring of habitat enhancements – year 5: Planning and application for SEG permit <ul style="list-style-type: none">- Field visit 1: observation points and various surveys of wetland and aquatic environments- Field visit 2: observation points and various surveys of wetland and aquatic environments Data entry + progress report	25,000
Total (\$)	72,000

A field visit is equivalent to one 40-hour week for two persons, i.e. 80 hours/field visit.

4.2 DEVELOPMENT OF LAPIERRE ISLAND

4.2.1 Parameters to be measured

In order to verify attainment of the objectives of the compensation project, the following habitat enhancements will be evaluated in the spring high-water period and in the low-water period for:

1. Wetlands

- Stability of the restoration of the hydraulic connection of the marsh with the Rivière des Prairies.

- Observation of areas of erosion or sediment accumulation using photography and an underwater camera, if necessary.
- ▶ Creation of new spawning habitats.
 - Fisheries (note the fishing gear used, species caught, area sampled, count, total length, etc.).
- ▶ Improved access to existing habitats.
 - Verify the condition of the culverts under the access road to the island.
- ▶ Control of invasive species.
 - Inventory of invasive species on the site.
- ▶ Restoration and improvement of habitat for avifauna, herpetofauna, aquatic mammals and small wildlife species.
 - Incidental observations.
 - Multi-species inventories.

2. Aquatic environments

- ▶ Stabilization of the restoration of the hydraulic connection of the marsh with the Rivière des Prairies.
 - Observation of areas of erosion or sediment accumulation using photography and an underwater camera, if necessary.
- ▶ Creation of new permanent habitats and new access to existing habitats.
 - Direct observation of spawning habitats, feeding sites, migration routes, shelters and nursery areas.
 - Fisheries (note the fishing gear used, species caught, area sampled, count, total length, etc.).
- ▶ Creation of a new watercourse with permanent grassbeds.
 - Biophysical characterization of the grassbeds (substrate, condition of the vegetation, herbaceous, shrub and tree species planted, density of the vegetation cover, length and width of the grassbed, etc.) and direct observation of fry instead of characterization. The use of photography and of an underwater camera will be necessary.
- ▶ Creation of new fishing sites.
 - Compilation of data on fishing success at the site.

4.2.1.1 Monitoring periods and frequency

For example, for calculation purposes, monitoring of the effectiveness of the compensatory habitat enhancement could be carried out, in the high-water and low-water period, three times over a five-year period, in years 1, 3 and 5, after the date of completion of the work, in order to validate attainment of the planned objectives for the aquatic and wetland environments. Therefore, six visits will be required in total. This frequency will be reviewed in a subsequent phase and may be modified based on the recommendations of the various departments concerned.

4.2.1.2 Projected costs

A bi-annual monitoring and follow-up program costs approximately \$23,000. If monitoring is carried out for three years (first, third and fifth year), the total cost of the program, including an inflation rate of 2% a year, would be \$72,000. The details of the cost estimate are provided in the table below.

Table 8 Cost estimate of the annual monitoring program for the Development of Lapierre Island Project spread over five years

Description	Amounts (\$)
Monitoring of habitat enhancements – year 1: <ul style="list-style-type: none">- Planning and application for SEG permit<ul style="list-style-type: none">o Field visit 1: observation points and various surveys of wetland and aquatic environmentso Field visit 2: observation points and various surveys of wetland and aquatic environments- Data entry + progress report	23,000
Monitoring of habitat enhancements – year 3: <ul style="list-style-type: none">- Planning and application for SEG permit<ul style="list-style-type: none">o Field visit 1: observation points and various surveys of wetland and aquatic environmentso Field visit 2: observation points and various surveys of wetland and aquatic environments- Data entry + progress report	24,000
Monitoring of habitat enhancements – year 5: <ul style="list-style-type: none">- Planning and application for SEG permit<ul style="list-style-type: none">o Field visit 1: observation points and various surveys of wetland and aquatic environmentso Field visit 2: observation points and various surveys of wetland and aquatic environments- Data entry + progress report	25,000
Total (\$)	72,000

A field visit is equivalent to one 40-hour week for two persons, i.e. 80 hours/field visit.

5. ESTIMATE OF THE TOTAL IMPLEMENTATION COSTS OF THE PROJECTS AND SUB-PROJECTS

The implementation costs of each project were estimated on the basis of information available in previous reports or on the basis of information obtained from municipalities, departments and organizations involved in environmental protection.

The cost of each project includes the cost of the additional studies identified in section 3 and the estimated cost for the implementation of the proposed monitoring and follow-up program detailed in section 4.

Tables 14 to 29 provide the cost breakdown based on the various activities, for each project and sub-project.

Table 9 Cost breakdown for the Théoret Point isolated marsh project, including the additional studies, the monitoring of the work and the follow-up program

Description	Amounts (\$)	
	Minimum	Maximum
Additional studies		
Hydraulic study and bathymetric surveys	\$20,000	\$30,000
Biological and habitat characterization	\$23,000	\$25,000
Analysis of archeological potential and archeological study	\$6,000	\$10,000
Phase I environmental site assessment	\$2,000	\$2,000
Phase II environmental site assessment (depending on the results of Phase I)	\$8,000	\$8,000
Permits and authorizations		
Federal, provincial and municipal authorizations, including the C.A. application.	\$11,000	\$17,000
Habitat enhancement work		
Plans and specifications	\$20,000	\$30,000
Modification of the bed of the supply channel	\$20,000	\$20,000
Planting of native species	\$3,000	\$5,000
Culvert under the road	\$102,000	\$102,000
Environmental monitoring program	\$5,000	\$5,000
Work site monitoring program	\$10,000	\$12,000
Follow-up program		
Year 1	\$23,000	\$23,000
Year 2	\$24,000	\$24,000
Year 3	\$25,000	\$25,000
Total (\$)	\$302,000	\$338,000

A request for a cost estimate was sent to a firm for implementation of the hydraulic study.

Table 10 Cost breakdown – Hydraulic study and bathymetric surveys – Théoret Point

Description	Amounts (\$)	
	Minimum	Maximum
Hydraulic study <ul style="list-style-type: none"> - Project management - Collection of historical data - Evaluation of current hydraulic conditions - Development of a one-dimensional hydraulic model and calculations - Technical report 	20,000	30,000
Total (\$)	20,000	30,000

The costs related to this study are based on the experience of CJB Environnement inc.

Table 11 Cost breakdown - Biological characterization of the planned work areas - Théoret Point

Description	Amounts (\$) 2 visits* 2 biologists	Amounts (\$) 3 visits 2 biologists
Preliminary analysis and characterization of the sites	2,000	2,000
Studies <ul style="list-style-type: none"> - Planning and application for SEG permit - Land surveys: - Wildlife - Plant - Aquatic surveys: - Wildlife - Plant - Data entry and reports 	21,000	23,000
Total (\$)	23,000	25,000

* The MDDELCC (MDDEP, 2012) suggests a minimum of two visits in order to identify the maximum of plants comprising the plant community.

Table 12 Cost breakdown – Analysis of archeological potential and archeological study – Théoret Point

Description	Amounts (\$)	
	Minimum	Maximum
Preliminary analysis and characterization of the sites	1,000	2,000
Archeological study <ul style="list-style-type: none"> - Excavation with exploratory pits - Technical report 	5,000	8,000
Total (\$)	6,000	10,000

Table 13 Cost breakdown – Phase I environmental site assessment – Théoret Point

Description	Amounts (\$)
Phase I environmental site assessment <ul style="list-style-type: none"> - Field visit - Technical report 	2,000
Total (\$)	2,000

Table 14 Cost breakdown – Phase II environmental site assessment – Théoret Point

Description	Amounts (\$)
Preliminary analysis and characterization of the site	1,000
- On-site work - Laboratory analyses - Technical report	7,000
Total (\$)	8,000

Table 15 Cost breakdown – Applications for authorizations – Théoret Point

Description	Amounts (\$)	
	Minimum	Maximum
Federal, provincial and municipal authorizations, including the C.A. application	11,000	17,000
Total (\$)	11,000	17,000

Table 16 Cost breakdown for the Lapierre Island development project, including the additional studies, the monitoring of the work and the follow-up program

Description	Amounts (\$)	
	Minimum	Maximum
Additional studies		
Hydraulic study and bathymetric surveys	\$10,000	\$52,000
Biological and habitat characterization	\$23,000	\$28,000
Phase II environmental site assessment – (depending on the results of Phase I)	\$35,000	\$37,000
Permits and authorizations		
Federal, provincial and municipal authorizations, including the C.A. application	\$11,000	\$17,000
Preparatory work*		
Remedial work on the access bridge	\$118,000	\$133,000
Habitat enhancement work		
Plans and specifications	\$20,000	\$30,000
Enhancement of the marsh and channel	\$2,232,000	\$2,441,000
Planting of native species	\$17,000	\$30,000
Environmental monitoring program	\$20,000	\$20,000
Work site monitoring program	\$30,000	\$36,000
Follow-up program		
Year 1	\$23,000	\$23,000
Year 2	\$24,000	\$24,000
Year 3	\$25,000	\$25,000
Total (\$)	\$2,588,000	\$2,896,000

* Since a number of trucks will have to cross the access bridge to Lapierre Island to transport equipment and the excavated soils, remedial work must be carried out on the bridge and bridge approaches to make it accessible. Two options are considered: 1) reduced width: \$118,000 or 2) full width: \$133,000.

Table 17 Cost breakdown - Hydraulic study and bathymetric surveys - Lapierre Island

Description	Amounts (\$)	
	Minimum	Maximum
Hydraulic study	10,000	52,000
- Project management		
- Collection of historical data		
- Evaluation of current hydraulic conditions		
- Development of a one-dimensional hydraulic model and calculations		
- Technical report		
Total (\$)	10,000	52,000

The costs related to this study are based on the experience of CJB Environnement inc.

Table 18 Cost breakdown - Biological characterization of the planned work areas - Lapierre Island

Description	Amounts (\$) 2 visits* 2 biologists	Amounts (\$) 3 visits 2 biologists
Preliminary analysis and characterization of the sites	2,000	2,000
Studies <ul style="list-style-type: none"> - Planning and application for SEG permit - Land surveys: <ul style="list-style-type: none"> - Wildlife - Plant - Aquatic surveys: <ul style="list-style-type: none"> - Wildlife - Plant - Data entry and reports 	21,000	26,000
Total (\$)	23,000	28,000

*The MDDELCC (2012) suggests a minimum of two visits in order to identify the maximum of plants comprising the plant community.

Table 19 Cost breakdown – Phase II environmental site assessment - Lapierre Island

Description	Amounts (\$)	
	Minimum	Maximum
Phase II environmental site assessment <ul style="list-style-type: none"> - Digging of 24 test trenches - Laboratory analyses - Technical report 	35,000	37,000
Total (\$)	35,000	37,000

Table 20 Cost breakdown – Applications for authorizations – Lapierre Island

Description	Amounts (\$)	
	Minimum	Maximum
Federal, provincial and municipal authorizations, including the C.A. application	11,000	17,000
Total (\$)	11,000	17,000

6. CONCLUSION

This assessment endeavoured to provide further detail on three compensation projects that were identified to compensate for the losses of wetlands and fish habitats caused during the construction of the NBSL as well as the deconstruction and reconstruction of the Nuns' Island Bridge. Subsequently, the additional studies which will generate information essential to the development of the plans and specifications for each project were identified, explained and budgeted. The general outline of a monitoring and follow-up program was also developed for each project. An estimate of the total cost was provided as well as a risk assessment related to the costs.

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APPENDIX 1

Table of all the additional studies

Théoret Point isolated marsh						
<ul style="list-style-type: none"> • Increase the availability of spawning habitat in flood plains and in wetlands over a proposed area of 1.3 ha. • The dimensions of the new channel and the construction of the culvert will ensure the free passage of water to avoid trapping fish in the marsh. • Stability of the habitat enhancements. • Create self-sustaining habitat enhancements that require no further maintenance following completion of the work. 						
Type of study	Justification	Objectives	Data to be collected	Method used to attain the objectives	Study implementation period	Cost of the additional study
Hydraulic study and bathymetric surveys	<ul style="list-style-type: none"> • Determine all the hydraulic parameters that must be met. • Ensure that the culvert chosen will be adequate based on the hydraulic parameters of the new supply channel. • Ensure the success of the proposed habitat enhancements which depends mainly on the hydraulic conditions. • Determine the target depth at the mouth of the Rivière des Prairies. 	<ul style="list-style-type: none"> • Identify the hydraulic parameters necessary in order to facilitate water flow and restore the link between the marsh which is currently isolated and the Rivière des Prairies. • Restore the free passage of fish and other wildlife groups present in the area to and from permanent aquatic and wetland habitats of good quality. • Provide a permanent still water habitat in addition to permitting the creation of a spawning habitat around the marsh. • Evaluate the areas where the work is to be carried out and the types of interventions proposed (slopes, levels, culvert) to facilitate water inflows and outflows based on the water level of the Rivière des Prairies. The water level in the marsh is currently higher than the level of the river and fish are trapped in the marsh. Maintain a water level in the marsh below the level recorded during low-water periods. 	<ul style="list-style-type: none"> • Flow facies; • Substrate (diameter and %); • Condition of the banks (erosion, slopes, predominant plant species, stability); • Depth of flow; • Width; • Recommendations on the proposed habitat enhancements based on the desired characteristics for the creation/enhancement of spawning habitats; • Historical water level and flow data for the St. Lawrence River • Spot measurements of flow and velocity; • Spot measurements of water level and depth; • Two-dimensional (2D) numerical modelling (hydraulic calibration and simulation of two habitat enhancement scenarios for three different flows (100-year flood, average spring conditions and low-water flow) for each site); • Land surveys and bathymetric surveys conducted using a vessel to determine elevation • Verify that there are no culverts under the access road to the island and, if present, determine their size. • Obtain the current elevations and target elevations for the various planned work in order to comply with the plan specifications. Determine the exact depth of the Rivière des Prairies at the mouth of the supply channel. 	<ul style="list-style-type: none"> • Obtain the historical water level and flow data for the Rivière des Prairies. • Evaluate current field conditions, such as the topography of the site and banks, bathymetry, profile of the channel, composition of the substrate as well as monitoring of the levels. • Develop a one-dimensional hydraulic model (HEC-RAS or equivalent) of the study area both for the existing conditions and the hydraulic parameters proposed by the habitat enhancement project. • Estimate the water levels and flows according to the ecological requirements and objectives. • Recommend the culverts to be installed (invert elevation, locations and dimensions of the culverts, design features within the culverts to ensure the free passage of fish). • Write a report outlining the conclusions and recommendations. 	<ul style="list-style-type: none"> • Bathymetric surveys: between May and November. • Hydraulic study: at any time • Land surveys and bathymetric surveys: between May and November over the course of the year. 	\$20,000 to \$30,000
Biological and habitat characterization	<ul style="list-style-type: none"> • Obtain an overview of the habitats of the study site for the reference state. • Target the subsequent biological surveys to certain plant and wildlife species at risk. • Identify the biological constraints that may prevent or impede project implementation. 	<ul style="list-style-type: none"> • Provide a description of the wildlife and plant communities. • Identify potential habitats and anticipate the presence of species with legal status. Plan the number and duration of field visits required based on the flowering/fruiting periods and the periods of use of these habitats by wildlife. • Evaluate the local plant and wildlife populations as well as the associated habitats to evaluate their ecological value. • Identify the biological/ecological constraints that may prevent or impede project implementation. 	<ul style="list-style-type: none"> • The list of species potentially present in the study area, both plant (tree, shrub and herbaceous) and wildlife. • The size of the populations as well as their area. • The maturity of the stands. • The delimitation of the habitats based on the forest stands. • The area of wetlands. • The general topography. • The type of cover. • Particular attention will be paid to the species identified during the analysis of the potential presence of species at risk or that have been reported by the CDPNQ. 	<ul style="list-style-type: none"> • Conduct an analysis of the potential presence of species at risk by drawing up a list of the species whose geographic distribution overlaps the study area and compare the habitat requirements of these species with the characteristics of the existing environments. • Identify the periods conducive for conducting surveys of target species (flowering/fruiting period, nesting period, spawning, etc.) as well as the number of visits necessary to cover all the species potentially present. • Verify the occurrence records of species around the study area with the CDPNQ. • Conduct the plant and wildlife surveys based on the preliminary analyses. 	<ul style="list-style-type: none"> • Plant survey: depends on the flowering period of the species, varies between May and August. • Wildlife survey: depends on each species. For example: <ul style="list-style-type: none"> ○ For amphibians, this is in the spring, sometimes even very early, depending on the species. ○ For birds, this is during the nesting period, usually in June. ○ For fish, this is from June to August 	\$23,000 to \$25,000

Théoret Point isolated marsh						
Type of study	Justification	Objectives	Data to be collected	Method used to attain the objectives	Study implementation period	Cost of the additional study
Analysis of archeological potential and archeological study	<ul style="list-style-type: none">Prevent the destruction of archeological remains.Prevent the losses of time associated with the discovery of archeological remains.	<ul style="list-style-type: none">Identify the potential constraints related to the discovery of archeological remains during the excavation work.	<ul style="list-style-type: none">The presence of known archeological sites in the vicinity.The history of use of the site.The cultural and natural characteristics of the study territory.	<ul style="list-style-type: none">Submit a request to the MCC in order to verify if there are any archeological sites located in the vicinity of the study area.Conduct an exhaustive archeological study, based on the results of the assessment of archeological potential.Sample, by digging by hand small trenches (30 cm in diameter), at 5-m intervals.Sift the excavated soils through a 6 mm mesh screen and fill in the pits.Intensify the search at 2.5 m intervals at locations where archeological interest was identified.	<ul style="list-style-type: none">Analysis of archeological potential: when the soil is not frozen, between May and November.Archeological study: at any time, after obtaining the information from the excavations.	\$6,000 to \$10,000
Phase I environmental site assessment	<ul style="list-style-type: none">Determine the history of use of the study area in order to assess the potential for contamination.In the event that the history of use of the study area may indicate some potential for contamination, it may be recommended to conduct a more detailed characterization of soils or groundwater (Phase II).No known contaminated sites were identified based on DFO's FCSI or the Quebec registry of contaminated sites of the MDDELCC.	<ul style="list-style-type: none">Describe the site and assess the potential for contamination.Demonstrate if the soils in the study area may exhibit contamination.	<ul style="list-style-type: none">The data to be collected:<ul style="list-style-type: none">OwnerAddressLot numberDescription of the siteAreaPresence and description of buildingsCurrent use of the building/siteYear of construction/workEnergy and heating methodDrinking water supplySanitary services	<ul style="list-style-type: none">Search for information in the property title chain, fire insurance records, aerial photographs, business records, environmental databases, regulatory authorities, previous reports and any other sources of information deemed necessary.Site visit and identification of potential sources of contamination.Writing of the report.	Phase I: at any time during the year.	\$2,000
Phase II environmental site assessment (depending on the results of Phase I)	<ul style="list-style-type: none">If required, determine if soil contamination is present, based on the recommendations made in Phase I.Manage the soils based on the results of the soil characterization (Phase II) and in accordance with the <i>Land Protection and Rehabilitation Regulation</i> and the <i>Regulation respecting the burial of contaminated soils</i> (where applicable) administered by the MDDELCC.No mention of the presence of contaminants in the study area (Quebec registry of contaminated sites of the MDDELCC as well as DFO's FCSI). However, these registries designate sites where Phase I and/or Phase II investigations have already been conducted.	<ul style="list-style-type: none">Identify the areas of contamination (extent and depth) based on the applicable criteria (generic criteria for soils of the <i>Soil Protection and Contaminated Sites Rehabilitation Policy</i> (MDDELCC).Determine the appropriate method for managing excavated materials (ship to official landfill sites if contamination is present, biopile, leave in place with risk assessment, etc.).	<ul style="list-style-type: none">Sample the soil on the entire study area and at various depths.Analyze the samples in order to detect the presence of contaminants (petroleum hydrocarbons (C₁₀-C₅₀), PAHs, metals (series of 13 heavy metals) and MAHs) in order to obtain an overview of the extent and depth of the contamination plume.Where soil contamination is confirmed, the drilling of observation wells and a groundwater analysis are generally necessary.	<ul style="list-style-type: none">Using an excavator, dig a single test trench in the centre of the excavation zone, since the excavation area is small (250 m²).Conduct analyses, at two different depths, based on the observations from the trench.	Phase II: ideally, between May and November/December.	Approximately \$8,000

Théoret Point isolated marsh						
Type of study	Justification	Objectives	Data to be collected	Method used to attain the objectives	Study implementation period	Cost of the additional study
Federal, provincial and municipal authorizations, including the C.A. application	<ul style="list-style-type: none">• A C.A. application must be submitted to the MDDELCC under section 22 of the Quebec <i>Environment Quality Act</i> (LQE) (c. Q-2) and to the MFFP under section 128.7 of the <i>Act Respecting the Conservation and Development of Wildlife</i> (c. C-61.1) in order to assess the project and its impacts on the environment.• Federal and municipal authorizations could be required.	<ul style="list-style-type: none">• Determine the various impacts of the Théoret Point project.• Assess, for the various phases of the project, the sources and types of impacts on the natural environment, nearby residents and users.	<ul style="list-style-type: none">• Description of the planned activities and work;• Description of the site where the activities will be carried out,• Description of the impacts of the planned activities on wildlife, wildlife habitat and the environment,• Economic aspects.	<ul style="list-style-type: none">• Obtain information from the authorities involved in the development of the project (government departments, municipality, private developer, contractor, etc.).• Provide an overall description of the project context, provide a detailed description of the project and determine the scope of the project.• Describe the receiving environment by consulting the available information sources (aerial photographs, ecoforestry maps, MDDELCC site, CDPNQ occurrence records and wildlife habitat records, organizations, municipalities, ZIP committee, etc.).• Assess the environmental impacts in order to identify, describe and assess the adverse effects of the project on the receiving environment.• Propose mitigation measures for the impacts identified and determine the residual effects.• Develop a monitoring and follow-up program, if necessary, in order to ensure compliance with environmental standards during the work and to verify attainment of the project objectives in subsequent years.	<ul style="list-style-type: none">• Application for certificate of authorization: at any time during the year.	\$11,000 to \$17,000

Development of Lapierre Island						
<ul style="list-style-type: none">• Increase the availability of aquatic habitats over a proposed area of 1.0 ha.• Increase the availability of spawning habitat in flood plains and wetlands over a proposed area of 1.5 ha.						
Type of study	Justification	Objectives	Data to be collected	Method used to attain the objectives	Study implementation period	Cost of the additional study
Hydraulic study and bathymetric surveys	<ul style="list-style-type: none">• Determine all the hydraulic parameters that must be met.• Ensure the success of the proposed habitat enhancements, which depends mainly on the hydraulic conditions.	<ul style="list-style-type: none">• Identify the optimal hydraulic conditions in order to create a marsh that will be permanently flooded by restoring the link with the Rivière des Prairies.• Improve the availability of still water fish habitats and increase the area of flood plains and wetlands.• Ensure the free circulation of water at all times over the entire length of the channel.	<ul style="list-style-type: none">• Flow facies;• Substrate (diameter and %);• Condition of the banks (erosion, slopes, predominant plant species, stability);• Depth of flow;• Width;• Recommendations on the proposed habitat enhancements based on the desired characteristics for the creation/enhancement of spawning habitats;• Historical water level and flow data of the Rivière des Prairies.• Spot measurements of flow and velocity;• Spot measurements of water level and depth;• Two-dimensional (2D) numerical modelling (hydraulic calibration and simulation of two habitat enhancement scenarios for three different flows (100-year flood, average spring conditions and low-water flow) for each site);• Land surveys and bathymetric surveys conducted using a vessel to determine elevation• Obtain the current elevations and target elevations for the various planned work in order to comply with the plan specifications.	<ul style="list-style-type: none">• Obtain the historical water level and flow data for the Rivière des Prairies at the study site.• Evaluate the current field conditions, such as the topography of the site and banks, bathymetry, profile of the channel, composition of the substrate as well as monitoring of water levels and flows during the periods of precipitation.• Develop a one-dimensional hydraulic model (HEC-RAS or equivalent) of the study area both for the existing conditions and the hydraulic parameters proposed by the habitat enhancement project.• Establish a topographical survey of the site.• Indicate, by means of wooden stakes placed in the ground at specific locations, the required spot elevations in order to comply with the planned elevations and slopes in the field.• Conduct a bathymetric survey aboard a motor vessel using a GPS with high-precision depth sounder according to a grid plan at the mouth of the channel.	<ul style="list-style-type: none">• Bathymetric surveys: between May and November.• Hydraulic study: at any time• Land surveys and bathymetric surveys: between May and November over the course of the year.	\$10,000 to \$52,000
Biological characterization of the planned work areas	<ul style="list-style-type: none">• Obtain an overview of the habitats of the study site for the reference state.• Target the subsequent biological surveys to certain plant and wildlife species at risk.• Identify the biological constraints that may prevent or impede project implementation.	<ul style="list-style-type: none">• Provide a description of the wildlife and plant communities.• Identify potential habitats and anticipate the presence of species with legal status. Plan the number and duration of field visits required based on the flowering/fruited periods and periods of use of these habitats by wildlife.• Assess the local plant and wildlife populations as well as the associated habitats to evaluate their ecological value.• Identify the biological/ecological constraints that may prevent or impede project implementation.	<ul style="list-style-type: none">• The list of species potentially present in the study area, both plant (tree, shrub and herbaceous) and wildlife.• The size of the populations as well as their area.• The maturity of the stands.• The delimitation of the habitats based on the forest stands.• The area of wetlands.• The general topography.• The type of cover.• Particular attention will be paid to the species identified during the analysis of the potential presence of species at risk or that have been reported by the CDPNQ.	<ul style="list-style-type: none">• Conduct an analysis of the potential presence of species at risk by drawing up a list of the species whose geographic distribution overlaps the study area and compare the habitat requirements of these species with the characteristics of the existing environments.• Identify the periods conducive for conducting surveys of target species (flowering/fruited period, nesting period, spawning, etc.) as well as the number of visits necessary to cover all the species potentially present.• Verify the occurrence records of species around the study area with the CDPNQ.• Conduct the plant and wildlife surveys based on the preliminary analyses.	<ul style="list-style-type: none">• Plant survey: depends on the flowering period of the species, varies between May and August.• Wildlife survey: depends on each species. For example:<ul style="list-style-type: none">○ For amphibians, this is in the spring, sometimes even very early, depending on the species.○ For birds, this is during the nesting period, usually in June.○ For fish, this is from June to August	\$23,000 to \$28,000

Development of Lapierre Island						
<ul style="list-style-type: none">• Increase the availability of aquatic habitats over a proposed area of 1.0 ha.• Increase the availability of spawning habitat in flood plains and wetlands over a proposed area of 1.5 ha.						
Type of study	Justification	Objectives	Data to be collected	Method used to attain the objectives	Study implementation period	Cost of the additional study
Phase II environmental site assessment	<ul style="list-style-type: none">• Assess the sectors of the work not covered by the previous assessment• Delimit the area where PAHs were discovered• Manage the soils based on the results of the soil characterization (Phase II) and in accordance with the <i>Land Protection and Rehabilitation Regulation</i> and the <i>Regulation respecting the burial of contaminated soils</i> (where applicable) administered by the MDDELCC.• Known and identified contaminated sites within 200 m of the study area.	<ul style="list-style-type: none">• Identify any areas of contamination (extent and depth) based on the applicable criteria (generic criteria for soils of the <i>Soil Protection and Contaminated Sites Rehabilitation Policy</i> (MDDELCC).• Determine the appropriate method for managing excavated materials (ship to official landfill sites if contamination is present, biopile, leave in place with risk assessment, etc.).	<ul style="list-style-type: none">• Sample the fill on the entire study area and at various depths.• Analyze the samples to detect the presence of contaminants (petroleum hydrocarbons (C₁₀-C₅₀), PAHs, metals (series of 13 heavy metals) and asbestos) in order to obtain an overview of the extent and depth of the contamination plume.• Where soil contamination is confirmed, the drilling of observation wells and a groundwater analysis are generally necessary.	<ul style="list-style-type: none">• Systematic exploration with test trenches according to a grid pattern of 25 m by 25 m (approximately 24 trenches), as recommended in the Guide de caractérisation des terrains [site characterization guide] (MENV, 2003).• Characterize vertically, at 50-cm depth intervals, the various layers of potential fill. Every second survey is submitted to two series of analyses, and every second survey to four series.	<ul style="list-style-type: none">• Phase II: ideally, between May and November/December.	\$35,000 to \$37,000
Federal, provincial and municipal authorizations, including the C.A. application	<ul style="list-style-type: none">• A C.A. application must be submitted to the MDDELCC under section 22 of the LQE (c. Q-2) and to the MFFP under section 128.7 of the <i>Act Respecting the Conservation and Development of Wildlife</i> (c. C-61.1) in order to assess the project and its impacts on the environment.• Federal and municipal authorizations could be required	<ul style="list-style-type: none">• Determine the various impacts of the Lapierre Island project• Assess, for the various phases of the project, the sources and types of impacts on the natural environment, nearby residents and users of the island.	<ul style="list-style-type: none">• Description of the planned activities and work;• Description of the site where the activities will be carried out,• Description of the impacts of the planned activities on wildlife, wildlife habitat and the environment,• Economic aspects.	<ul style="list-style-type: none">• Obtain information from the authorities involved in the development of the project (government departments, municipality, private developer, contractor, etc.).• Provide an overall description of the project context, provide a detailed description of the project and determine the scope of the project.• Describe the receiving environment by consulting the available information sources (aerial photographs, ecoforestry maps, MDDELCC site, CDPNQ occurrence records and wildlife habitat records, organizations, municipalities, ZIP committee), etc.).• Assess the environmental impacts in order to identify, describe and assess the adverse effects of the project on the receiving environment.• Propose mitigation measures for the impacts identified and determine the residual effects.• Develop a monitoring and follow-up program, if necessary, in order to ensure compliance with environmental standards during the work and to verify attainment of the project objectives in subsequent years.	<ul style="list-style-type: none">• Application for certificate of authorization: at any time during the year.	\$11,000 to \$17,000