Ponts
JACQUES CARTIER +
CHAMPLAIN
Bridges
Canada

Contract No 62453

CHAMPLAIN BRIDGE, CONSULTANCY SERVICES, FEASIBILITY STUDY ON THE DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE (2016-2017)

Environmental Effects Evaluation - Partial Baseline Study
Final Report

February 2017

Parsons
Tetra Tech
Amec Foster Wheeler

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Environmental effects evaluation

Partial baseline study

Final report

Prepared by: [redacted]

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List of Revisions

REVISION	DATE	DESCRIPTION
A	January 13, 2017	Preliminary
0	February 10, 2017	Final
1	February 14, 2017	Final – Revision 1

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1 PROJECT SUMMARY

1.1 PROJECT PROPONENT

The proponent of the Project at this time is The Jacques Cartier and Champlain Bridge Incorporated (JCCBI), a federal crown corporation acting and exercising its powers as an agency of Her Majesty in right of Canada. JCCBI hereafter is thus referred to as the Owner of the Project.

The proponent contact is:

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1.2 TITLE OF PROJECT

The Project is entitled "Champlain Bridge Deconstruction".

1.3 PROJECT LOCATION

The Champlain Bridge crosses the St. Lawrence River and the St. Lawrence Seaway between the municipality of Brossard on the South Shore and Nuns' Island in the City of Montreal, in the province of Quebec. The bridge lies entirely within a federal government Right-of-Way extending across the river and the seaway and connecting to federal lands on both sides of the waterway. The Champlain Bridge connects at both ends to access and exit lanes, many of which also originate on the federal lands.

The portion of the overall Champlain Bridge and approaches with which this Project is concerned is that between the bridge abutments at the northern end of Nuns' Island and Brossard, designated as Section 5 (Nuns' Island to the St. Lawrence Seaway), Section 6 (crossing of the St. Lawrence Seaway), and Section 7 (the St. Lawrence Seaway to Brossard).

The location of the Champlain Bridge and the federal property limits under the jurisdiction of JCCBI are shown on Drawing 101 (Appendix 1).

1.4 SUMMARY OF THE PROJECT

The Project encompasses the systematic deconstruction of the Champlain Bridge in an orderly series of activities, the further deconstruction of selected components, the transportation of materials from the bridge to laydown areas for further reduction as appropriate, and the ongoing transportation of materials to final points of disposition or disposal.

The overall Project also includes the valuation of the various materials as salvage value of the bridge deconstruction. Finally, it includes the identification of potential value-added projects which may enhance the areas left behind once the deconstruction is completed, and may also take advantage of particular components of the bridge, such as piers or parts of piers, which may be left in place.

1.5 JCCBI INVOLVEMENT IN THE PROJECT

It is possible that JCBBI will be designated as the lead federal agency acting as the Proponent of the Project. And as the designed manager of the Champlain Bridge, JCCBI would therefore be the federal authority for purposes of the *Canadian Environmental Assessment Act* (CEAA 2012). That is, at this time, and subject to final confirmation by the federal government, the ultimate decision regarding the environmental acceptability of the Project within the dictates of Section 67 of CEAA 2012 (see section 2.5 below) would lie with JCCBI in this self-assessment process.

1.6 OTHER FEDERAL AUTHORITIES

Other federal agencies may play a role in the environmental review process dictated by CEAA 2012, should they have a regulatory decision to make with respect to a federal permit or authorization regarding one or other aspect of the Project. In this case, Transport Canada will have to approve of any activities that may be considered to interfere with navigation, as will the St. Lawrence Seaway Management Corporation, under the *Navigation Protection Act;* the Department of Fisheries and Oceans (DFO) will have to approve the potential loss of fish habitat, as well as the conceptualization and design of offsetting measures, under Section 35 (2)(b) of the *Fisheries Act*; Natural Resources Canada regulates the transport, storage and use of explosives under the *Explosives Regulations, 2013.* The Canadian Wildlife Service of Environment and Climate Change Canada may be required to issue a permit with respect to the *Migratory Birds Convention Act*. The same department also shares the administration of SARA, the *Species at Risk Act*, with the DFO. The Minister of Environment and Climate Change Canada is directly responsible for the Parks Canada Agency with respect to species/individuals in or on national parks, national historic sites and national marine conservation areas of Canada, and for all other species or individuals other than aquatic species, while the Minister of Fisheries and Oceans is responsible for aquatic species, with the exception of those found in federal lands administered by the Parks Canada Agency. This Act is expected to play a role in this evaluation.

All of these federal agencies can thus act as federal authorities as defined in CEAA 2012 and can be expected to play a role in the review and approval process.

1.7 PROVINCIAL AND MUNICIPAL AGENCIES

The Quebec *Act Respecting Threatened or Vulnerable Species,* administered by the Department of Sustainable Development, Environment and the Fight Against Climate Change, is the provincial counterpart to the federal SARA. It will form an important piece of legislation which will be taken into consideration in this EEE.

Any Project activities that take place outside of the federal right-of-way across the river and the federal lands at either end of the bridge may be subjected to other provincial authorizations, such as regulations respecting noise limits and atmospheric emissions. On the municipal side, the Project should be in conformity with municipal land use plans and also with regulations respecting noise and air quality.

Other components of the Project could also be covered by municipal by-laws. However, at this stage of the Project planning, it is not possible to identify particular situations as much will depend upon the individual contractors who are successful in winning tenders for distinct aspects of the overall deconstruction process, and the techniques/solutions that each will apply to his/her component of the Project.

Finally, a number of value-added projects have been identified which may take advantage of restored areas and/or elements of the Project such as piers, or parts of piers, in order to enhance the residual aspects of the Project. These value-added projects will require close coordination with local authorities to ensure compatibility of said projects with local uses of adjacent lands, and with longer range municipal land use plans.

1.8 SCOPE OF THE ENVIRONMENTAL EFFECTS EVALUATION

This partial Environmental Effects Evaluation (EEE) will investigate the potential environmental and selected social effects that may be associated with any of the activities of the deconstruction of the Champlain Bridge and with the transportation of deconstructed materials. It will not address the valuation component of the overall Project, nor will it analyze the potential environmental effects of any of the value-added or enhancement projects that may be proposed. These enhancement projects will be addressed as part of a separate process, although they will be identified and briefly described as part of this EEE.

In addition, there are several components of the usual bio-physical and socio-economic environment considerations which constitute an EEE which it was not possible to address in this evaluation due to scheduling issues. These omissions are described further in section 2.6 below.

1.9 AUTHOR OF THE EEE

This partial EEE has been prepared by the Consortium Parsons / Tetra Tech / Amec Foster Wheeler (PTA), on behalf of JCCBI. A list of individual participants is included in Appendix 2.

2 DETAILED PROJECT DESCRIPTION

2.1 PROJECT PROPONENT

It is possible that JCBBI will be designated as the proponent for this Project. The Jacques Cartier and Champlain Bridges Incorporated is a federal Crown corporation reporting to Parliament through the Minister of Infrastructure and Communities. The Corporation has responsibility for the Jacques Cartier Bridge, the Champlain Bridge, the Champlain Bridge Ice Control Structure, the Île des Sœurs Bypass Bridge, the federal sections of Bonaventure Expressway and the Honoré Mercier Bridge, as well as the Melocheville Tunnel. The Corporation ensures that these critical structures remain safe, fully functional and aesthetically pleasing; it conducts construction, rehabilitation and reinforcement projects on the infrastructure under its responsibility and oversees the operation and maintenance of these structures.

In 2015, the management of the west and east approaches to the Champlain Bridge and of the federal section of Highway 15 was transferred to Infrastructure Canada in view of the New Champlain Bridge Corridor (NCBC) project.

Operations, maintenance and traffic management over these sections is now the responsibility of Signature on the Saint Lawrence (SSL) the consortium responsible for the NCBC project. Given that the New Champlain Bridge is now under construction, it is possible that JCCBI will be charged with the management and oversight of the deconstruction of the existing Champlain Bridge, once the new bridge becomes operational.

2.2 JUSTIFICATION OF THE PROJECT

The Champlain Bridge, opened in 1962, has in recent years required ever increasing maintenance and operation costs in order to ensure the safety of its users. The bridge was not designed to handle the current high volume of traffic, consisting of approximately 59 million vehicles annually, including 200,000 buses. The use of de-icing salt has also contributed to corrosion and the degradation of concrete. Over the years there have been major maintenance requirements, such as the complete re-painting of the steel structure, the replacement of the original concrete deck with a steel deck, development and implementation of the unique modular trusses technology, and the large-scale emergency “super beam” installation. Ongoing maintenance activities have included pier repairs, steel repairs, replacement of deck joints, and girder reinforcements. As it approaches the end of its service life, the bridge has presented some unique challenges, to which JCCBI responded with exceptional measures, including reinforcement of a number of spans, installation of instrumentation to monitor the state of components of the bridge, introduction of a dynamic lane signal system, implementation of an accelerated inspection cycle, and others.

Despite these measures, with the progressive deterioration of the bridge and the ever increasing costs of necessary maintenance to ensure safety for users, the decision has been made to replace the existing bridge. A pre-feasibility study was carried out in 2011 to examine various options for replacing the bridge, including both bridge and tunnel alternatives. The study considered transportation requirements, forecasted traffic demands, environmental aspects, implementation modes and financial considerations. The study concluded that a new bridge was the preferred solution. Other studies also contributed to that decision. The new bridge is now under construction, and once it becomes operational, now scheduled to be at the end of 2018, the deconstruction of the existing bridge is planned to begin.

2.3 PURPOSE OF THE STUDY

This partial Environmental Effects Evaluation (EEE) report has been prepared in partial fulfilment of the Canadian Environmental Assessment Act (CEAA 2012), Section 67.

The EEE process is a tool used by the federal government, to ensure that those federal agencies proposing to develop a project on federal lands have satisfied themselves that all potentially adverse environmental effects have been examined and will be adequately managed. While it is essentially a self-assessment process, other agencies with an applicable federal regulatory approval or permitting function may also be involved. Finally, the process is intended to provide potentially affected stakeholders and other interested parties an opportunity to have input into project planning, with the objective of developing a project which is both compliant with applicable regulations and statutes, and cognisant of stakeholder concerns and interests.

2.4 LOCATION OF THE PROJECT AND STUDY AREA

The Champlain Bridge Deconstruction Project is located from the western bridge abutment on the northern end of Nuns’ Island in Montreal to the eastern bridge abutment at Brossard. The Project Area encompasses an envelope somewhat wider than the width of the bridge itself, to take into account the various activities that will take place in the immediate vicinity of the bridge during the deconstruction process. This envelope is shown on Drawing 102 (Appendix 1).

The Study Area for the EEE is larger again than the Project Area, in that it extends upriver to just beyond the St. Lawrence Ice Control Structure, and downriver from the Champlain Bridge a distance of approximately 1 kilometre. It also extends inland from both bridge abutments into Brossard and across Nuns’ Island into Montreal, in order to take into account potential environmental and socio-economic effects upon the terrestrial surroundings of the bridge. This Study Area was discussed and agreed with a representative of DFO at a meeting on 29 September 2016. The Study Area is demonstrated on Drawing 103 (Appendix 1).

DFO also directed that a field survey of fish habitat was to be conducted in the area between the upstream limit of the previous fish habitat field work (for the new bridge Environmental Assessment) and the ice control structure. This field survey was deferred until the summer of 2017 due to the lateness of the season and the consequent lack of aquatic vegetation which forms such an important component of fish habitat.

2.5 LEGAL CONTEXT

The Deconstruction of the Champlain Bridge is not as of this day a designated project as such projects are set out in the *Regulations Amending the Regulations Designating Physical Activities*, taken pursuant to Section 84 of CEAA 2012. Subsection 28 of the Schedule of that regulation reads in part as follows:

"The construction, operation, decommissioning and abandonment of a new

- (b) bridge over the St. Lawrence Seaway".

The key word is "new", and as the existing Champlain Bridge is not a new bridge, therefore the deconstruction of this bridge is not a designated project pursuant to the Regulation. Thus, subject to the following regarding section 14 (2) of the Act, it is not subject to the formal environmental assessment as directed by the Act.

However, the proponent of the proposed deconstruction activity is to be a federal Authority, as defined in CEAA 2012, and the project is to be carried out on federal lands. It is possible that the federal Authority will be JCCBI. It is also possible that another federal Authority (DFO, TC, ECCC) may be required to issue a regulatory permit, approval or authorization respecting some aspect of the proposed project, in order to enable the project to proceed. Therefore, the Champlain Bridge Deconstruction Project is subject to Section 67 of CEAA 2012, and hence to Subsection 4(2), which commits the Authority or Authorities to protecting the environment and human health, and applying the precautionary principle.

The Project is considered to be a "non-basic project" as described in the document "Projects on Federal Lands; Making a Determination under Section 67 of the *Canadian Environmental Assessment Act*, 2012" (Canadian Environmental Assessment Agency 2014). That is, the project has the potential to negatively affect the environment, and these effects may not all be manageable by "established and effective" mitigation measures. Therefore, an Environmental Effects Evaluation (EEE) is to be undertaken. Once such an evaluation by the federal authority is satisfactorily completed, there is no legal requirement to then submit it to the CEA Agency for further review/approval. However, it can be assumed that the final EEE will be submitted to the Agency for eventual inclusion on its CEAA Registry.

That said, there is a provision in CEAA 2012 which could change the assumptions made above. Under Section 14 (2) of the Act, the Minister of Environment and Climate Change can designate a physical activity not included in the *Regulations Amending the Regulations Designating Physical Activities*, if in the Minister's opinion it has the potential to cause adverse environmental effects, or if public concerns related to those effects may warrant such designation. Incidentally, this authority cannot be used if there has been a prior federal decision related to the project or if construction has already started (Section 14 (5) (b) of CEAA 2012). It is interesting to note that such a prior federal decision has already been made – the deconstruction of the existing Champlain Bridge was included as an integral part of the formal Project Description in the Environmental Impact Assessment (EIA) carried out in 2012/2013 under the old CEAA for the "New Bridge for the St. Lawrence". Potential environmental effects related to the deconstruction of the bridge were identified, and mitigation measures were recommended so as to reduce any residual effects to the level of "non-significance". This EIA did go through the former CEAA process, at the screening level, and received federal approval in October 2013, subject to a number of mitigation and monitoring measures. However, the methodology for the deconstruction of the Champlain Bridge was not well defined at that time, and did not consider the alternatives available for taking apart the various components of the bridge.

2.6 SCOPE OF THE PROJECT AND THE STUDY

The scope of the overall deconstruction Project includes the Champlain Bridge between the abutments at the western and eastern ends of the bridge, at Nuns' Island and Brossard, respectively. The bridge is categorized as having three sections, designated as follows:

- Section 5, from the Nuns' Island abutment to the St. Lawrence Seaway (+/- 2,150m);
- Section 6, the span over the St. Lawrence Seaway (+/- 763m); and
- Section 7, between the St. Lawrence Seaway and Brossard (+/- 528m).

The detailed scope of work includes the deconstruction of the bridge components including the concrete and the steel decks, pier caps, the piers shafts and the footings. For each of these components, alternatives are to be examined and the best option or options recommended, in terms of most appropriate methodology and cost. As well, in addition to these criteria, JCCBI has a strong focus upon sustainable development of its projects, and thus the concept of sustainability was also brought to bear upon the options under consideration (see section 2.7 below).

Similar studies are to be carried out for the various transportation options in order to move the materials from the area of the bridge to transfer points, possible further deconstruction sites, and on to final disposal locations. The salvage value, or valuation, of the deconstructed materials is to be determined. Finally, the study is to examine the potential for projects that could enhance the area of the deconstructed bridge once that process is completed. The option selection methodology integrates the concept of sustainability, the various alternatives being scored for technical, economic, environmental and social criteria (see section 2.7).

The scope of the Environmental Effects Evaluation was originally intended to encompass a complete environmental analysis of the recommended approaches to the deconstruction and transportation aspects of the Project. However, this scope was curtailed partway through the schedule of the overall Project, so that only a partial study is now included. That study includes the presentation of a project description and a summary of available baseline information for selected environmental disciplines, and the identification of Valued Ecosystem Components (VECs) as they were able to be identified within those disciplines. The Table 1 below represents JCCBI's directions regarding the scope to be achieved within the truncated schedule.

Table 1 –Scope of the study

<table>
<tr><th rowspan="2">ITEMS PROVIDED IN THE RFP</th><th colspan="2">ITEMS TO BE COMPLETED BEFORE THE END OF THE TERM (DECEMBER 2016/JANUARY 2017)</th><th rowspan="2">CANCELLED ITEMS</th></tr>
<tr><th>ITEMS TO BE COMPLETED TO 100%</th><th>ITEMS TO BE COMPLETED PARTIALLY</th></tr>
<tr><td>The justification of the project</td><td rowspan="5">100%</td><td></td><td></td></tr>
<tr><td>The legal framework</td><td></td><td></td></tr>
<tr><td>A complete project description and works to be executed</td><td></td><td></td></tr>
<tr><td>The scope of the project</td><td></td><td></td></tr>
<tr><td>The scope of the environmental effects assessment</td><td></td><td></td></tr>
<tr><td>An analysis of deconstruction alternatives</td><td></td><td rowspan="3">Partially, to the extent possible</td><td></td></tr>
<tr><td>A deconstruction works schedule</td><td></td><td></td></tr>
<tr><td>A description of the environment (physical, biological and human) and valued environmental components (VEC), including, but not limited to, species at risk under the Species at Risk Act (LC 2002, ch. 29) and the Act on threatened or vulnerable species (RLRQ c E-12.01)</td><td></td><td></td></tr>
</table>

ITEMS PROVIDED IN THE RFP	ITEMS TO BE COMPLETED BEFORE THE END OF THE TERM (DECEMBER 2016/JANUARY 2017)		CANCELLED ITEMS
	ITEMS TO BE COMPLETED TO 100%	ITEMS TO BE COMPLETED PARTIALLY	
The environmental effects assessment methodology			Cancelled
A description of the environmental effects and mitigation measures			
An assessment of residual impacts			
A summary table of environmental effects according to project activities, including mitigation measures and residual impacts			
A cumulative impact assessment			
An environmental management plan			
References			
Appendices			
Figures			
Photos			
Analytical results			
Inventories			

Most of the basic bio-physical disciplines have been described below in terms of the baseline conditions, as determined from the review of available reports and data. However, several components of the usual environmental baseline conditions have been omitted due to the curtailment of the schedule; these are hydrology (given the proposed use of temporary jetties), the socio-economic environment, and the archaeological setting.

2.7 SUSTAINABILITY APPROACH

In keeping with its Mission statement, JCCBI required the Project to integrate sustainability principles into the decision-making process, in order to reach the best possible equilibrium between the technical, economic, environmental and social dimensions of the Project. The feasibility study was initially divided into four fields (deconstruction, material transport, material valuation, asset enhancement).

In order to select the best option(s) for each field, a multi-criteria evaluation was conducted. Based on JCCBI's mission, as well as governmental and public interests, five technical evaluation criteria and five criteria for each sustainable dimension (economic, environmental and social) were retained. Thus all alternatives were evaluated with the same set of criteria, with the exception of the technical criterion that was closely related to each specific field of study. In order to represent the results according to the four dimensions studied, a four-axis graphic representation is proposed to facilitate the visualization of the results of each field of study.

Finally, a cross analysis between deconstruction options and options of the other three study fields was made to ensure compatibility of selected best options. These selected best options are described in section 2.10.

2.8 STAKEHOLDERS

In order to complete the sustainability approach implemented in the multi-criteria evaluation, stakeholders have been identified and were compartmentalized and ranked according to their influence on the project (Table 2). An extensive stakeholder consultation process has been initiated to ensure concerns and needs were properly reflected in the retained evaluation criteria. However, it was not possible to complete the process within the timeframe dictated by the forshortened EEE process.

Table 2 –Stakeholders

	STAKEHOLDER IDENTIFICATION	INTERACTION DESCRIPTION
Governance	[redacted]	
Expert Resources		
Economic Partners		

Those stakeholders which were consulted are highlighted in green. From these consultations it should be noted that:

- Transport Canada requires specific pier footing levelling in the navigable and non-navigable areas;
- Fisheries and Oceans Canada does not allow controlled blasting for the deconstruction of the deck and will carefully study the use of explosives for deconstructing the piers and footings;
- JCCBI Infrastructure Innovation Centre (IIC) will likely implement a research program in partnership with research institutes and specialized companies and;
- The St. Lawrence Seaway Management Corporation (SLSMC) presented the process followed by the SSL Group to set up certain facilities and carry out certain work on its territory. A similar process will be required from JCCBI for its own work. In addition, SLSMC insists that most of the work directly above the navigation channel will have to be completed during the winter closure period, from late December to mid-March.

2.9 DESCRIPTION OF STRUCTURE

The Champlain Bridge is divided into three sections (Figure 1):

- Section 5: between Nuns' Island and the Seaway (±2,150 m)
- Section 6: crossing over the Seaway (±763.45 m)
- Section 7: between the Seaway and the City of Brossard (±528.07 m)

The Champlain Bridge is made up of two main structural systems. The approach spans are made of prestressed girders (sections 5 and 7 – 50 spans), while the spans over the Seaway are made of steel trusses (section 6).

The Ice Control Structure is also discussed, although this structure will not be deconstructed as it plays a key role in the project.

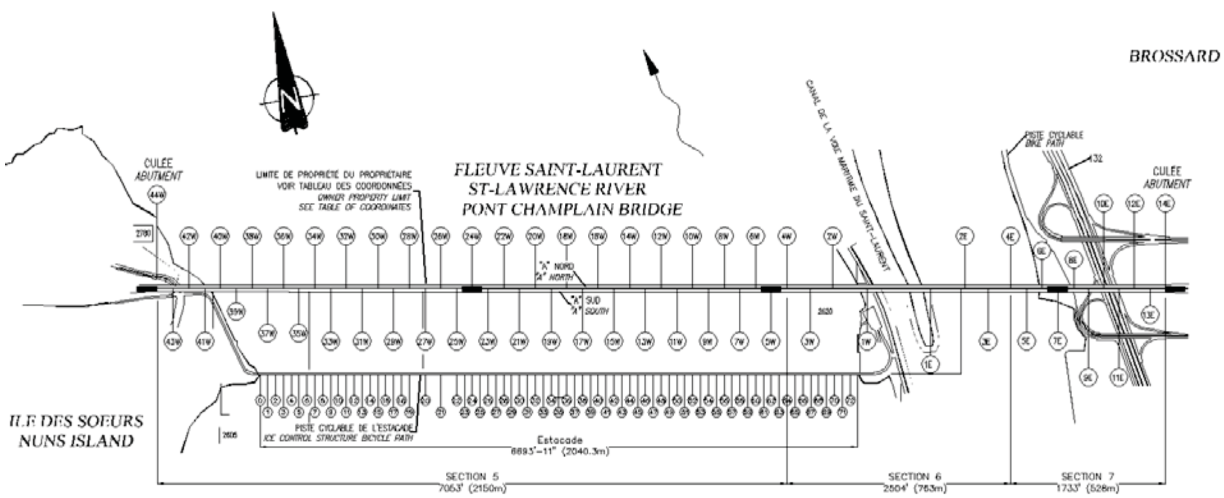

Figure 1 – Section of Champlain Bridge

2.9.1 SECTION 5

Section 5, which links Nuns' Island to the Seaway, is the longest section of the Champlain Bridge. It is comprised of 40 spans measuring 53.75 m each (total length: 2,150 m) and extends from axis 44W (abutment) to axis 4W. The spans between axes 44W and 41W are over land while the others are over the river. Span 43W-42W extends over Boulevard René-Lévesque on Nuns' Island. The deck is made up of seven precast post-tensioned prestressed girders (Figure 2) with a spacing of 3.721 m. There are three lanes in each direction.

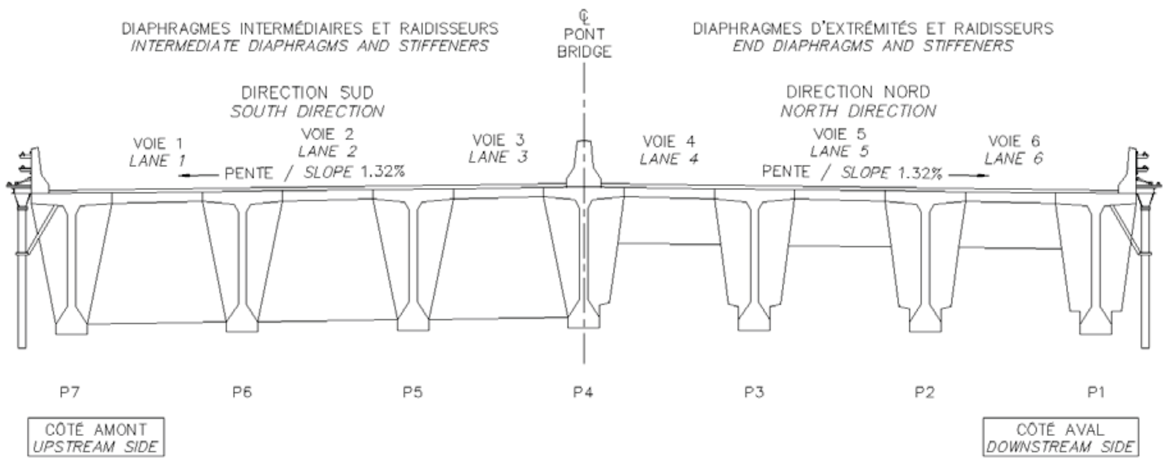

Figure 2 – Cross-section – Section 5

The main characteristics of section 5 are presented in Table 3.

Table 3 – Section 5

	SECTION 5
Overall width	24,08 m
Number of spans	40
Span length	53,75 m (176' 4'')
Girder length	53,65 m (176')
Number of girders/span	7
Girder height	3,07 m
Girder spacing	3,721 m
Intermediate diaphragms	2
Reinforced concrete slab thickness	216 mm
Number of prestressing tendons	24 tendons: 12 7-mm strands/tendon
Type of prestressing	Freyssinet (STUP)
Type	Simple spans
Total length	2 150 m

The girders rest on reinforced concrete hammerhead piers (Figure 3). The footings rest on the bedrock. Pier height ranges from 4.5 to 28 m.

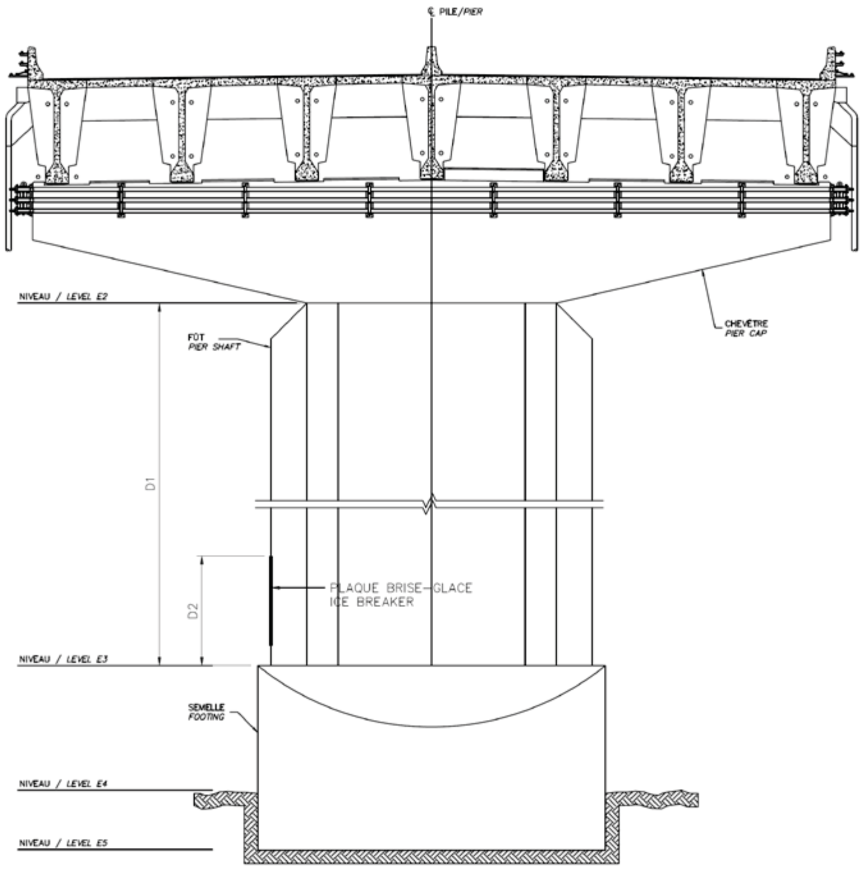

Figure 3 – Typical pier – Section 5

2.9.2 SECTION 6

Section 6 crosses over the Seaway. It is made up of steel trusses. This section extends from axis 4W to axis 4E and has a total length of 763.45 m (Figure 4). The bridge clearance over the St. Lawrence Seaway is 36 m above the high water level.

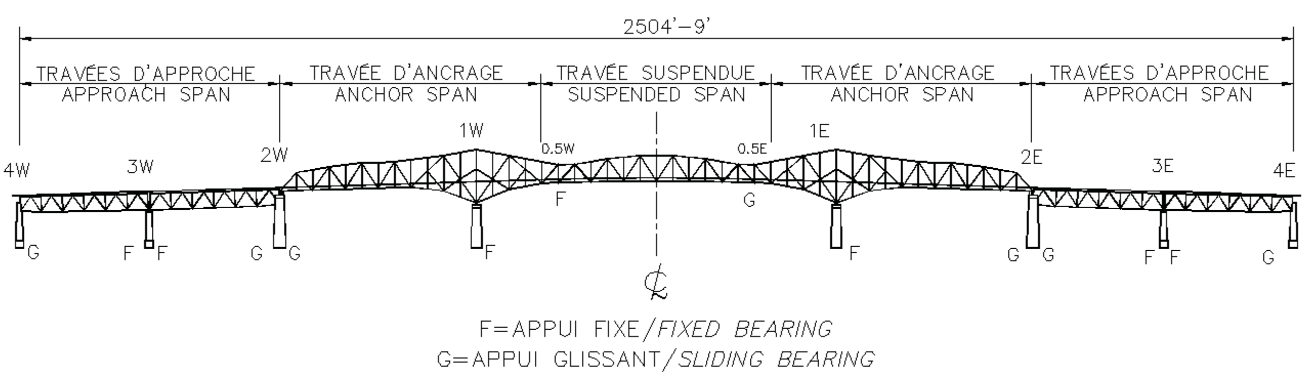

Figure 4 – Section 6 – Elevation

Approach spans are made up of four upper-deck trusses (Figure 5), while the main span is a cantilever span (anchor span) with a suspended central span made up of three trusses (Figure 6). For this entire section, the original concrete deck was replaced with an orthotropic steel deck installed between 1990 and 1993.

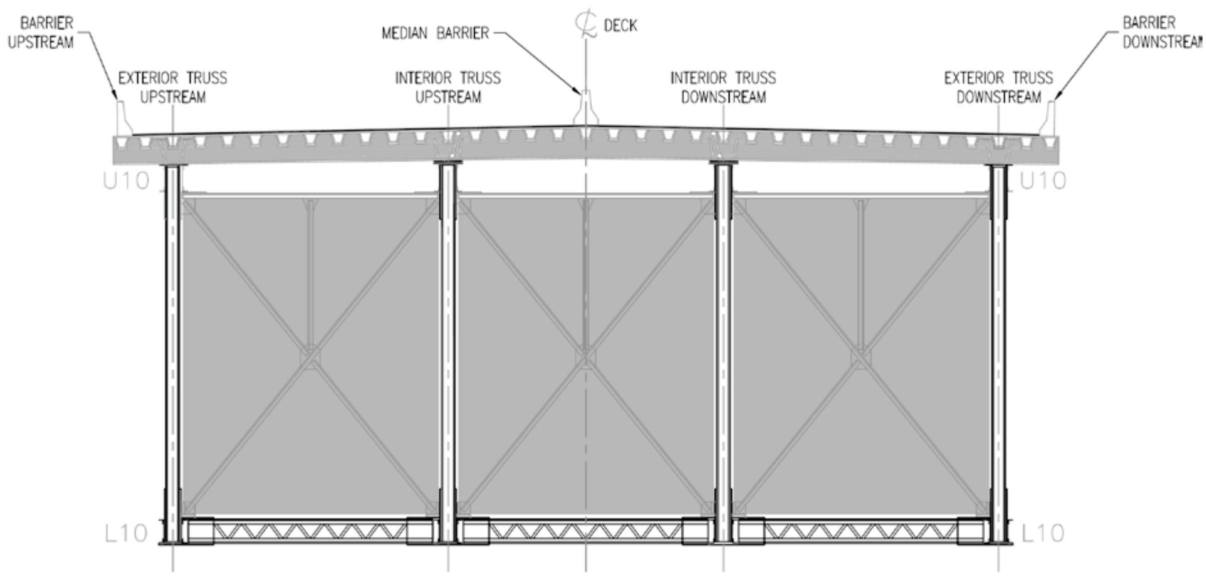

Figure 5 – Typical cross-section of spans 4W-2W/2E-4E – Section 6 (Source: JCCBI nomenclature drawings)

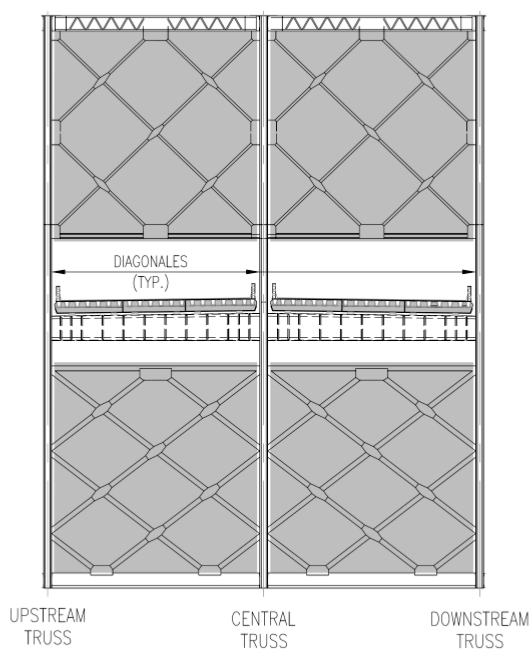

Figure 6 – Cross-section of spans 2W to 2E – Section 6 (Source: JCCBI nomenclature drawings)

The main characteristics of section 6 are presented inTable 4.

Table 4 – Section 6

	SECTION 6 SPANS 4W-3W AND 3E-4E	SECTION 6 SPANS 3W-2W AND 2E-3E	SECTION 6 SUSPENDED SPAN 0.5W-05E	SECTION 6 ANCHOR SPANS 2W-1W AND 1E-2E	SECTION 6 CANTILEVER SPAN 1W-05.W AND 0.5E-1E
Width	24.08 m (overall width)	24.08 m (overall width)	22.10 m (c-c of edge trusses)	22.10 m (c-c of edge trusses)	22.10 m (c-c of edge trusses)
Number of spans	2	2	1	2	2
Span length	78 m (256')	78.5 m (257' 6")	117.50 m (385' 6")	117.50 m (385' 6")	48.9506 m (160' 7 ½")
Number of girders/span	4	4	3	3	3
Girder height (c-c of chords)	9.14 m (30')	9.14 m (30')	15.19 m (49' 10 1/16" max)	31.70 m (104' max)	31.70 m (104' max)
Girder spacing	7.11 m (23' 4")	7.11 m (23' 4")	13.25 m (43' 6")	13.25 m (43' 6")	13.25 m (43' 6")
Slab	Orthotropic	Orthotropic	Orthotropic	Orthotropic	Orthotropic
Type	Simple spans	Simple spans	Continuous spans	Continuous spans	Continuous spans
Total length	763.45 m (2,504' 9")				

2.9.2.1 Paint – trusses

Although the steel spans have been extensively painted over time, it is virtually impossible for all paint containing lead to be disposed of. Since they are assembled members, areas painted or treated in the shop are never accessible during painting work and as a result, lead will always be present.

2.9.3 SECTION 7

Section 7 links the Seaway to the City of Brossard. As in section 5, the deck is made up of seven precast post-tensioned prestressed girders (Figure 7) with a spacing of 3.721 m.

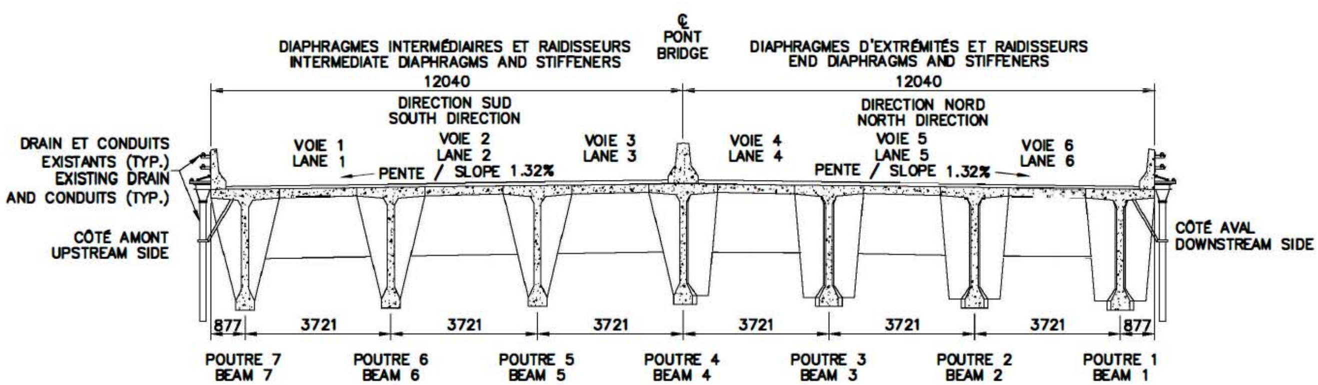

Figure 7 – Typical cross section – Section 7B

Section 7 consists of 10 spans with lengths ranging from 53.75 m to 51.41 m (total length of 528.07 m) and extends from axis 4E to axis 14E (abutment).

Only axes 4E and 5E are located over the St. Lawrence. Span 10E-11E crosses Highway 132 in the City of Brossard. The longitudinal slope is significant, close to 3%.

The main characteristics of section 7 are presented in Table 5.

Table 5 – Section 7

	SECTION 7A	SECTION 7A	SECTION 7B	SECTION 7B
Spans	4E to 8E	8E to 10E	10E to 13E	13E-14E
Overall width	24.08 m	24.08 m	24.08 m	24.08 m
Number of spans	4	2	3	1
Span length	53.75 m (176' 4")	51.41 m (168' 8")	52.53 m (172' 4")	52.68 m (172' 10")
Girder length	53.65 m (176')	51.308 m (168' 4")	52.451 m (172' 1")	52.451 m (172' 1")
Number of girders/span	7	7	7	7
Girder height	3.07 m	3.07 m	3.07 m	3.07 m
Girder spacing	3.721 m	3.721 m	3.721 m	3.721 m
Intermediate diaphragms	2	2	5	5
Reinforced concrete slab thickness	216 mm	216 mm	216 mm	216 mm
Type	Simple spans	Simple spans	Simple spans	Simple spans
Number of prestressing tendons	24 tendons: 12 7-mm strands/tendon	24 tendons: 12 7-mm strands/tendon	19 tendons 22 (10E-11E)	19 tendons
Type of prestressing	Freyssinet (STUP)	Freyssinet (STUP)	GTM (SEEE system)	GTM (SEEE system)
Total length	528.07 m (1732' 6")			

The girders rest on reinforced concrete hammerhead piers (Figure 8). The footings rest on the bedrock. Pier height ranges from 9 to 26 m.

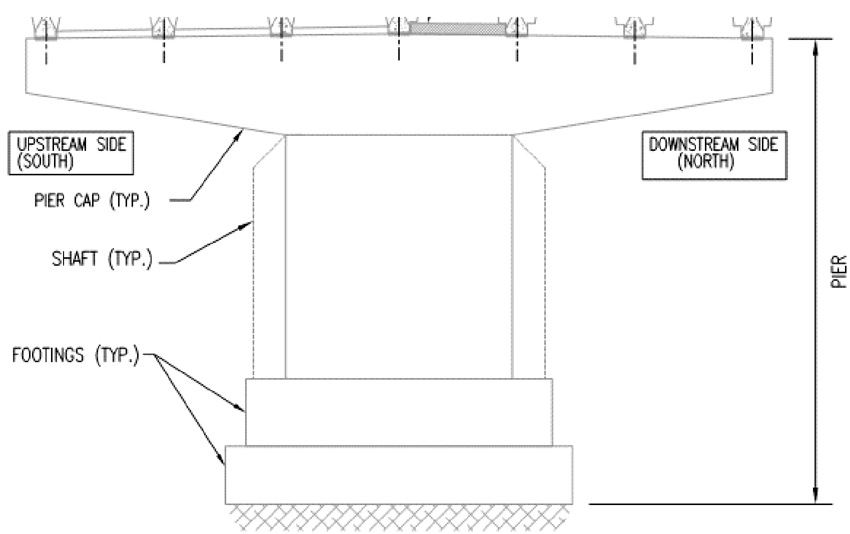

Figure 8 – Piers – Section 7 (Source: JCCBI nomenclature plans)

2.9.4 REINFORCEMENTS AND MAJOR REPAIRS

Over time, numerous reinforcements and repairs were needed to ensure the safety of users and the integrity of the structure. The prestressed concrete spans, and especially the edge girders, are the components that have deteriorated the most and that therefore have been the subject of the most repairs or reinforcements.

The main types of repairs and reinforcements are listed below. The following tables summarize the number of reinforcements carried out or planned before the deconstruction according to the information available as of June 8, 2016. Other strengthening or repairs could be added before the deconstruction, depending on the evolution of the structure.

Table 6 – Reinforcements – Girders – Sections 5 and 7

	NUMBER OF EDGE GIRDERS	WEIGHT OF THE REINFORCEMENT PER GIRDER (CONCRETE COMPONENT OF THE REINFORCEMENT)	WEIGHT OF THE REINFORCEMENT PER GIRDER (STEEL COMPONENT OF THE REINFORCEMENT)
Type 1 external post-tensioning (EPT1)	100	6 t	1 t
Type 2 external post-tensioning (EPT2)	63 and 26 internal girders	S. O.	5 t
Type 1 Queen-posts (QP1)	26	39 t	20 t
Type 2 Queen-posts (QP2)	14	20 t	7 t
Carbon Fibre Reinforced Polymer (CFRP)	72 and 27 internal girders	Not applicable	Not applicable
Strengthening under the span with posts	6	Not applicable	130 t per span
Modular trusses	90	Not applicable	50 t (QP1) or 32 t
Auxiliary girders	4	Not applicable	Not available

Table 7 – Reinforcements – Slab – Sections 5 and 7

	NUMBER OF SPANS	WEIGHT OF THE REINFORCEMENT PER SPAN (CONCRETE COMPONENT OF THE REINFORCEMENT)	WEIGHT OF THE REINFORCEMENT PER SPAN (STEEL COMPONENT OF THE REINFORCEMENT)
Slab – PT	27	1 t	0,70 t
Slab – passive	6	Not applicable	3,25 t

Table 8 – Reinforcements – Foundations – Sections 5 and 7

	NUMBER OF AXES	WEIGHT PER PIER (STEEL COMPONENT OF THE REINFORCEMENT)
Steel lining for pier shafts (average)	22	9,40 t
Pier caps – PT (internal or external)	48	1,15 t

2.9.5 SCOPE OF WORKS (QUANTITIES)

The unit weight used corresponds to the values in Table 3.4 of Standard S6-14: 24.5 kN/m³ for prestressed concrete, 24.0 kN/m³ for reinforced concrete, 23.5 kN/m³ for the asphalt wear layer. The quantities presented below are values appropriate for a preliminary design study and do not constitute data that can be used for drawings and specifications or calls for tenders.

2.9.5.1 Sections 5 and 7 – Concrete spans

The estimated quantities for the deck and foundations of sections 5 and 7 are respectively presented in Table 9 and Table 10.

Table 9 – Summary quantities – Deck

	SECTION 5 & 7A	SECTION 7B	TOTAL
Number of spans	44	6	50
Number of girders	308	42	350
Weight of girders and diaph. per span	1,210 t	1,030 t	59,420 t
Slab weight per span	345 t	335 t	17,190 t
Barrier weight per span	130 t	125 t	6,470 t
Weight of concrete reinforcements			1,925 t
TOTAL - Concrete			**85,005 t**
Total volume of concrete			34,037 m³
Weight of steel reinforcements			4,795 t
Weight of asphalt per span (65 mm)	190 t	185 t	9,470 t

Table 10 – Summary quantities – Piers

	SECTION 5	SECTION 7	TOTAL
Number of piers	39	9	48
Weight of pier cap	365 t	365 t	17,520 t
Mean height of pier shaft	16.90 m	15.10 m	
Mean weight of pier shaft	935 t	840 t	44,025 t
TOTAL			**61,545 t**
Total volume of concrete for pier cap/pier shaft			25,157 m³
Min. height of pier shaft	3.30 m	9.30 m	
Max. height of pier shaft	26.15 m	22.85 m	
Mean weight of footings	920 t	920 t	**44,745 t**
Total volume of concrete footings			18,290 m³
Weight of steel reinforcements (lining and PT pier caps)			**270 t**

2.9.5.2 Section 6 – Steel spans

The estimated quantities for the section 6 deck and foundations are presented in Table 11 and Table 12, respectively.

Table 11 – Summary quantities – Superstructure

	SECTION 6 SPANS 4W-3W AND 3E-4E	SECTION 6 SPANS 3W-2W AND 2E-3E	SECTION 6 SPAN 2W-2E	TOTAL
Number of edge trusses	4	4	2	
Number of internal trusses	4	4	1	
Weight of edge trusses	434 t	441 t	1,896 t	2,771 t
Weight of internal trusses	508 t	513 t	1,639 t	2,660 t
Weight of bracing	156 t	151 t	943 t	1,250 t
Weight of steel deck	990 t	996 t	3,276 t	5,262 t
Weight of steel railings	N/A	N/A	559 t	559 t
TOTAL – Steel				**12,502 t**
Concrete barriers	341 t	343 t	N/A	
TOTAL – Concrete				**684 t**
Asphalt weight	445 t	458 t	1,391 t	**2,294 t**

Table 12 – Summary quantities – Foundations

	SECTION 6
Number of piers	8
Min. height of pier shaft	37.37 m
Max. height of pier shaft	25.71 m
Mean height of pier shaft	30.61 m
Weight of pier shafts	34,765 t
Weight of footings	26,287 t
Total weight	**61,052 t**
Total volume	24,955 m^3

2.9.5.3 Summary

Table 13 provides a summary of the quantities.

Table 13 – Summary quantities – Total

	SECTIONS 5, 6 AND 7
Concrete	253,031 t
Steel	17,567 t
Asphalt	11,764 t

2.9.6 ICE CONTROL STRUCTURE

The Ice Control Structure, located upstream of the Champlain Bridge, was built in 1965, mainly for ice control in the La Prairie Basin and to reduce the erosion of the islands near Montreal, especially those created for Expo 67.

The 2,040-m-long structure is made up of 73 spans: 70 in concrete (precast prestressed concrete girders) 26.87 m in length, and three steel spans 53.34 m in length. This structure provides access to the Seaway dike, mobilization areas and dock located near pier 1W on the Champlain Bridge. This road access reduces the number of bridge closures.

The Ice Control Structure deck was recently rehabilitated and, according to Stantec's study (Stantec 2015a), is able to withstand legal loads. In the absence of an evaluation of the icebreaker piers, it is assumed that they have at least the same capacity. The Ice Control Structure is critical to the deconstruction project: it will provide access to the work area and serve as an essential link for the supply of materials to the work site and the removal of materials.

The approaches to the Ice Control Structure, both on Nuns' Island and at the Seaway dike, are currently being upgraded. The purpose of this work is to improve the layout and setup of control and monitoring equipment.

Figure 9 – Ice Control Structure

2.10 DETAILED PROJECT ACTIVITIES

In the sub-sections which follow, the various deconstruction options that have been considered are discussed, and the preferred alternatives are presented. The Champlain Bridge is described in above in sufficient detail to allow for consideration of the particular deconstruction techniques suitable for the major components of the bridge. Each of these techniques is then described and reasons forwarded as to why each is applicable, often supported by figures and pictures to demonstrate the actual use of that technique. The major components of the bridge are the concrete deck, the steel deck, the piers and the footings. Alternate techniques to address the deconstruction of each major component are then compared and a preferred option is selected. And it is important to recognize that each section of the bridge, and there are three of them, presents different challenges requiring different approaches.

The various techniques that have been considered are presented in Table 14 in section 2.10.1.3.

2.10.1 DECONSTRUCTION WORK

2.10.1.1 Available mobilization areas

The available mobilization areas under JCCBI jurisdiction are:

2.10.1.1.1 Nuns' Island

On the Nuns' Island side (north shore), a mobilization area is available along the road leading to the Champlain Bridge Ice Control Structure. However, redevelopment work is planned at the Ice Control Structure approaches, which limits the available area. This area does not provide any direct access to the water, but it is possible to build a jetty between axes 41W and 36W and access it via the Ice Control Structure road (Figure 10).

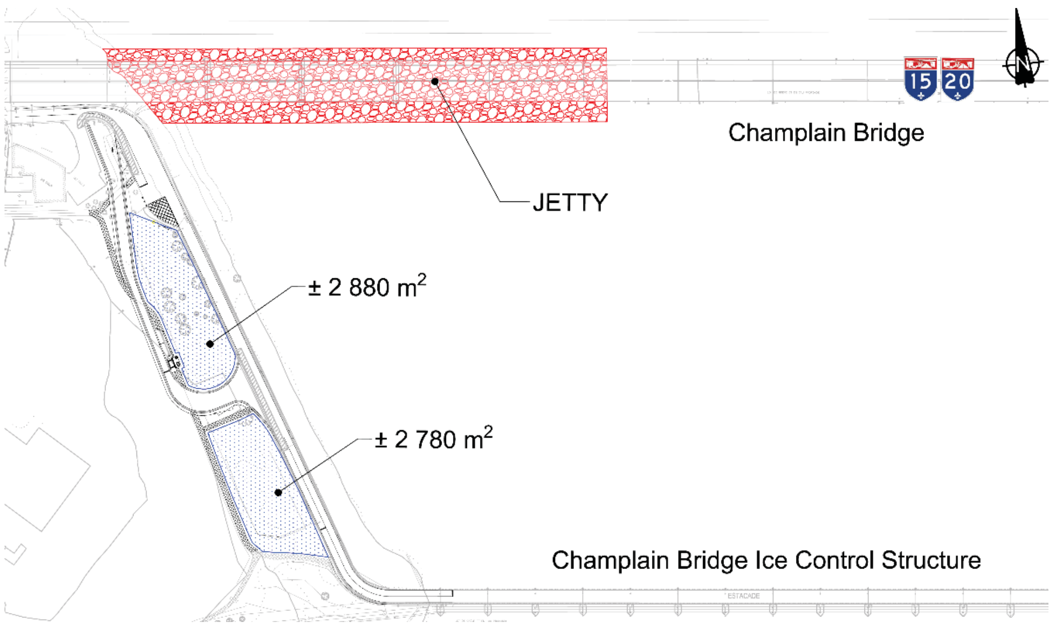

Figure 10 – Mobilization area – Nuns' Island

2.10.1.1.2 St. Lawrence Seaway dike

This area is located at the base of pier 1W on the St. Lawrence Seaway dike. The Ice Control Structure must be used to access the area by road. It is a private road under the jurisdiction of JCCBI. The dike can also be accessed by the river, and various docks have been set up there (Figure 11).

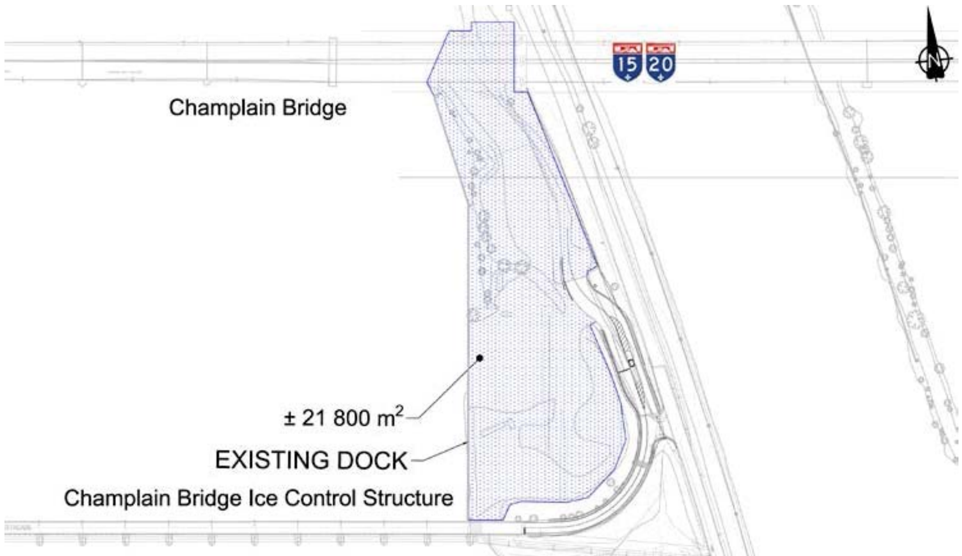

Figure 11 – Mobilization area – St. Lawrence Seaway dike

2.10.1.1.3 Brossard

Two mobilization areas are available on the South Shore side. The first area is located between axes 6E and 9E. A dock was set up that allows access to the Small La Prairie Basin, by barge or with a temporary jetty. The second area is located inside the highway onramps (Figure 12).

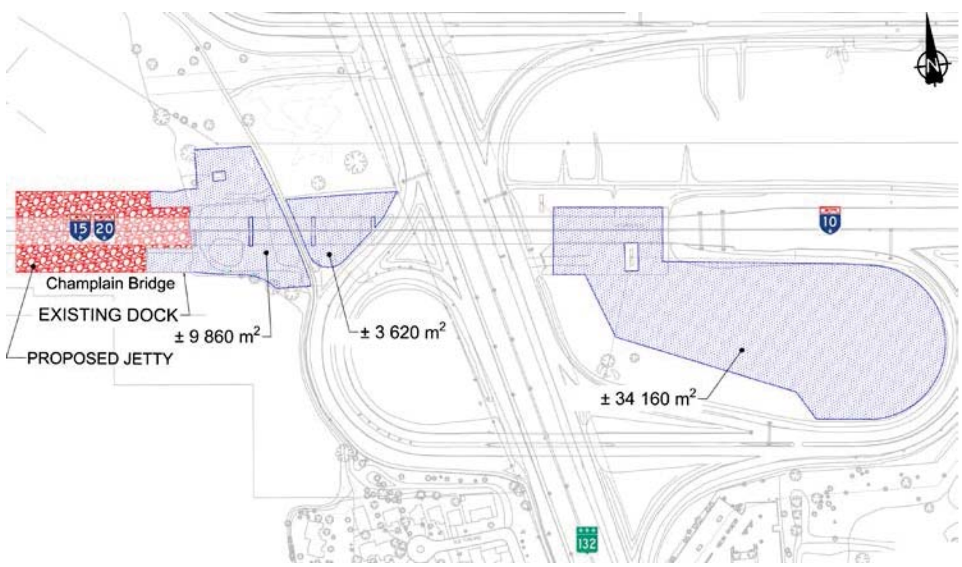

Figure 12 – Mobilization area – City of Brossard

2.10.1.2 Access to the various areas

This section presents the options for accessing the Champlain Bridge to carry out the deconstruction work. Access will involve a combination of methods, as the complexity of the structure does not allow the use of a single method. The access methods for the recommended scenario are:

- Access by the deck
- Access by land
- Access by barge
- Access by temporary jetty

The access method is dependent on several variables, including:

- Chosen demolition method
- Location of the components to be deconstructed
- Characteristics of the ground or river in the location of the component to be deconstructed
- Height of the component to be deconstructed

2.10.1.3 Selected deconstruction methods

Several deconstruction methods have been considered for the deck, the piers and the foundations. Pertinence, efficiency, pros and cons were analysed. Methods were then selected, based on technical, economic and environmental critieria. Table 14 summarizes the methods selected.

Table 14 – Selection of methods

<table>
<tr><th>METHOD</th><th>RETAINED / NOT RETAINED</th><th>CRITERIA FOR USE / REASON FOR EXCLUSION</th></tr>
<tr><td>Standard methods:</td><td></td><td></td></tr>
<tr><td>• Hydraulic hammer</td><td rowspan="3">Retained for:
• Concrete deck
• Pier caps and pier shafts
• Footings</td><td>Height up to about 15 m to limit dust problems and to use relatively standard equipment</td></tr>
<tr><td>• Concrete crusher with shear jaws</td><td>Height up to about 15 m to limit dust problems and to use relatively standard equipment</td></tr>
<tr><td>• Sawing and cutting</td><td>Suited to the piers and the sawing of the slab and diaphragms</td></tr>
<tr><td>• Hydrodemolition</td><td rowspan="4">Not retained</td><td>Not effective for large volumes ; used mainly for localized deconstructions</td></tr>
<tr><td>• Splitting</td><td>Not effective for large surfaces ; only for occasional work</td></tr>
<tr><td>• Demolition wrecking ball and crane</td><td>Not efficient for this project due to a lack of accuracy</td></tr>
<tr><td>• Thermal cutting and drilling</td><td>Not effective for large surfaces ; only for occasional work</td></tr>
<tr><td>Unlaunching (reverse launching):</td><td></td><td></td></tr>
<tr><td>• Standard launching gantry</td><td>Retained for:
• Concrete deck</td><td></td></tr>
<tr><td>• Lateral launching gantry</td><td>Not retained</td><td>Cumbersome logistics and of little interest compared to removal by crane</td></tr>
<tr><td>Removal by crane</td><td>Retained for:
• Concrete and steel deck
• Pier caps and pier shafts
• Footings</td><td>Retained for the Champlain Bridge only if access by water or jetty is required</td></tr>
</table>

METHOD	RETAINED / NOT RETAINED	CRITERIA FOR USE / REASON FOR EXCLUSION
Explosives	Retained for: • Pier caps and pier shafts • Footings Not retained for: • Concrete deck • Approach spans (4W-2W, 2E-4E) • Anchor spans (2W-0.5W, 0.5E-2E) • Suspended span (0.5W-0.5E)	If there is a reasonable alternative, which is the case here, this method is not acceptable to DFO for components other footings Environmental constraints based on the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters Risk of temporarily blocking the Seaway for longer than anticipated
Removal of full span	Not retained for the remainder of the study.	High risk for transporting large pieces Width exceeds that of the locks Transportation difficult
Reverse erection	Retained for: • Approach spans (4W-2W, 2E-4E) • Anchor spans (2W-0.5W, 0.5E-2E) • Suspended span (0.5W-0.5E)	Temporary bents in the water required for approach spans and anchor spans
Strand Jack Lowering	Retained for: • Approach spans (4W-2W, 2E-4E) • Suspended span (0.5W-0.5E)	Strengthening required to make modifications to the structure and allow hoisting Negotiation of closure of Seaway for a short period or work in the winter for the suspended span
Lift trusses off bearings – whole span	Not retained for the remainder of the study.	Problem maintaining the stability of existing parts during the hoisting of the cantilever portion of the anchor spans Uses high-capacity cranes
Balanced cantilever dismantling	Retained for: • Anchor spans (2W-0.5W, 0.5E-2E)	Technically unsuited for approach spans since they are simple spans
Span cable stays	Not retained for the remainder of the study.	Probably more costly and complex than temporary bents Presents an advantage if there are additional constraints (e.g., environmental, navigation) that limit or prohibit the installation of temporary bents in the water

2.10.1.4 Recommended scenario

The following scenario is recommended for deconstruction:

- Unlaunching for the concrete deck (T2)
- Cranes/cantilever/hoisting for the steel deck (TA1)
- Standard methods/sawing for pier caps and pier shafts (F1)
- Controlled explosion for the footings (S2)

2.10.1.4.1 Description of recommended scenario

Several usual methods were analyzed by integrating the specific constraints of the Champlain Bridge. Following an option analysis, a scenario that combines the methods was recommended. For the recommended method, a sequence of the work is presented.

2.10.1.4.1.1 Preparatory work

1. Remove lights, road signs, lane traffic lights and any other equipment.
2. Remove asphalt.
3. Remove barriers (it is the contractor's decision whether to remove them as the work progresses or to remove them all at the same time).
4. Remove span expansion joints (it is the contractor's decision whether to remove them as the work progresses or to remove them all and install plates to permit work site vehicles to access the site).
5. Install work site barriers (if needed).
6. Use conventional measures to prevent the fall of debris or materials (protect waterways, crossings, etc.).
7. Set up conventional measures to prevent workers from falling.

Access from the deck (all zones)

2.10.1.4.1.2 Deck – Concrete spans

2.10.1.4.1.2.1 Recommended scenario (T2)

Scenario T2 consists of using a standard launching gantry to remove the concrete girders. This technique can be used for all the concrete girders. However, the first span (44W-43W) on the Nuns' Island side will probably be deconstructed with the standard methods simply due to shoring under the girders. This will probably be easier.

Table 15 – Scenario T2

AREA	DECK METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
5-1	Unlaunching	By the deck	Self-propelled modular trailer	Brossard site or Seaway dike site
5-2				
5-3				
7-1				
7-2				

Deconstruction sequence – first span on Nuns' Island

1. Remove the reinforcements from the slab (passive and active supports and external prestressing on the diaphragms. Active reinforcements are considered to be able to be relaxed, otherwise the cables have to be cut;
2. Girder reinforcements:
    a. Reinforcement columns: remove before work
    b. PTE: remove if possible before work - loosen cables or cut with torch;
3. Using equipment on the ground, demolish the beams, slabs and diaphragms with hydraulic jaws, breakers or other devices. Small pieces fall to the ground. This debris is then transported to nearby sites or evacuated directly by trucks;

4. Special attention is required for the last beam: its stability must be ensured to prevent it from lateral buckling, a temporary device (steel elements will probably be sufficient) retaining it to the pier cap is therefore necessary.

Ground access (zones 5-1)

Unlaunching of the concrete deck

This method has been retained for the majority of the concrete deck. This method stems directly from the method used to build the current bridge structure, as well as for many works of this type, by "reversing" the construction process using a metal frame known as a "launching gantry."

The principle consists of separating the girders, such as by sawing the middle slab and crossbeams, before they are picked up by the launching gantry.

Launching gantries are generally made up of two main interwoven steel trusses (Figure 13). Their total length is close to twice the span to be crossed.

Figure 13 – Launching gantry

The weight of the launching gantry may constitute a disadvantage since it must be supported by the structure. However, the standard designs avoid having the launching gantry rest on the deck when in motion and, naturally, when handling girders. As shown in Figure 14, the launching gantry is supported by two or three feet, depending on the project phase, and these in turn are supported by way of the piers.

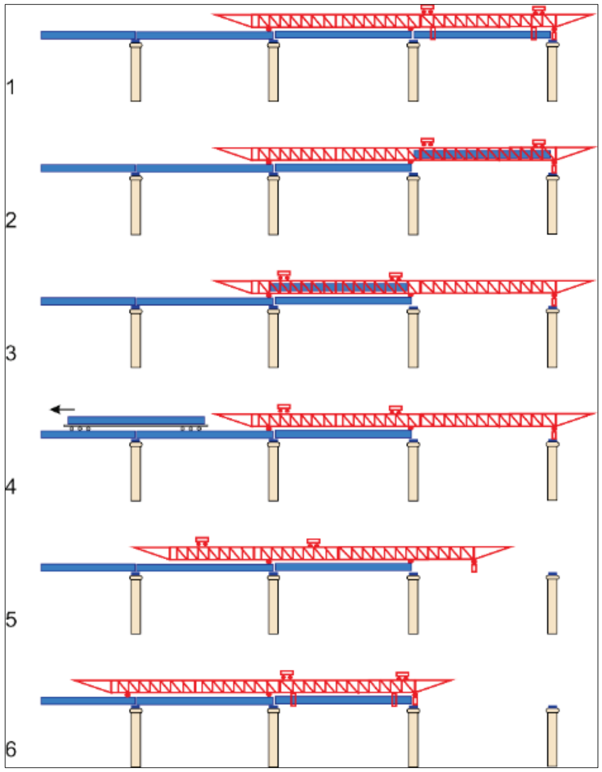

Figure 14 – Unlaunching

Deconstruction sequence – Concrete deck

1. Set up the slab support system: transversal steel beams or similar supports, attached to the girders and supporting the slab (see principle in Figure 15). This support system must be installed on the deck from the beginning over the entire width of the slab. Once the first strips have been installed, the contractor can either install the supports over the entire length of the span, or install them as the sawing progresses, continuing to place the supports over the entire width of the slab. Otherwise, because of the structural system, the connection between the slab segments and the girder will not be ensured.

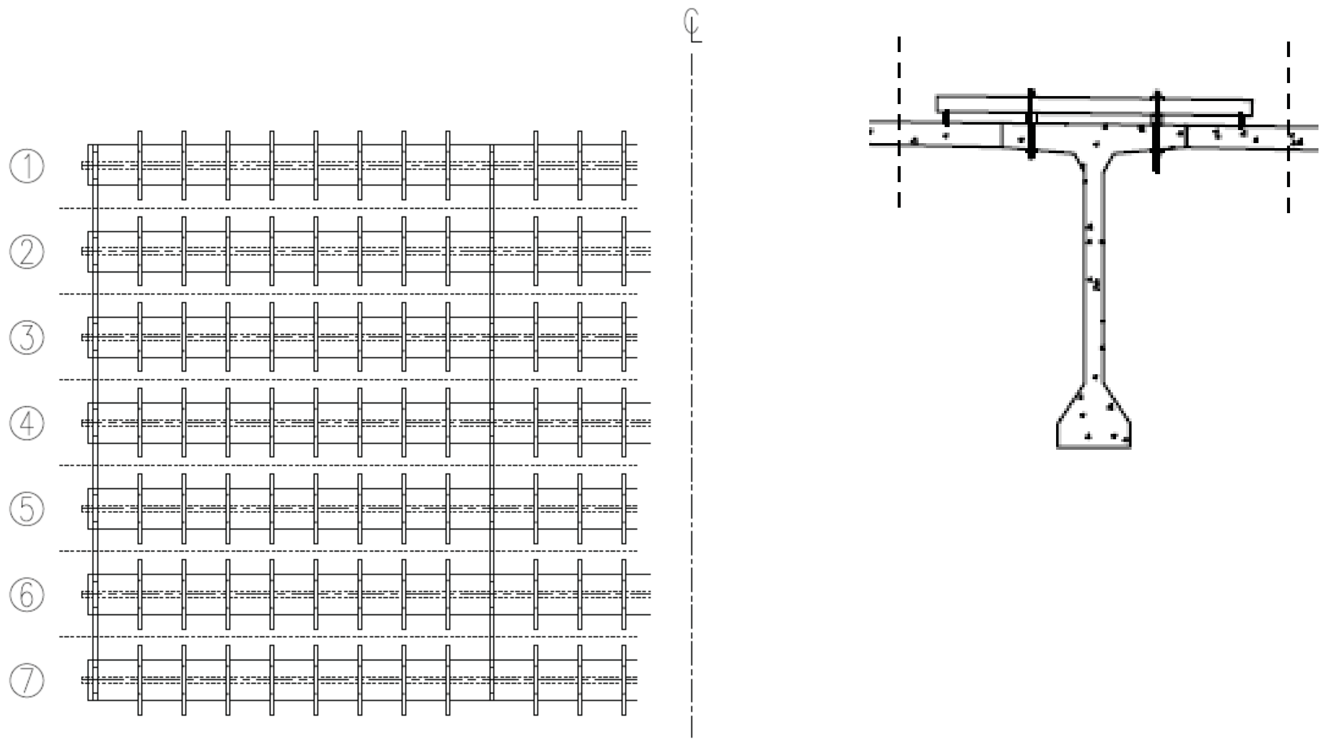

Figure 15 – Concept of slab support system: Plan view of the 7 girders (left) and cross section of one girder

2. Set up anti-lift mechanisms for the modular truss supports, at the edge of the pier cap opposite to the span being removed (these mechanisms can be reused for all the modular trusses as the work progresses).
3. Remove slab reinforcements (passive and active supports) and external prestressing of crossbeams. It is expected that the active reinforcements and external prestressing can be slackened; otherwise, the tendons will have to be cut.
    a. Option 1:
        i. Release all the prestressing tendons of the slab in one bay.
        ii. Cut the tendons with a torch: the heat will progressively slacken them.
    b. Option 2:
        i. Protect the edge of the slab with a metal plate or equivalent system in order to hold the lateral prestressing slab anchors that may be ejected and injure either workers or river users.

4. Saw the slab between the girders, in the middle.
5. Girder reinforcements:
    a. Modular trusses: leave the modular trusses in place and remove them immediately after removing the girder, also with the launching gantry (Figure 16 and Figure 17).
    b. External post-tensionning: leave in place and haul the girder away with the reinforcement
    c. Queen post #1: cut the bars with a torch and remove before releasing the girder.
    d. Queen post #2: leave in place and haul the girder away with the reinforcement.
6. Stabilize the girder that will be removed using a temporary mechanism connecting the crossbeam to the pier cap (this mechanism can be reused for all the girders).
7. Saw the crossbeam, including the internal prestressing cables, one bay at a time.
8. Depending on the method:
    a. Conventional launching gantry: the launching gantry places the girder on a self-propelled modular trailer on the deck, on the rear span (Figure 18 and Figure 19)
    b. Lateral launching gantry: the launching gantry moves the girder transversely past the edge of the deck and lowers it to a self-propelled modular trailer (SPMT) or barge, depending on the area.

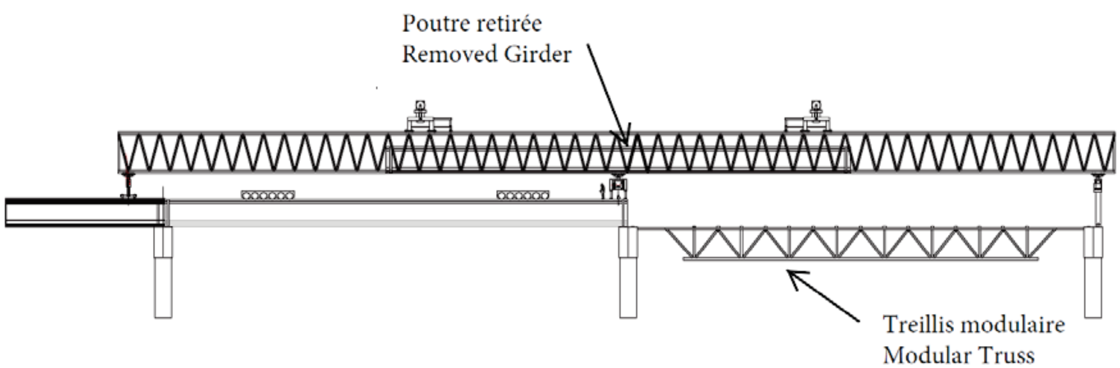

Figure 16 – Launcher - Elevation

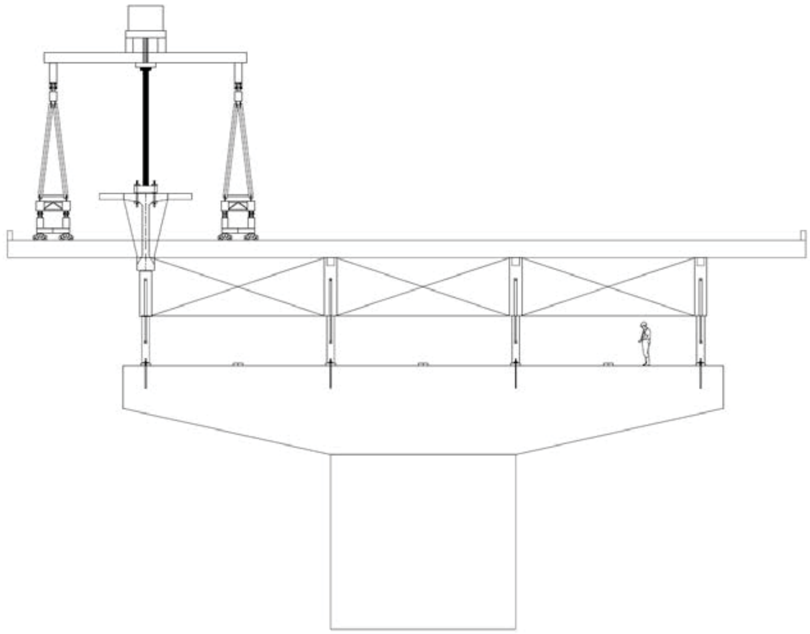

Figure 17 – Launcher – transverse section

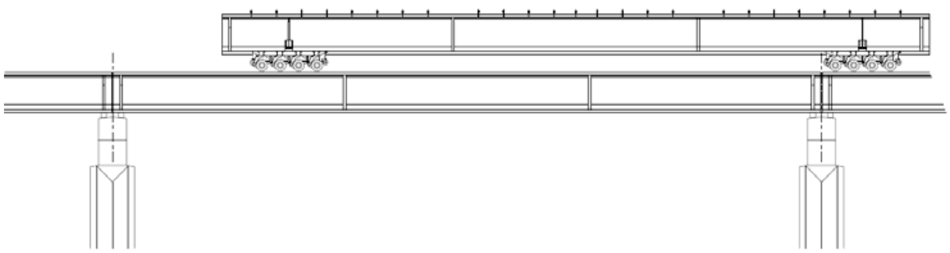

Figure 18 – SPMT – Elevation

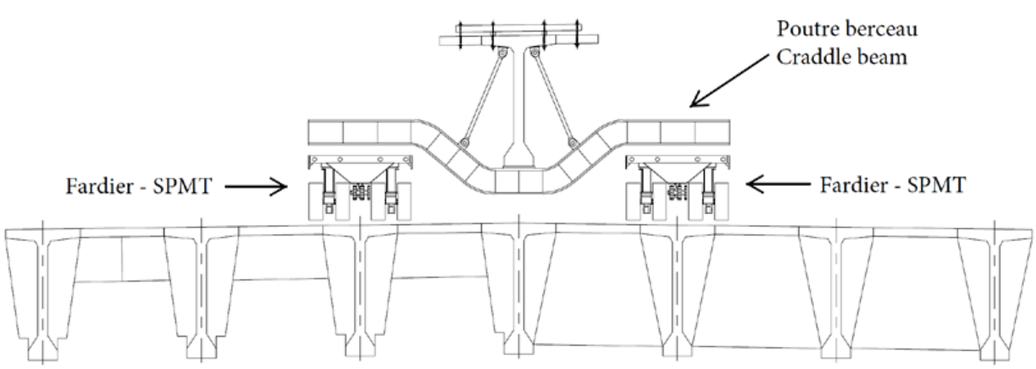

Figure 19 – SPMT – Transverse section – at mid-span (left) and over bearings (right)

Access by the deck (all areas). There are two possible options for hauling the girders away using the SPMT:

a. The SPMT accesses an area outside the deck where the girder is taken for subsequent operations (transport or on-site dismantlement);

b. The SPMT brings the girder to one of the steel spans at the Small La Prairie Basin (span 2E-3E or 3E-4E) where a stationary crane picks it up and places it on a barge to be hauled away, as this section has direct access to the Seaway.

Required mobilization area and equipment

With the recommended scenario, for an on-site dismantling, it is planned to use the area on the Brossard side. The space in this area allows enough girders to be stored to not decrease the optimal pace of the launching gantry, which is one to two girders per day.

2.10.1.4.1.2.2 Scenario T1 (option)

This scenario mainly consists of two methods: standard deconstruction method and removal by crane. When all optimal conditions for the standard method are present, it is used. When conditions are more difficult, removal by crane is used.

Table 16 summarizes the methods selected for each area.

Table 16 – Scenario T1

AREA	DECK METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
5-1	Conventional	By land	Truck	Nuns' Island site
5-2	Removal by crane	By jetty/floating wharf	Trucks or barges	Jetty
5-3	Removal by crane	By barge	Barges	Seaway dike or off site (transport directly by barge)
7-1	Removal by crane	By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-2	Conventional	By land	Trucks	Brossard site

2.10.1.4.1.3 Deck – Steel spans

2.10.1.4.1.3.1 Recommended scenario (TA1)

This scenario is a combination of several methods. Table 17 summarizes the methods selected for each area.

Table 17 – Scenario TA1

AREA	DECK METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
6-1	Hoisting of trusses in pairs	By barge	Barges	Seaway dike or off site (transport directly by barge)
6-2	Reverse erection with balanced cantilever	Using a temporary support	Barges	Seaway dike or off site (transport directly by barge)
6-3	Lower with strand jacks	By barge	Barges	Seaway dike or off site (transport directly by barge)
6-4	Reverse erection with balanced cantilever	Using a temporary support	Barges	Brossard site or off site (transport directly by barge)
6-5	Hoisting of trusses in pairs	By barge	Barges	Brossard site or off site (transport directly by barge)

Suspended span - Strand Jack Lowering

Strand jack lowering allows for the removal of large bridge sections. While the preparation for span removal can be quite involved, the actual removal operation can be completed rather quickly. The main span of the bridge was constructed in such a way that lowering the suspended span with strand jacks should be achievable with limited retrofit to the structure.

For the main span structure, the suspended span is designed to span as an independent unit from the ends of the cantilever structure. Strand jacks would be attached to the ends of the cantilever spans and the strand jack anchors to the corners of the suspended span truss. The suspended span would be separated from the main structure and lowered to a barge below. Two examples are illustrated in Figure 20 and Figure 21.

Figure 20 – Lowering of Suspended Span of the Carquinez Bridge
(source: Courtesy of Foothills Bridge Co (Photo by Jakub Mosur))

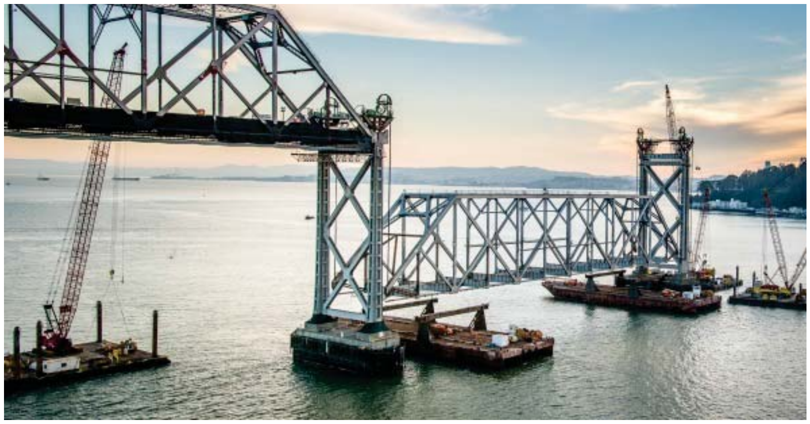

Figure 21 – San Francisco Oakland Bay Bridge – 504' Span Dismantling
Image Courtesy of Foothills Bridge Co (Photo by Sam Burbank)

For the suspended span, strand jack lowering would substantially consist of:

1. Remove the steel orthotropic deck in the anchor span or along the full length of the structure.
2. Install temporary supports under the anchor spans.
3. Install lowering components including strand jacks at the ends of the cantilever structure.
4. Attach strand jack anchorages to the suspended span and engage the strand jacks.
5. Cut the suspended span free from the cantilever structure and lower to barge below (Figure 22)
6. Transport span to processing area for dismantling.

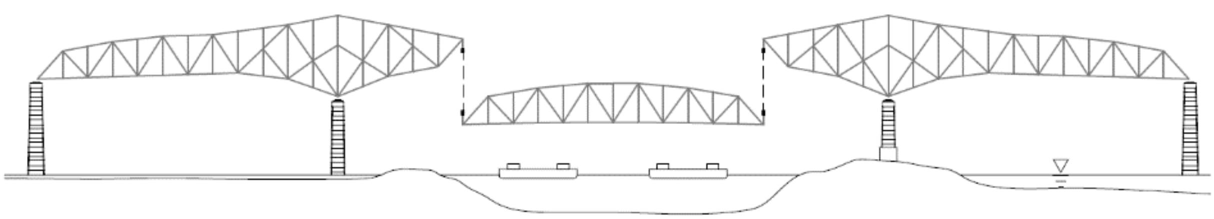

Figure 22 – Section 6 – Strand Jack Lowering – Suspended Span

Required mobilization area and equipment

Access below the main span varies and includes shallow water, the active Saint Lawrence Seaway channel, and land-to-water transitions. The suspended span will require barges positioned in the Seaway. The size of the suspended span will likely limit the distance it can be transported in the Seaway. Dismantling of the suspended span will likely need to be completed in the basin adjacent to the Seaway or at a processing site on land nearby.

Anchor spans – Reverse Erection

The reverse erection method attempts to reverse the original construction sequence used to erect the steel truss spans including the deck truss approach spans and the cantilever truss main span. The bridge was constructed using temporary supports with lightweight derrick cranes operating along the deck of the partially built structure. The reverse erection method reverses this sequence. Larger equipment will likely be limited for portions of the structure that are not supported by temporary supports (cantilever and suspended spans of the bridge main span). The contractor may choose to retrofit the bridge to allow for larger equipment in the cantilever and suspended spans or choose a different method of removal for this area.

The original erection of the main span was completed using piece-by-piece assembly, starting from the anchor span piers (2W and 2E) and working toward midspan. Three temporary support towers were used in each anchor span of the main span structure to support the truss as it was erected out to piers 1W and 1E and into the cantilever span (see Figure 23). The truss continued to be constructed out to midspan of the suspended span of the main span structure with two long cantilevers meeting in the middle. Jacking operations were used to “swing” the suspended span of the main span structure, freeing it from the cantilever span of the main span structure such that it simply hangs from the hangers at each end of the cantilever span of the main span structure. Once the main span truss structure was complete, concrete deck was added along the length. (It should be noted that a later bridge retrofit replaced the concrete deck and stringers with a lighter steel orthotropic deck.)

Reverse erection for the main span would involve piece-by-piece dismantling and substantially reversing the original erection sequence utilizing temporary supports in the anchor spans as required. It is likely that bridge removal would need to be completed using lighter bridge mounted derrick cranes or equipment operating below the structure from the water or from a temporary jetty.

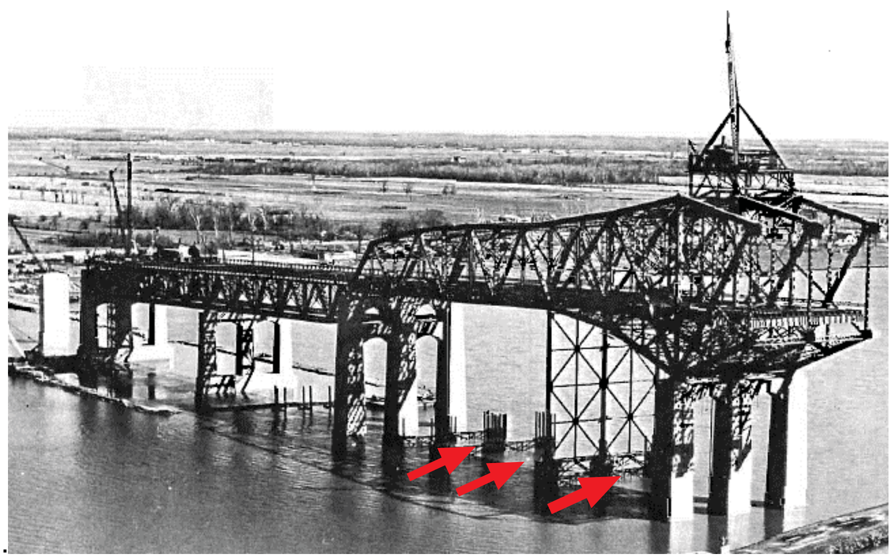

Figure 23 – Erection of Champlain Bridge Mainspan, Three Temporary Support Foundations Visible (source: The Champlain Bridge: A Photographic Story by Hans Van Der Aa)

The reverse erection method for the entire main span is presented here and would substantially consist of:

1. Install temporary supports under the anchor spans. Engage required support towers to support both anchor spans. It is likely that only one temporary support is required for this stage of removal.
2. Remove the steel orthotropic deck along the full length of the structure.

3. Dismantle the truss piece by piece working from midspan back to the anchor span of the main span structure. Temporary supports will likely require adjustment as the bridge is dismantled (Figure 24).

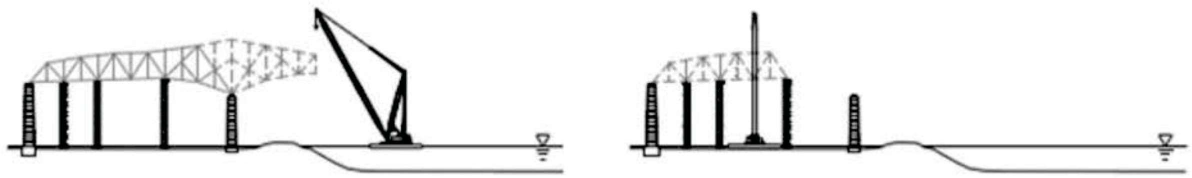

Figure 24 – Section 6 – Reverse Erection – Main Span

Required mobilization area and equipment

The reverse erection method provides the option of completing the removal operation from the bridge deck or from land/water below. Access below the main span varies and includes shallow water, the active Saint Lawrence Seaway channel, and land-to-water transitions. Thus, if reverse erection is completed from below the structure, the use of a temporary jetty, low draft barges, barge mounted cranes, or other means would be required. Bridge sections can be processed onsite or transported via barge or truck to offsite facilities.

The available mobilization zones are compatible with this method; the Seaway dike as well as the site in Brossard offer sufficient space to store steel parts. Moreover, if the parts are evacuated directly by barges to a site off-site, there are even fewer problems of space.

Approach spans – Lift the Trusses off Bearings

Similar to using strand jacks to lower spans, the lifting of trusses in complete sections off their bearings also allows for the removal of large bridge sections. It the recommended method for the approach span trusses.

Description of lifting operation

This operation will include the use of a marine crane operating on the water or a land crane operating on a temporary jetty. Depending on the size of crane used, either individual trusses or truss pairs can be lifted at one time. The lifting of truss pairs is generally more structurally stable, but requires a larger crane and more complex rigging. The removal of a full span by lifting individual approach span trusses is presented here and would substantially consist of:

1. Remove the steel orthotropic deck off the approach span.
2. Rig to the first truss with the primary crane.
3. Separate the first truss from the adjacent truss and remove the first truss with the primary crane.
4. Repeat steps 2 and 3 for the second truss.
5. Use hold crane or other means to temporarily support the fourth truss.
6. Repeat steps 2 and 3 for the third truss.
7. Rig primary crane to the fourth truss.
8. Release the hold crane and remove the fourth truss with the primary crane.

Required mobilization area and equipment

The approach spans are located over a shallow water area in the basin and in the Saint Lawrence River. It seems reasonable that a barge supported operation could be used for the proposed full span removal using modular jacking towers. For removal of individual truss spans, there is limited access for the two cranes required to remove the final two individual truss spans. The contractor will need to consider the location of the new bridge relative to the existing bridge for crane placement.

2.10.1.4.1.3.2 Scenario TA2 (option)

This scenario consists of deconstructing the bridge using reverse erection. Table 18 summarizes the methods selected for each area.

Table 18 – Scenario TA2

AREA	DECK METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
6-1	Reverse erection	Temporary supports (equipment on structure)	Barges	Seaway dike or off site (transport directly by barge)
6-2		Temporary supports (equipment on structure)	Barges	Seaway dike or off site (transport directly by barge)
6-3		Temporary supports (equipment on structure)	Barges	Seaway dike or off site (transport directly by barge)
6-4		Light equipment on structure	Barges	Brossard site or off site (transport directly by barge)
6-5		Temporary supports (equipment on structure)	Barges	Brossard site or off site (transport directly by barge)

2.10.1.4.1.4 Pier caps and pier shafts

2.10.1.4.1.4.1 Scenario F1 (recommended)

This scenario consists of two methods: standard demolition and sawing. When all optimal conditions for the standard method are present, then it is used. When conditions are more difficult, sawing is preferred.

Table 19 summarizes the methods selected for each area.

Table 19 – Scenario F1

AREA	PIER CAP AND PIER SHAFT METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
5-1	Standard	By land	Truck	Nuns' Island site
5-2		By jetty/floating wharf	Trucks or barges	Jetty
5-3	Sawing	By barge	Barges	Seaway dike or off site (transport directly by barge)
6-1/6-2		By barge	Barges	Seaway dike or off site (transport directly by barge)
6-4/6-5		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-1		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-2	Standard	By land	Trucks	Brossard site

Standard concrete demolition

This is the standard method used to demolish a structure. It makes use of standard equipment and techniques with which contractors are generally very familiar. These methods are therefore especially suited to areas where deck height, from the ground or barge level, does not exceed about 15 m. These methods can also be used to demolish the pier shafts, pier caps and footings outside the water.

Among the standard techniques, those retained are demolition by hydraulic and pneumatic hammers, shear-type concrete breaker (jaws) (Figure 25), and sawing. Some of these techniques are only optimal for partial demolition and cannot be considered effective for full demolition, especially given the size of the Champlain Bridge. Hydrodemolition, splitting and thermal cutting and drilling have therefore not been retained for the remainder of this study. Wrecking balls and cranes have also been discarded, as this type of demolition provides less control.

Figure 25 – Standard barge method used for the demolition of the Long Island Bridge in Boston Harbour (Source: Walsh Construction 2016)

Demolition sequence – Pier shafts, pier caps and footings – Access from the ground or jetty

1. Remove the external prestressing of the pier caps.
    a. The external prestressing can be slackened if corresponding measures have been taken, or cut with a torch.
    b. Internal prestressing: it will be handled by the machinery, as it was for the girders.
2. Using equipment on the ground or on a jetty, demolish the pier cap, pier shaft and footings in the areas above the ground or above the jetties, using jaw crushers, rock crushers, etc (Figure 26). Smaller pieces will then fall to the ground or the jetty. Excavators will be used to pick up the debris. The debris is then transported to nearby available sites (Nuns' Island, South Shore, St. Lawrence Seaway dike) or directly hauled away by barge or truck.

Access from the ground (areas 5-1 and 7-2) and from a jetty (area 5-2).

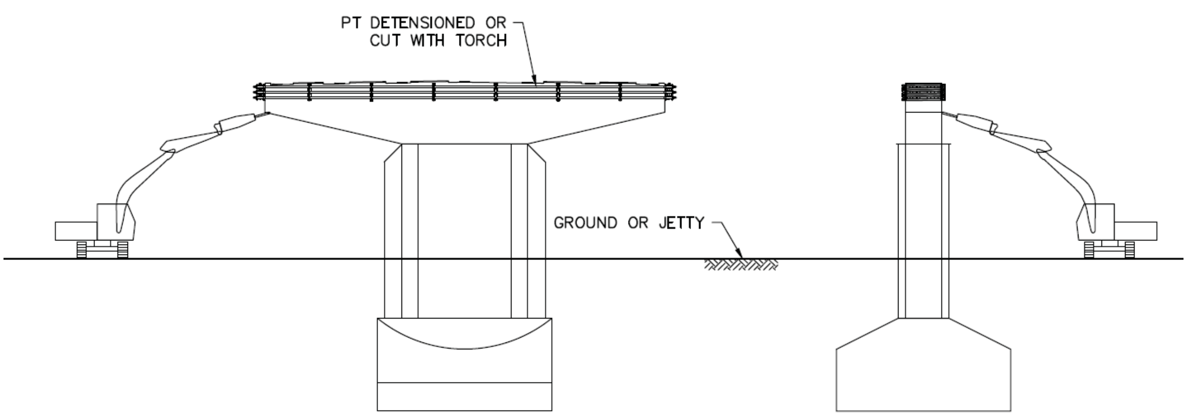

Figure 26 – Standard method – Foundations above water – Front and side views

Required mobilization area and equipment

The currently available mobilization areas are sufficient for this method to be used. Cranes and shovels are of standard size and do not require any particularly large spaces.

A temporary jetty is an access solution for shallow water areas. These jetties are generally made of backfill placed in the waterway and removed once the work has been completed. Access by jetty allows the same work methods to be used as for work over land. A jetty could potentially have environmental and hydraulic effects upon the St. Lawrence River that must be taken into account.

A few sections of the new Champlain Bridge are being built from temporary jetties (Figure 27). Reusing these jetties, by either modifying their configuration or simply reusing the materials, should be considered.

Figure 27 – View of the jetty for the construction of the new Champlain Bridge from the St. Lawrence Seaway dike

(photograph taken on June 22, 2016)

Two jetties are being considered, one on the Nuns' Island side, between axes 41 W and 36 W, which corresponds to area 5-2, and another between axes 4E and 6E, which corresponds to area 7-2; this jetty could even be extended to 1E (areas 6-4-partial and 6-5), as is being done for the construction of the new Champlain Bridge (see Figure 28 and Figure 29). The first jetty is required since the water depth does not allow the spans to be accessed by water. The second jetty is proposed, since it provides access to the spans at all time rather than for a determined period. Indeed, the water level is lowered during the seaway closure period, which makes the use of barges impossible. In addition, working from a jetty is simpler and more flexible than from barges, for example regarding allowed dimensions and weight of machinery and transport of materials.

Figure 28 – Diagram – Jetty on Nuns' Island side

Figure 29 – Jetty on Brossard side – New Champlain Bridge (Source: newchamplain.ca)

Crane removal for pier caps and pier shafts

The use of cranes to remove pieces from the piers is the recommended solution for piers with higher heights. The cranes can be installed on barges and other barges can go upstream to deposit the pieces at an area off site or to the available sites of mobilization. The deconstruction of the elements on mobilization sites should be planned to match the pace of the cranes, thus creating a smooth and efficient process.

Demolition sequence – Pier shafts, pier caps and footings – River area and Seaway dike

1. Remove pier cap prestressing.
   a. The external prestressing can be slackened or cut with a torch.
   b. Internal prestressing: it will be sawed, as with the girders (this applies to the piers in sections 5 and 7 as well as section 6: 2W and 2E).
2. Saw the pier cap either at the juncture with the pier shaft or in several pieces (cantilever portion, then at the juncture with the pier shaft, for instance). This option requires temporary supports for the parts of the cantilever pier cap (Figure 30).
3. For the section 6 piers with a steel lining from top to bottom (1W and 1E), the lining will be sawed at the same time as the concrete (Figure 31).
4. Take the pieces and place them on a barge or a transport vehicle using cranes.
5. Saw the non-submerged part of the pier shaft in layers with a weight that is compatible with the capacity of the crane.
6. Take the pieces and place them on a barge or a transport vehicle using cranes.
7. Remove or saw the pier shaft steel lining: if the steel lining is sealed, it must be sawed (section 6, for instance).
8. Saw the pier shafts in layers: the sawing is done by divers protected from the current by deflectors.
9. Haul the pieces away using cranes.

Access by barge (areas 5-3 and 7-1).

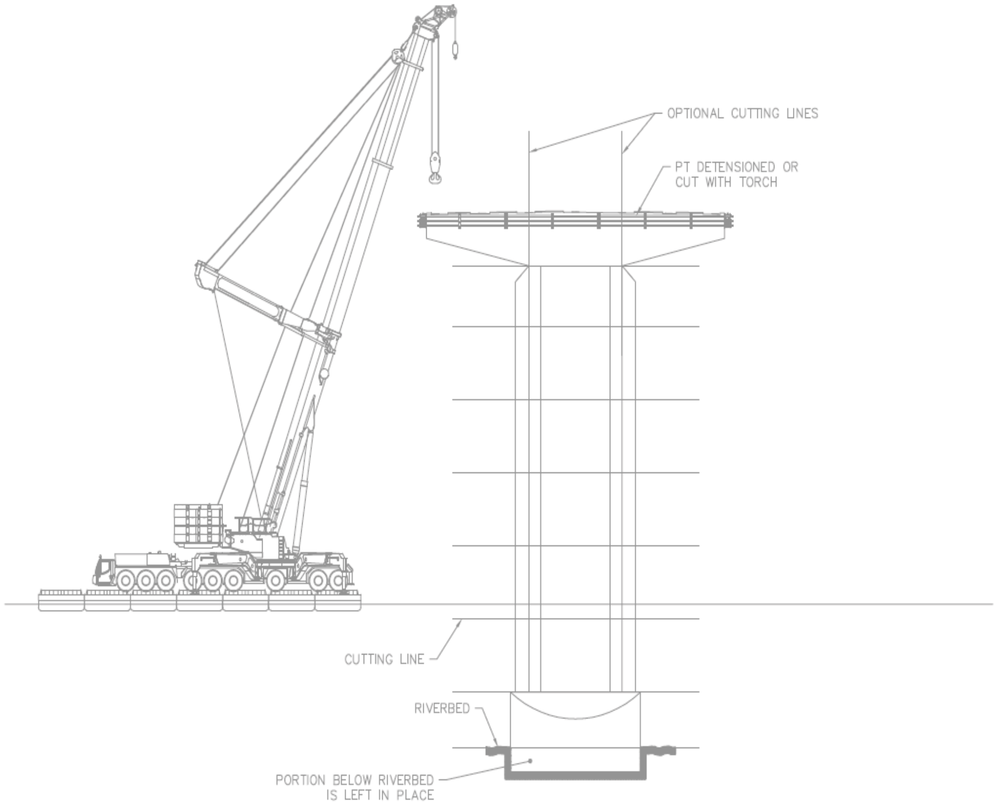

Figure 30 – Piers – Section 5 - Sawing

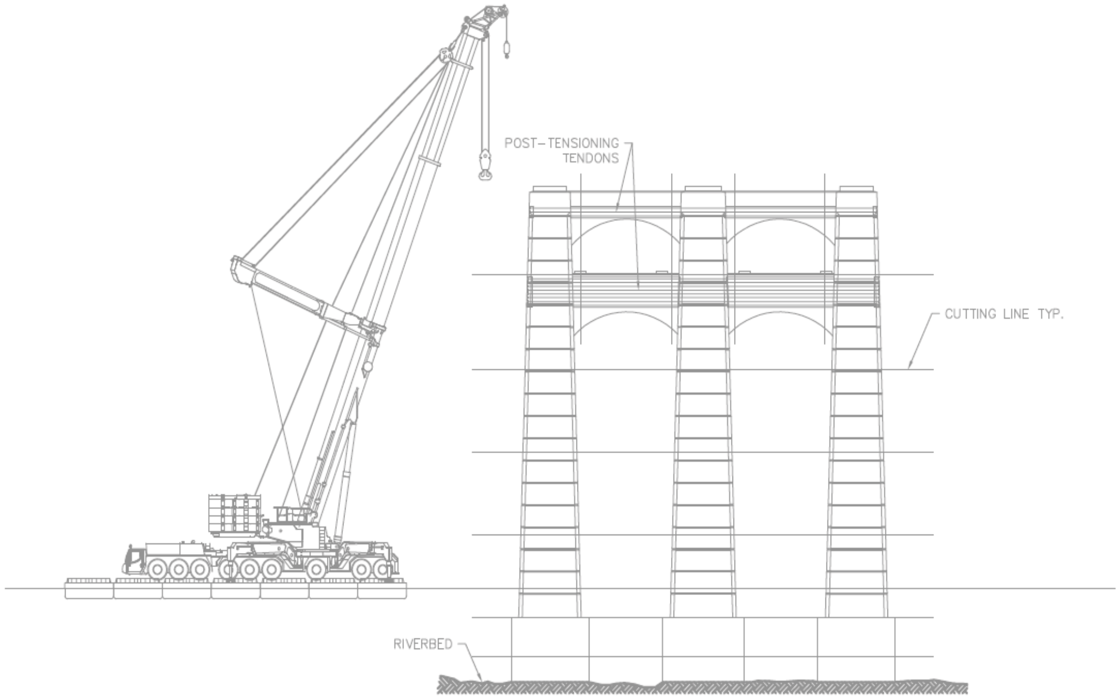

Figure 31 – Piers – Section 6 - Sawing

Required mobilization area and equipment

The cranes needed to lift the girders and the pier caps are not standard cranes. They must have a capacity of 500 to 1000 t, depending on the options that are chosen. This equipment is not particularly difficult to obtain, although it does require the use of companies specialized in heavy lifting.

The available mobilization areas are compatible with this method; the Seaway dike and the South Shore have enough space to store the pier caps, pier shafts and foundation components. In addition, if parts are hauled away directly by barge to an off-site area, then this frees up additional space for other activities.

2.10.1.4.1.4.2 Scenario F2 (option)

Scenario F2 consists of using the standard method to demolish the pier caps and pier shafts accessible from land (areas 5-1, 5-2 and 7-1) and explosives for all the others.

Table 20 summarizes the methods selected for each area.

Table 20 – Scenario F2

AREA	FOOTING METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
5-1	Standard	By land	Truck	Nuns' Island site
5-2		By jetty/floating wharf	Trucks or barges	Jetty
5-3	Explosives	By barge	Barges	Seaway dike or off site (transport directly by barge)
6-1/6-2		By barge	Barges	Seaway dike or off site (transport directly by barge)
6-4/6-5		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-1		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-2	Standard	By land	Trucks	Brossard site

2.10.1.4.1.5 Footings

2.10.1.4.1.5.1 Level of demolition of footings

The level of demolition of the footings must be clearly established. Most of the footings are embedded in the bedrock and completely removing them would require a reworking of the riverbed. For the time being, the level of demolition being considered is at the riverbed level. This hypothesis is compatible with the requirements stated by Transport Canada:

For navigation, the required levelling height depends on the following cases:

In navigable waters:

- *Piers levelled below the water level: a minimum draught of 2.0 m must be ensured at all times (low water levels). This requirement was used for the demolition of the Nuns' Island Bridge.*
- *Piers levelled above water level: Piers must be levelled (or not) high enough so that they are visible even during high waters (no minimum prescribed height). This requirement pertains to navigation only, but other factors may come into play (e.g., hydraulic behaviour, ice movement).*

In non-navigable waters:

- *Beyond approximately pier no. 40, where the draught is too low for navigation, the piers must be levelled to the riverbed.*

2.10.1.4.1.5.2 Scenario S2 (recommended)

Scenario S2 consists of using the standard method to demolish the footings accessible from land (areas 5-1, 5-2 and 7-1), and using explosives for all the others.

Table 21 summarizes the methods selected for each area.

Table 21 – Scenario S2

AREA	FOOTING METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
5-1	Standard	By land	Truck	Nuns' Island site
5-2		By jetty/floating wharf	Trucks or barges	Jetty
5-3	Explosives	By barge	Barges	Seaway dike or off site (transport directly by barge)
6-1/6-2		By barge	Barges	Seaway dike or off site (transport directly by barge)
6-4/6-5		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-1		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-2	Standard	By land	Trucks	Brossard site

Controlled explosion for footings under water

Controlled explosion is suited for use on the Champlain Bridge, despite the proximity of the new bridge. The demolition is highly controlled, and it is possible to demolish very close components, as is virtually always the case for explosion demolitions of buildings in urban areas. Demolition using explosives is the recommended method for footings under water.

Footings can be broken up using explosives, after which excavators can be used to remove the components. This method is feasible for the footings outside of the water as well as footings in the water, by placing excavators on the shore, on a temporary jetty or on barges. After the controlled explosion, the components would be removed with excavators.

Mitigation measures for the protection of fish are required. The identified measures consist of:

- Cofferdams around the footings: by pumping water into the cofferdam, the shockwave from the controlled explosion is no longer directly transmitted to the water around the cofferdam.
- A bubble curtain, used to dampen the shockwave transmitted into the water.
- Use of scare charges to scare off fish in the affected area.

The advantage of this demolition method is that it minimizes the work time in the water compared with other possible methods.

Demolition sequence - underwater footings

1. Set up the charges in accordance with a carefully designed blasting plan.
2. Potentially set up containment mechanisms and other means of environmental protection.
3. Proceed to detonate the charges.
4. Collect the debris using excavators.

5. Place debris on barges or trucks.

Required mobilization area and equipment

The mobilization areas are sufficient; they will be used to store the excavators and debris. The required equipment will consist of means of access (such as aerial platforms to access the girders from the deck, and barges for the piers) and corers to set up the explosives. Excavators will then be needed to pick up the debris.

2.10.1.4.1.5.3 Scenario S1 (option)

This scenario mainly consists of two methods: standard demolition and sawing. When all optimal conditions for the standard method are present, it is used. When conditions are more difficult, sawing is preferred.

Table 22 summarizes the methods selected for each area.

Table 22 – Scenario S1

AREA	FOOTING METHOD	ACCESS	TYPE OF TRANSPORT	MOBILIZATION AREA
5-1	Standard	By land	Truck	Nuns' Island site
5-2		By jetty/floating wharf	Trucks or barges	Jetty
5-3	Sawing	By barge	Barges	Seaway dike or off site (transport directly by barge)
6-1/6-2		By barge	Barges	Seaway dike or off site (transport directly by barge)
6-4/6-5		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-1		By barge/jetty/floating wharf	Trucks or barges	Brossard site or off site (transport directly by barge)
7-2	Standard	By land	Trucks	Brossard site

2.10.1.4.2 Technical assessment criteria

The technical assessment criteria are presented in Table 23. Our analysis thus far has allowed us to draw up a list of the following criteria and to retain five (highlighted in the table):

Table 23 – Technical criteria - Deconstruction

	CRITERION	DESCRIPTION	SELECTED	JUSTIFICATION
1	Duration of work	Total duration of deconstruction work – Quantitative / Moderate accuracy	Yes	
2	Risk of additional delays	Vulnerability of option considered with respect to additional delays: frequent interruptions due to climatic conditions, etc. – Qualitative / Moderate accuracy	No	Cost criterion
3	Risks for road and water crossings (Seaway, Highway 132, René-Lévesque Blvd.) and neighbouring structures (new bridge)	Risks generated by the option considered: traffic interruptions, damage to neighbouring structures (roads, new bridge) – Qualitative / Moderate accuracy	Yes	
4	Risk of damage to new bridge	Possibility that the method being considered could damage the structure: piers, deck, etc. – Qualitative / Moderate accuracy	No	Included in criterion 3 This risk will be controlled in all the options; therefore, there is no adequate differentiation among the options
5	Technical difficulty of the method	Inherent level of difficulty of the method – Qualitative / Moderate accuracy	Yes	
6	Difficult access	Option considered makes use of complex access techniques – Qualitative / Moderate accuracy		Included in criterion 5
7	Problems associated with existing reinforcements	Inclusion of the option considered with the existing reinforcements and resulting added complexity – Qualitative / Moderate accuracy		Included in criterion 5
8	Availability of equipment and specialized crews required for the method	Ease of finding the equipment needed for the option being considered – Qualitative / Moderate accuracy	Yes	
9	Origin of labour	Problem filling the type of jobs needed for the option being considered (local, regional and national levels) – Qualitative / Moderate accuracy	No	Included in criterion 8.
10	Origin of contractors and subcontractors	Problem finding contractors with the required resources at the local, regional and national levels – Qualitative / Moderate accuracy	No	Included in criterion 8.
11	Origin of suppliers	Problem finding suppliers with the required resources at the local, regional and national levels – Qualitative / Moderate accuracy	No	Included in criterion 8.
12	Origin of consultants	Problem finding consultants with the required resources at the local, regional and national levels – Qualitative / High accuracy	No	Included in criterion 8.
13	Required vs. available mobilization areas	Mobilization areas required for the successful implementation of the method being considered – Qualitative / Moderate accuracy	Yes	

2.10.1.5 Analysis of Options

By applying the methodology described in section 2.7, the assessment of the deconstruction options for the existing Champlain Bridge was completed and is shown in Table 24, Table 25, Table 26 and Table 27.

The assessment was carried out primarily by the team in charge of the deconstruction study, assisted by PTA experts for social and environmental issues.

Table 24 – Multicriteria analysis grid for deconstruction options – Concrete deck

ANALYSIS GRID PART 1 : DECONSTRUCTION WORK								
SUSTAINABLE DEVELOPMENT COMPONENT	CRITERIA	EVALUATION OF OPTIONS / SCENARIOS - CONCRETE DECK						
		WEIGHTING	T1: std/cranes			T2: unlaunching		
			Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result
TECHNICAL	Duration of work	1	5	5	51	4	4	56
	Risks for road and water crossings (Seaway, Route 132, René-Lévesque Blvd.) and neighbouring structures (new bridge)	4	4	16		5	20	
	Technical difficulty of the method	3	4	12		4	12	
	Availability of equipment and specialized crews required for the method	3	4	12		4	12	
	Required vs. available mobilization areas	2	3	6		4	8	
ECONOMIC	Costs	4	4	16	58	5	20	57
	Jobs	3	5	15		4	12	
	Origin of labour	4	4	16		3	12	
	Risk of overstepping project deadline	2	3	6		4	8	
	Commercial navigation	1	5	5		5	5	
ENVIRONMENTAL	Water quality	3	2	6	23	3	9	39
	Greenhouse gas emissions	2	1	2		3	6	
	Biodiversity	3	2	6		3	9	
	Contaminated soil and sediment	2	3	6		5	10	
	Consumption of resources/Residual materials	1	3	3		5	5	
SOCIAL	Recreational navigation	1	3	3	40	4	4	60
	Nuisances	4	2	8		3	12	
	Public support	3	3	9		4	12	
	Health and safety	4	3	12		4	16	
	Knowledge/Innovation	4	2	8		4	16	
Total points obtained*			T1: std/cranes		172	T2: unlaunching		212

***see graphical representation of results for visualization by component**

Table 25 – Multicriteria analysis grid for deconstruction options – Steel deck

ANALYSIS GRID PART 1 : DECONSTRUCTION WORK									
SUSTAINABLE DEVELOPMENT COMPONENT	CRITERIA	EVALUATION OF OPTIONS / SCENARIOS - STEEL DECK							
		WEIGHTING	TA1: cranes/cantilever/strand jack			TA2: reversed erection			
			Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result	
TECHNICAL	Duration of work	**1**	5	5	**42**	4	4	**44**	
	Risks for road and water crossings (Seaway, Route 132, René-Lévesque Blvd.) and neighbouring structures (new bridge)	**4**	4	16		3	12		
	Technical difficulty of the method	**3**	2	6		2	6		
	Availability of equipment and specialized crews required for the method	**3**	3	9		4	12		
	Required vs. available mobilization areas	**2**	3	6		5	10		
ECONOMIC	Costs	**4**	5	20	**51**	3	12	**51**	
	Jobs	**3**	3	9		5	15		
	Origin of labour	**4**	3	12		4	16		
	Risk of overstepping project deadline	2	3	6		3	6		
	Commercial navigation	1	4	4		2	2		
ENVIRONMENTAL	Water quality	**3**	3	9	**37**	2	6	**29**	
	Greenhouse gas emissions	**2**	2	4		2	4		
	Biodiversity	**3**	3	9		2	6		
	Contaminated soil and sediment	**2**	5	10		4	8		
	Consumption of resources/Residual materials	**1**	5	5		5	5		
SOCIAL	Recreational navigation	**1**	4	4	**56**	4	4	**52**	
	Nuisances	**4**	3	12		3	12		
	Public support	**3**	4	12		4	12		
	Health and safety	4	3	12		3	12		
	Knowledge/Innovation	4	4	16		3	12		
Total points obtained*			TA1: cranes/cantilever/strand jack		**186**	TA2: reversed erection		**176**	

***see graphical representation of results for visualization by component**

Table 26 – Multicriteria analysis grid for deconstruction options – Pier shafts and pier caps

ANALYSIS GRID PART 1 : DECONSTRUCTION WORK								
SUSTAINABLE DEVELOPMENT COMPONENT	CRITERIA	EVALUATION OF OPTIONS / SCENARIOS - PIER CAPS AND PIER SHAFTS						
		WEIGHTING	F1: std/cranes			F2: controlled explosion		
			Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result
TECHNICAL	Duration of work	1	2	2	45	5	5	40
	Risks for road and water crossings (Seaway, Route 132, René-Lévesque Blvd.) and neighbouring structures (new bridge)	4	4	16		3	12	
	Technical difficulty of the method	3	4	12		3	9	
	Availability of equipment and specialized crews required for the method	3	3	9		2	6	
	Required vs. available mobilization areas	2	3	6		4	8	
ECONOMIC	Costs	4	3	12	54	5	20	54
	Jobs	3	5	15		3	9	
	Origin of labour	4	4	16		3	12	
	Risk of overstepping project deadline	2	3	6		4	8	
	Commercial navigation	1	5	5		5	5	
ENVIRONMENTAL	Water quality	3	2	6	23	1	3	17
	Greenhouse gas emissions	2	1	2		2	4	
	Biodiversity	3	2	6		1	3	
	Contaminated soil and sediment	2	3	6		1	2	
	Consumption of resources/Residual materials	1	3	3		5	5	
SOCIAL	Recreational navigation	1	3	3	40	2	2	40
	Nuisances	4	2	8		2	8	
	Public support	3	3	9		2	6	
	Health and safety	4	3	12		2	8	
	Knowledge/Innovation	4	2	8		4	16	
Total points obtained*			F1: std/cranes		**162**	F2: controlled explosion		**151**

***see graphical representation of results for visualization by component**

Table 27 – Multicriteria analysis grid for deconstruction options – Footings

ANALYSIS GRID PART 1 : DECONSTRUCTION WORK								
SUSTAINABLE DEVELOPMENT COMPONENT	CRITERIA	EVALUATION OF OPTIONS / SCENARIOS - FOOTINGS						
		WEIGHTING	S1: std/cranes			S2: controlled explosion		
			Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result
TECHNICAL	Duration of work	1	1	1	38	5	5	44
	Risks for road and water crossings (Seaway, Route 132, René-Lévesque Blvd.) and neighbouring structures (new bridge)	4	4	16		4	16	
	Technical difficulty of the method	3	2	6		3	9	
	Availability of equipment and specialized crews required for the method	3	3	9		2	6	
	Required vs. available mobilization areas	2	3	6		4	8	
ECONOMIC	Costs	4	3	12	54	5	20	54
	Jobs	3	5	15		3	9	
	Origin of labour	4	4	16		3	12	
	Risk of overstepping project deadline	2	3	6		4	8	
	Commercial navigation	1	5	5		5	5	
ENVIRONMENTAL	Water quality	3	3	9	30	1	3	25
	Greenhouse gas emissions	2	1	2		2	4	
	Biodiversity	3	4	12		4	12	
	Contaminated soil and sediment	2	2	4		1	2	
	Consumption of resources/Residual materials	1	3	3		4	4	
SOCIAL	Recreational navigation	1	3	3	48	2	2	48
	Nuisances	4	3	12		3	12	
	Public support	3	3	9		2	6	
	Health and safety	4	4	16		3	12	
	Knowledge/Innovation	4	2	8		4	16	
Total points obtained*			S1: std/cranes		**170**	S2: controlled explosion		**171**

***see graphical representation of results for visualization by component**

2.10.1.6 Analysis and Conclusion

2.10.1.6.1 Concrete deck

The multicriteria evaluation shows that the unlaunching solution (T2) presents a clear advantage (Figure 32). This solution is not only the best one from a technical standpoint, but also from an environmental and social standpoint. With respect to cost, this option is comparable to removal by crane.

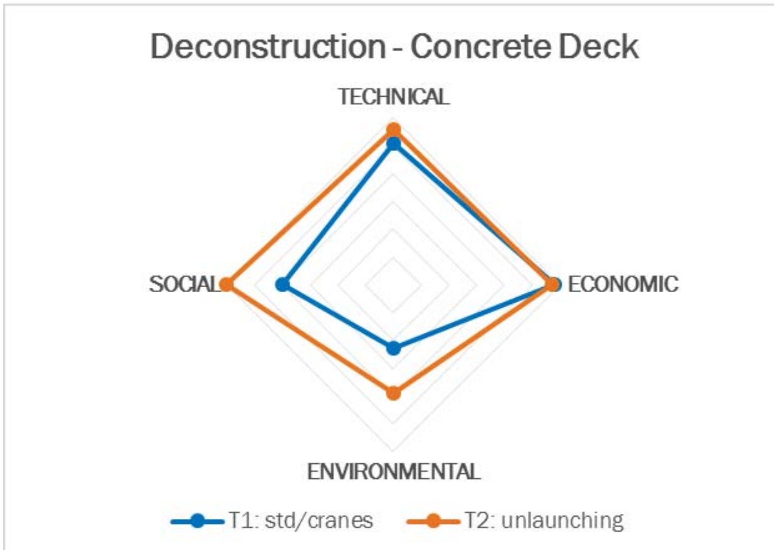

Figure 32 – Comparative analysis – Concrete deck

2.10.1.6.2 Steel deck

The multicriteria evaluation shows that the crane/cantilever/hoisting solution (TA1) presents a slight advantage (Figure 33). It also presents an advantage from a social standpoint.

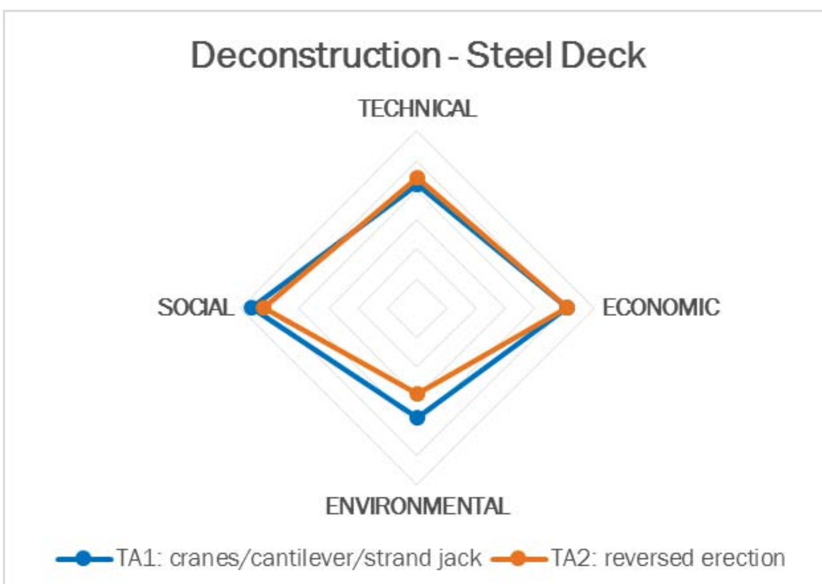

Figure 33 – Comparative analysis – Steel deck

2.10.1.6.3 Pier caps and pier shafts

The multicriteria evaluation shows that the standard method and cranes solution (F1) presents a clear advantage (Figure 34). This solution is better or equivalent for all four criteria (technical, cost, environmental and social).

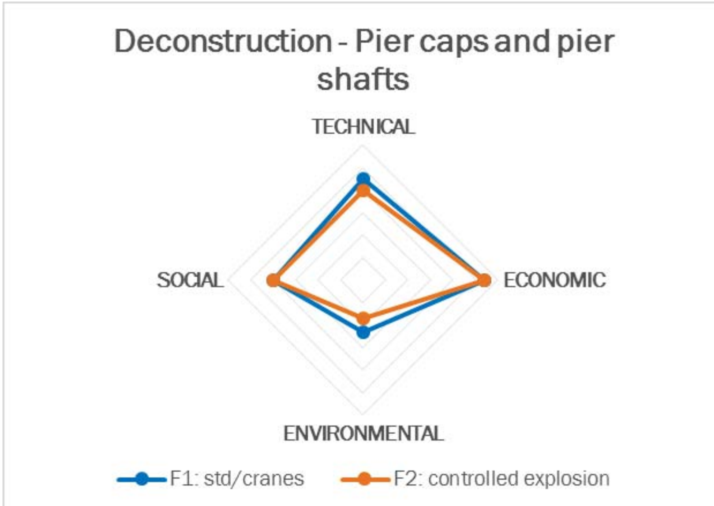

Figure 34 – Comparative analysis – Pier shafts and pier caps

2.10.1.6.4 Footings

The multicriteria evaluation shows that the two solutions are equivalent (Figure 35). They have almost the same total score. However, the controlled explosion solution (S2) is better from a technical standpoint, and it has a substantially shorter timeframe than the standard methods and sawing. In fact, the duration of the work performed with the latter method is especially long; it is estimated at more than three times the duration of the explosion method, which has a considerable impact on the total duration of the work. The reason is that the sawing operations require a lot of time and the number of crews working simultaneously is limited by the availability and cost of the high-capacity cranes required to remove the materials. Therefore, controlled explosion is the preferred solution.

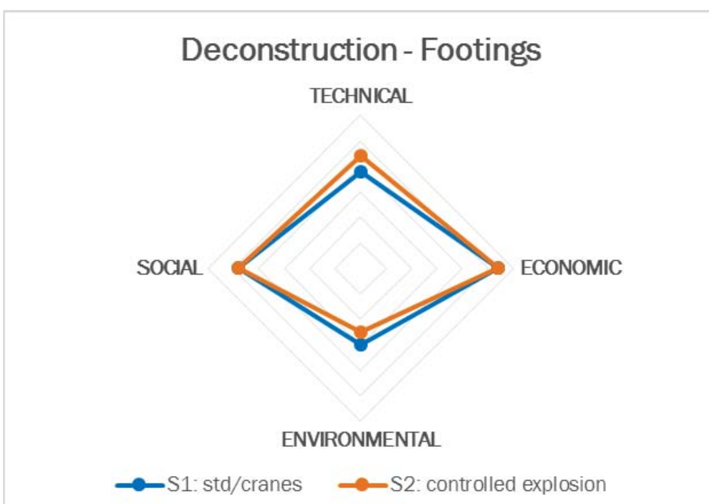

Figure 35 – Comparative analysis – Footings

2.10.2 MATERIALS TRANSPORTATION

The transportation of materials is an important activity in the bridge deconstruction project. It depends on, among other things, the deconstruction methods and sequences, and the valuation of materials. It must be flexible with minimal disruption to citizens.

The materials to be transported are mainly concrete from beams, slabs and piers, steel from modular trusses and structural repairs, and other materials from lighting system, electrical boxes, signaling system, spinning, structural monitoring system, etc. Given their relative importance in terms of quantity, transportation of steel and concrete have been analysed. As for the other materials, they have to be removed before the deconstruction work of the structural elements begins.

2.10.2.1 Potential Recovery Sites

The transportation alternatives are directly linked to the location of the recycling facilities and recovery sites. Several demolition contractors have confirmed that all the materials can be recycled in the Montreal area. This would be the most economical approach, because transportation costs are fairly high and have a direct impact on recycling. It is therefore understandable that the need to transport materials over large distances makes it less interesting and less profitable for the more remote recyclers and contractors, who would tend to prefer to source locally.

During bridge deconstruction, the contractor may use various recycling sites on Montreal's north or south shore or send some of the materials (such as crushed concrete) directly to other construction sites in the metropolitan area.

For the purposes of the study, we have considered various Montreal-area recycling centres, which are shown in Figure 36. Table 28 lists their names and indicates how far they are from the Champlain Bridge. These recyclers recycle concrete and/or steel.

Our discussions with demolition and recycling companies also led us to understand that concrete is often processed directly on site before transportation, and steel from demolition is normally cut into pieces that are free from oil or paint residues before being shipped to a steel mill and/or sold at auction. However, the steel mill in Contrecœur has indicated that they could recover the entire steel structure directly if it were delivered to their site.

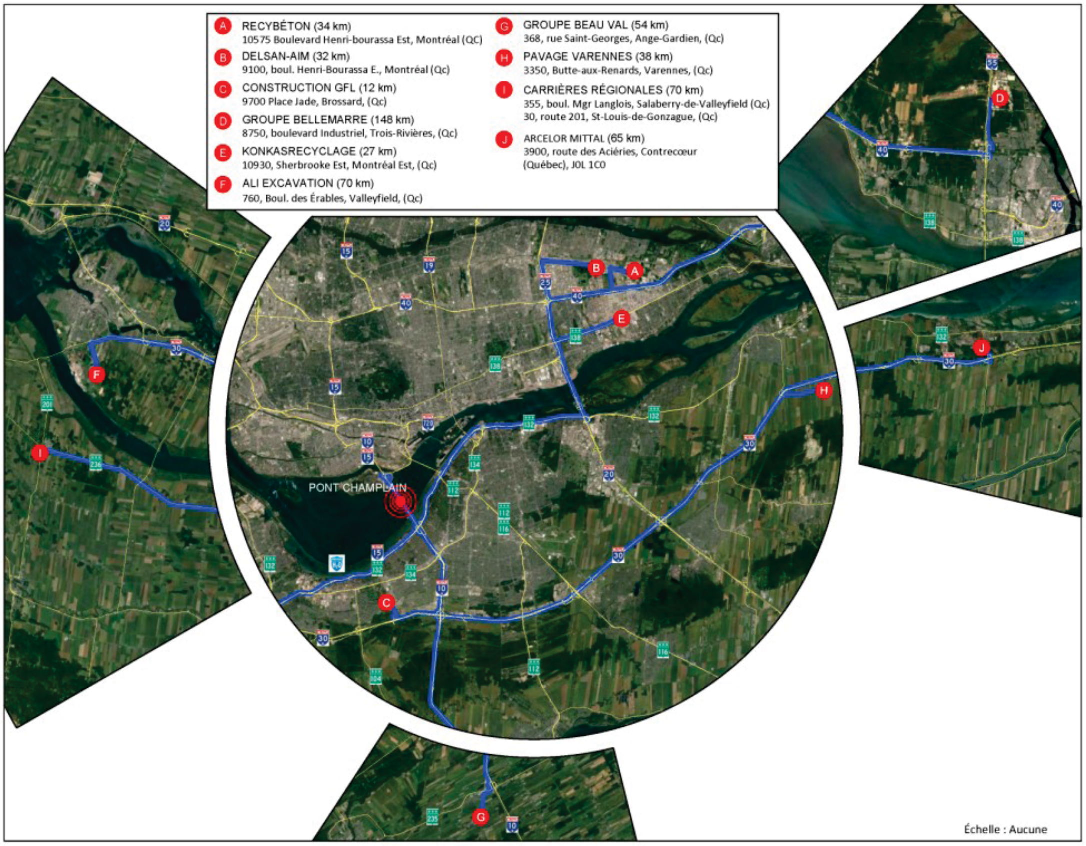

Figure 36 – Recycling Centres

Table 28 – Distance by Road from the Champlain Bridge to the Recycling Centres

	NAME	ADDRESS	DISTANCE
A	Recybéton	10575, boul. Henri-Bourassa E., Montréal	32 km
B	Delsan-AIM	9100, boul. Henri-Bourassa E., Montréal	32 km
C	Construction GFL	9700 Place Jade, Brossard	18 km
D	Groupe Bellemarre	8750, boul. Industriel, Trois-Rivières	150 km
E	Konkas Recyclage	10930, Sherbrooke E. Montréal	36 km
F	Ali Excavation	760, boul. des Érables, Valleyfield	73 km
G	Groupe BauVal	368, rue Saint-Georges, Ange-Gardien	60 km
H	Pavages Varennes	3350, Butte-aux-Renards, Varennes	44 km
I	Carrières Régionales	355, boul. Mgr Langlois, Valleyfield	67 km
J	Arcelor Mittal	3900, rue des aciéries, Contrecoeur	65 km

2.10.2.2 Dismantling and Handling Sites

Based on the deconstruction methods identified in the previous section, the following dismantling and handling sites will be required:

A. Île-des-Sœurs site;
B. Seaway dike site;
C. Brossard site north of Route 132;
D. Brossard site south of Route 132.

Sites A and C both have a land portion and a marine portion. The sections of the bridge over land can be accessed from grade, and the zones close to Île-des-Sœurs and the South Shore in Brossard can be accessed from jetties. The two semi-permanent jetties proposed for these zones provide work areas near the bridge for deconstruction, dismantling and materials handling, as well as for marine transportation around the bridge.

The deconstruction work zones and dismantling and handling sites can therefore be grouped as follows:

Table 29 – Dismantling and Handling Sites

DECONSTRUCTION ZONE	SPAN (AXES)	MODE OF TRANSPORTATION TO THE HANDLING SITE	DISMANTLING AND HANDLING SITE
5-1	44W to 41W	Land	A
5-2	41W to 36W	Land (Jetty)	A
5-3, 6-1 and 6-2	36W to 0.5W	Marine	B
6-3	0.5W and 0.5E	Seaway	C
6-4, 6-5 and 7-1	0.5E to 4E	Marine	C
7-1	4E to 6E	Marine or land where there is a jetty	C
7-2	6E to 10E	Land	C
7-2	10E to 14E	Land	D

Deconstruction Zones 5-1 and 5-2 –> Dismantling and Handling Site "A"

For the land portion of the Champlain Bridge on Île-des-Sœurs between Axes 44W and 41W (Zone 5-1), demolition can take place directly from grade. In this area, the materials from demolition would be dismantled or demolished, bulk crushed, and inventoried for transportation, directly in the work area (Figure 37).

For deconstruction of the spans between Axes 41W and 36W (Zone 5-2), a semi-permanent jetty similar to the current one for the new Champlain Bridge will have to be built, as barges cannot access this zone directly due to the shallow draft. Like the other zone, the area on the jetty should allow for demolition directly from grade, processing of the materials, and truck loading and haulage.

Conventional demolition of these bridge sections between Axes 44W and 36W is expected to generate an estimated 25,000 t of concrete (10%) and 500 t of steel (3%).

Note that this bridge zone at the edge of Ile-des-Sœurs is particularly constrained, and the lack of space could be a problem should the contractor choose to use the unlaunching method to remove a significant proportion of the bridge's concrete girders in this area. More detailed analysis will therefore be required at the next engineering stages to confirm the space available in relation to the new bridge, determine the actual surface area of the semi-permanent jetty and lay out traffic lanes for trucks coming off the Ice Control Structure during the work.

Figure 37 – Dismantling and Handling Site "A" - Île-des-Sœurs

Deconstruction Zones 5-3, 6-1 and 6-2 —> Dismantling and Handling Site "B"

These deconstruction zones are between Axes 36W and 0.5W. They include the concrete section of the bridge over the St. Lawrence River, which represents approximately 65% of the concrete (36W-4W), and part of the metal structure around and above the dike (4W-0.5W). The current plan is to use barges to create a work surface on the water to transport and support the deconstruction equipment (i.e., cranes) and to receive the materials, bridge elements (trusses, girders, etc.) and debris from demolition.

The demolition materials will be transported to dismantling and handling site "B" on the Seaway dike, illustrated in Figure 38. This is an existing work area with a surface area of approximately 22,000 m². It is currently being used for maintenance work on the Champlain Bridge, with road access via the Champlain Bridge Ice Control Structure. The location of this site is of particular interest because it is relatively far from residential areas, and the noise generated by material processing activities would therefore be less audible.

Dismantling site "B" will be used to:

- Dock the barges used for demolition;
- Serve as a dismantling and handling centre;
- Receive and load trailers for road transport;
- Receive and load river barges to transport materials to ports such as Montreal, Contrecœur, Trois-Rivières and Valleyfield.

Assuming that the concrete girders will be deposited by crane, the quantities of materials to be dismantled and treated between Axes 36W and 0.5W represent approximately 160,000 t of concrete and 10,000 t of steel. For the dismantling of the concrete spans, a steady demolition rate of about one span per week represents 2,000 to 2,500 tonnes of concrete per week. In this case, the 22,000 m² of space available on the dike is sufficient for the demolition equipment (shovels, crusher) and for loading onto trucks or barges.

In the case of barge transport, however, handling and transportation of materials from the deconstruction of the bridge's concrete spans could be a problem if the barges cannot move freely on the St. Lawrence River during the winter months.

Figure 38 – Dismantling and Handling Site "B" – Seaway Dike

Deconstruction Zones 6-3, 6-4, 6-5, 7-1 and 7-2 —> Dismantling and Handling Site "C"

These deconstruction zones between Axes 0.5W and 10E include the suspended span over the Seaway (0.5W-0.5E), the steel structure of the river segment to the south (0.5E-4E), a concrete section over water (4E-6E) and part of the land section north of Route 132 (6E-10E). Axes 0.5W to 4E would normally be deconstructed using barges. Axes 4E to 6E of the bridge could be dismantled using a semi-permanent jetty similar to the zone on the shore of Île-des-Sœurs, and/or barges. The land-based section between Axes 4E and 10E would normally be deconstructed by conventional methods using hydraulic excavators.

The quantities of materials between Axes 0.5W and 10E represent approximately 53,000 t of concrete and 10,000 t of steel. The available surface area is approximately 13,500 m² plus the surface area of the jetty, which is approximately 6,000 m². This entire area would be used to handle the transported materials to be demolished or dismantled, bulk crushed and inventoried for transportation.

Figure 39 shows the location of the semi-permanent jetty and the available work area.

Figure 39 – Dismantling and Handling Site "C" and "D" – Brossard

Deconstruction Zone 7-3 –> Dismantling and Handling Site "D"

The land-based section of the Champlain Bridge in Brossard above and south of Route 132 between spans 10E and 14E allows for conventional demolition directly from grade. The quantities of materials in this section to be dismantled and processed represent approximately 13,000 t of concrete and 100 t of steel.

The surface area available between the access ramps is 34,160 m². An area of approximately 10,000 m² would be required to handle the demolition materials, crush the concrete and organize road transport to recycling facilities and recovery sites. Note, however, that the entire available surface area of the site (34,000 m²) would be occupied by the site facilities and a storage area.

2.10.2.3 Transportation alternatives

The transportation alternatives presented are an initial assessment for the project. Note that a marine scenario is one that is characterized by marine transportation of materials over a longer distance than simply to one end of the bridge by barge. Given the presence of the river, barges will obviously be used for the sections being deconstructed. This section examines the option of transporting them over longer distances.

To compare the transportation scenarios, the following primary assumptions were made:

- 90% (250,000 t) of the demolished materials will be transported in bulk form, either by road, marine or rail transport;
- 10% (25,000 t) of the steel materials such as girders, light stands, safety barriers and the like will be transported as separate pieces (breakbulk). Individual pieces of steel, like the bulk products, can also be transported by road, marine or rail;
- Dismantling operations will take place:
  - 5 days per week;
  - 180 days per year (9 months).
- It is assumed that deconstruction will not take place during the winter months, except in the case of Section 6;
- In order to ease traffic congestion during the day, the hours of operation for road transport will be between 6:00 p.m. and 6:00 a.m., for a total of 10 hours per day, 5 days per week;
- The final assumption is that transportation of materials for the Champlain Bridge demolition project will be ongoing for three years, or 540 days.

2.10.2.3.1 Road transportation

Compared to other transportation methods, road transport allows to remove materials from the demolition zone quickly and continuously, depending, of course, on the transportation infrastructure found near the site.

Truck transportation offers the advantage of a high degree of flexibility and the ability to service virtually all recovery sites directly. It also allows direct travel from point A to point B, i.e., from the point of origin to the final destination, without changing modes. It can also easily adjust supply (capacity) to demand, which is not necessarily the case for other modes. On the other hand, a significant portion of trucking costs are borne by the public, as trucking uses subsidized public infrastructure at a low cost, unlike other modes of transportation, which generally own their own infrastructure or operate on the basis of a "user-pays" model.

Road transport involves the use of diffrents sizes of trailer depending on the type and size of material to be transported. For the deconstruction project, the following assumptions have been taken:

- Dump trailer (with belt) with a 37-tons rating for the payload is the type of trailer that is expected to be used to haul the broken or crushed concrete to the recycling centres.

Figure 40 – Dump Trailer

- Flat-bed trailer with a 34-tons payload rating will be used for the transportation of steel beams, plates, and other steel products in section. Flat bed trailer can be 14.6 to 16.1 m (48 to 53 ft) long.

Figure 41 – Flat-bed Trailer

Based on the primary assumptions listed above, demolition of the Champlain Bridge will result in about 14 trucks per day between the dismantling sites and the recycling centres.

Table 30 – Number of Trucks per Day

TRAILER TYPE	PAYLOAD (TONNES)	PRODUCT (TONNES)	NUMBER OF LOADS (TOTAL)	PERIOD (DAYS)	NUMBER OF LOADS (PER DAY)
Dump Trailer	37	250,000	6,757	540	13
Flat-bed Trailer	34	25,000	735	540	1

To meet a demand of 13 to 14 loads per day, a fleet of two to five trailers would be required for road transport, depending on the round trip distance between the Champlain Bridge and the selected recycling site. Table 31 shows the number of trailers per day a carrier would need to meet the transportation needs, for each potential site.

Table 31 – Trailers to Support Transportation Flow

ACTIVITY	COMPANY	RETURN TRIP (KM)	TRAVEL SPEED (90 KPH)	TRAVEL TIME (MIN)	LOADING AND UNLOADING (MIN)	TOTAL TRIP TIME (MIN)	OPERATING PERIOD (10 HOURS) (600 MIN)	NUMBER OF TRIPS (#/DAY)	TRAILER FLEET
Recycler	Recybéton (Montréal)	64	90	43	60	103	600	6	3
Recycler	Delsan-AIM (Montréal)	64	90	43	60	103	600	6	3
Recycler	Consruction GFL (Brossard)	36	90	24	60	84	600	8	2
Recycler	Groupe Bellemarre (Trois-Rivières)	300	90	200	60	260	600	3	5
Recycler	Konkas Recyclage (Montréal)	72	90	48	60	108	600	6	3
Recycler	Ali Excavation (Valleyfield)	146	90	97	60	157	600	4	4
Recycler	Groupe BauVal (Ange-Gardien)	120	90	80	60	140	600	5	3
Recycler	Pavages Varennes (Varennes)	88	90	59	60	119	600	6	3
Recycler	Carrières Régionales (Valleyfield)	134	90	89	60	149	600	5	3

Road Vehicle Load and Size

The Vehicle Load and Size Limits Guide is published by the Quebec's *Ministère des Transports, de la Mobilité durable et de l'Électrification des transports*. The maximum length of a tractor-trailer is 23 m. On average, the trailer alone measures 48 to 53 ft. (14.65 to 16.20 m). Trailer width is 2.6 m, and the height of the vehicle with its load must not exceed 4.15 m.

Annual Permit for Outsized Loads

Transportation companies in Quebec can obtain an annual permit for exceptional transport. A special travel permit is required if the load of a truck and its trailer is more than 27.5 m long, 4.40 m wide and 4.30 m high.

Thaw Zones and load restrictions

Thaw zones restrinctions apply between mid-March and mid-May each year. Trucks operating during that period will be subject to load restrictions. The Champlain Bridge is located in Thaw Zone 1. Load restrictions are shown in the Table 32.

Table 32 – Thaw Period Load Restrictions

PERIOD	START	END	DUMP TRAILER (TONNES)	FLATBED TRAILER (TONNES)
Normal	Mid-May	Mid-March	37	34
Thaw	Mid-March	Mid-May	30	28

Trucking network

The map below (Figure 42) shows the trucking network under *Ministère des transports, de la Mobilité durable et de l'électrification des Transports* (MTMDET) jurisdiction. Sections in green are roads with unrestricted access, those in red are roads where trucking is completely or partially banned, and finally those in yellow are restricted roads. It should be noted that overweight vehicles have not been allowed on the existing Champlain Bridge since October 11, 2016.

The trucking network can be studied in more detail once the recovery site(s) for the Champlain Bridge demolition have been selected. At this stage of the study, it can nevertheless be conclude that most of the recycling sites identified below are accessible via the trucking network.

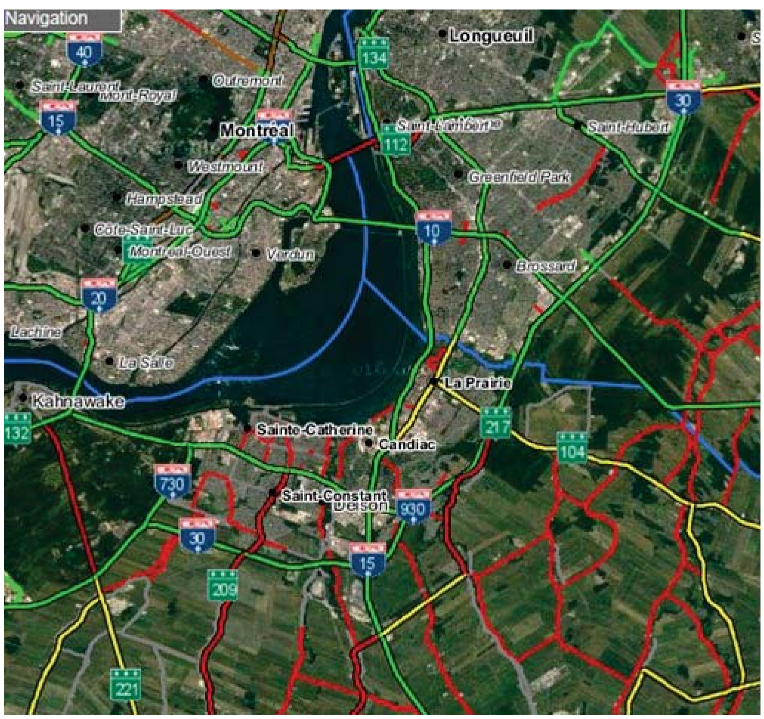

Figure 42 – Trucking Network under MTMDET Jurisdiction
(Source: Atlas des transports)

Routes and Technical Constraints

Truck removal of debris and materials from the Champlain Bridge deconstruction will take place at both ends of the bridge, i.e., Île-des-Sœurs and Brossard, as well as via the Ice Control Structure from the St. Lawrence Seaway dike.

Nuns' Island

On the Nuns' Island side, the new Champlain Bridge to the South Shore and Highway 15 North can be accessed from the western exit of the Ice Control Structure. Trucks must either manoeuver around the Champlain Bridge access ramps, or use René-Lévesque Boulevard and Nuns' Island Boulevard. This latter route offers a more standard geometric configuration, as shown in Figure 43.

Figure 43 – Truck Route on Nuns' Island

To access Highway 15 North, trucks must take René-Lévesque Boulevard through a roundabout to the north side of Nuns' Island, as shown in Figure 44.

Figure 44 –Nuns' Island Routes

The two figures above show the routes for a truck coming off the Ice Control Structure. On their return, the same trucks, now empty, will have to access the Ice Control Structure. Trucks from both the South Shore and the A-15 South will therefore be using the local road network to access the Ice Control Structure.

Finally, it is important to underscore that on Nuns' Island, the geometric configuration of some intersections and the location of access ramps may change somewhat with the development of the approaches to the new Champlain Bridge and construction of the *Réseau Électrique Métropolitain* (REM).

Brossard

On the Brossard side, there is already a work area linked to the construction of the new bridge (Figure 45). The main access is sufficiently wide to permit truck entry and exit manoeuvers. It is located on the Route 132 West service road, approximately halfway between an entrance ramp and an exit ramp. There is also a secondary access just at the entrance to the Highway 10 East access ramp. Due to its location, this is likely only used as an entrance, as exiting could be dangerous given the curve of the access ramp.

For the deconstruction of the Champlain Bridge, the work area would need to be somewhat adjusted, as the work space would have to be located in front of the old bridge. Nevertheless, the current points of access to the area could still be used.

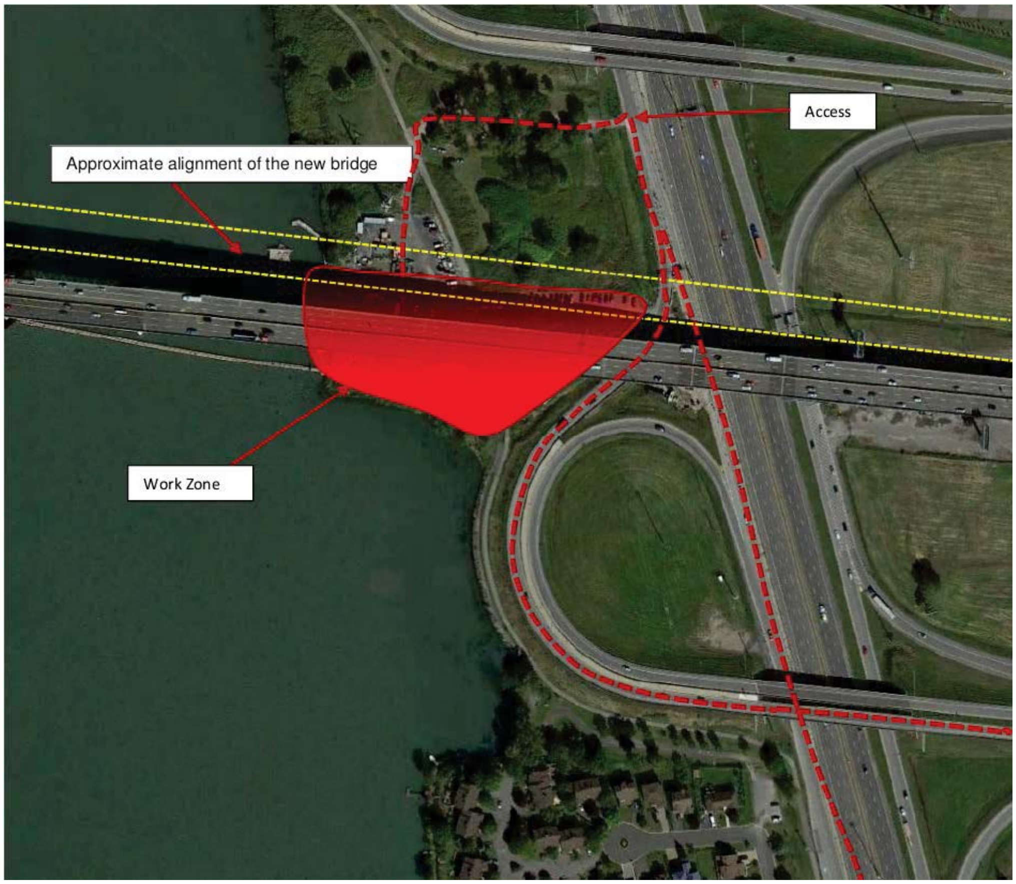

Figure 45 – Truck Routes in Brossard

The work area south of Route 132 would need to be extended for the deconstruction of the Champlain Bridge approach spans to be demolished. However, accessing this land clearly remains a problem, as everything is done via access ramps or the Route 132 access road, which see heavy traffic at rush hour, as well as during the rest of the day. Figure 46 shows the possible points of access to this area.

Figure 46 – Truck Route in Brossard

Transporting the recycled materials between the dismantling sites and the recycling centres by road offers advantages and disadvantages relative to other modes of transport. The advantages of road transport centre on the flexibility of the operations. Once loaded at the dismantling site, the truck and its trailer travel directly to a recycling facility, where they can be unloaded with ease. Furthermore, having a subcontractor to track makes cost control easier to manage. On the other hand, road transport is the most energy-intensive of all the transportation modes proposed in this study.

2.10.2.3.2 Marine Transportation

This section considers marine transportation as a means of transporting the materials off site towards recycling centres.

The recycling centres used in the marine transportation mode must obviously have port access, which is why only the recycling centres located in Montreal, Valleyfield and Trois-Rivières were selected for this mode.

Marine transport of the deconstruction material is based on the following assumptions:

- The point of departure is one of the dismantling and handling sites;
- Once crushed or cut up at these sites, the materials (concrete and steel) will have to be transloaded onto shortsea shipping barges. This transloading activity could be carried out using a conveyor, a truck with a dump trailer or a shovel/loader.
- Once the materials have been loaded onto the shortsea shipping barges, the transport units will have to proceed to their port destinations. Note that the shorter the travel distance, the higher the cost/tonne compared to road transport. In the Montreal area, for instance, truck transport between the Champlain Bridge and the recycling centre would be cheaper. Between the Champlain Bridge and the Gaspé Peninsula, however, the marine mode will have an economic advantage.

- The next step is to moor the shortsea shipping barge or ship at its port of destination and transload its cargo into bulk silos or sheds. In Québec, major ports such as Montréal, Québec and Sept-Îles have higher unloading costs than the municipal port of Valleyfield, the Sainte-Catherine dock or the port of Contrecoeur.
- Once transloaded into bulk silos or sheds, the materials will have to be transloaded a second time at the same port into trucks with dump trailers.
- The tractor-trailers then head for the recycling centres.

Marine constraints around the Champlain Bridge

Marine transportation to the west and east of the Champlain Bridge is feasible by barge but it is limited by physical constraints (bridge clearances, Ice Control Structure clearance, locks, islands, rapids, etc.) and regulatory constraints (pleasure boating, commercial shipping, safety, etc.). The main constraints are:

- To the west: The presence of the Lachine Rapids west of the Champlain Bridge prevents the use of the St. Lawrence River. Any westward travel therefore requires the use of the Seaway.
- To the east: preliminary analysis of the bathymetry highlights the shallow draft to the east on the St. Lawrence River. That being said, a number of physical constraints complicate marine travel to the east (locks, the Victoria Bridge, the Concorde Bridge, islands, shallows, strong currents, etc.). Here again, the use of the Seaway would facilitate travel.

The marine transportation companies indicated us that it is possible to transport the demolition materials by the St. Lawrence River between the Champlain Bridge site and the Port of Montreal using a special barge equipped with a powerful winch and a tug to steer the barge in the narrow (200 ft - 60.6 m), winding navigable channel that has a low draft (about 7.5 ft (2.27 m) in summer. In addition to the challenge of the channel, the other constraint to consider is the vertical clearance under the Concorde Bridge, which is 38 ft (11.5 m) in spring and 41 ft (12.4 m) in summer. Given that the girders are 3.07 m high and the freeboard of the barges is of the order of 3 m, barges loaded with girders could pass under the Concorde Bridge to travel farther east. The passage of the tug under the bridge could, however, require some manoeuvring of the antennas.

The St. Lawrence Seaway allows the marine transportation of the material from the south side of the bridge. The navigation period generally extends from mid-March to the end of December.

Marine Equipment

The major barge operators [redacted] recommend roughly the same marine operating model within the limits of the Champlain Bridge and the Concorde Bridge. Basically, they recommend the use of two shallow tugs near the Champlain Bridge, because of the low draft between the Champlain Bridge and the Concorde Bridge. These tugs have capacities of 400 to 1,000 hp. They would operate in the Champlain Bridge area with the barges used for deconstruction activities and with the transport barges to the Concorde Bridge.

East of the Concorde Bridge, a more powerful tug (1,200 to 1,400 HP) would take over to tug the barges to a transloading port. The proposed model for short sea shipping uses the following assumptions:

- Approximately 230,000 tonnes (materials from areas B and C) will be transported by barge over short distances.
- One of the operators recommends using a MM -180 barge with a payload (deadweight) capacity of 2,000 tonnes per trip. However, the barge loading capacity could be lower, depending on the work area and water depth.

On the basis of the planned work schedule and the equivalent of 36 months of materials transportation, it can be assumed that one loaded barge per week would head downstream on the St Lawrence River and return to the Champlain Bridge empty.

Like the road transport mode, the marine mode offers economic and social advantages and disadvantages.

2.10.2.3.3 Evaluation

Four alternatives were thus considered for the transportation:

1. Exclusive road transportation
2. Short distance maritime transportation
3. Rail transportation
4. Multimodal transportation

Road transportation has advantages in terms of costs and logistics, in particular flexibility, but not necessarily from an environmental perspective as it is a very energy-consuming mode. Short distance maritime transportation presents a high load capacity and low environmental and social impacts. It is, however, very expensive and less flexible. It involves many handling points that makes it less interesting. As rail transportation does not apply for short distances and the materials resulting from the deconstruction will be valued in the metropolitan area, this option is not retained. Several multimodal scenarios combining road, maritime and rail transportation are possible and depend on locations of potential valuation or recycling sites. These multimodal scenarios could be analyzed if appropriate in the next steps depending on the recycling site(s) used.

Road transportation is considered the most sustainable option for materials transportation. More simple, more flexible, much less expensive and able to transport all deconstruction materials, this mode is unavoidable.

The assessment of the materials transportation options was completed and is shown in Table 33. The four-axis graphic representation below summarises these recommendations (Figure 47).

Table 33 – Multicriteria analysis grid for materials transportation options

ANALYSIS GRID PART 2 : TRANSPORTATION OF MATERIALS								
SUSTAINABLE DEVELOPMENT COMPONENT	CRITERIA	ASSESSMENT OF OPTIONS						
		WEIGHTING	Road transport			Marine transport		
			Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result
TECHNICAL	Flexibility / Adaptability	3	4	12	43	3	9	34
	Availability of required mobilization areas	2	3	6		3	6	
	Number of handling operations required	3	5	15		3	9	
	Route disruption	2	3	6		4	8	
	Required permits / authorizations	1	4	4		2	2	
ECONOMIC	Costs	4	5	20	67	3	12	50
	Jobs	3	4	12		3	9	
	Origin of labour	4	5	20		5	20	
	Risk of overstepping project deadline	2	5	10		3	6	
	Commercial navigation	1	5	5		3	3	
ENVIRONMENTAL	Water quality	3	3	9	31	3	9	35
	Greenhouse gas emissions	2	1	2		3	6	
	Biodiversity	3	3	9		3	9	
	Contaminated soil and sediment	2	5	10		5	10	
	Consumption of resources/Residual materials	1	1	1		1	1	
SOCIAL	Recreational navigation	1	5	5	35	4	4	48
	Nuisances	4	2	8		3	12	
	Social adhesion	3	2	6		4	12	
	Health and Safety	4	3	12		3	12	
	Knowledge / Innovation	4	1	4		2	8	
Total points obtained *			Road transport		**176**	Marine transport		**167**

*** see graphical representation of results for visualization by component**

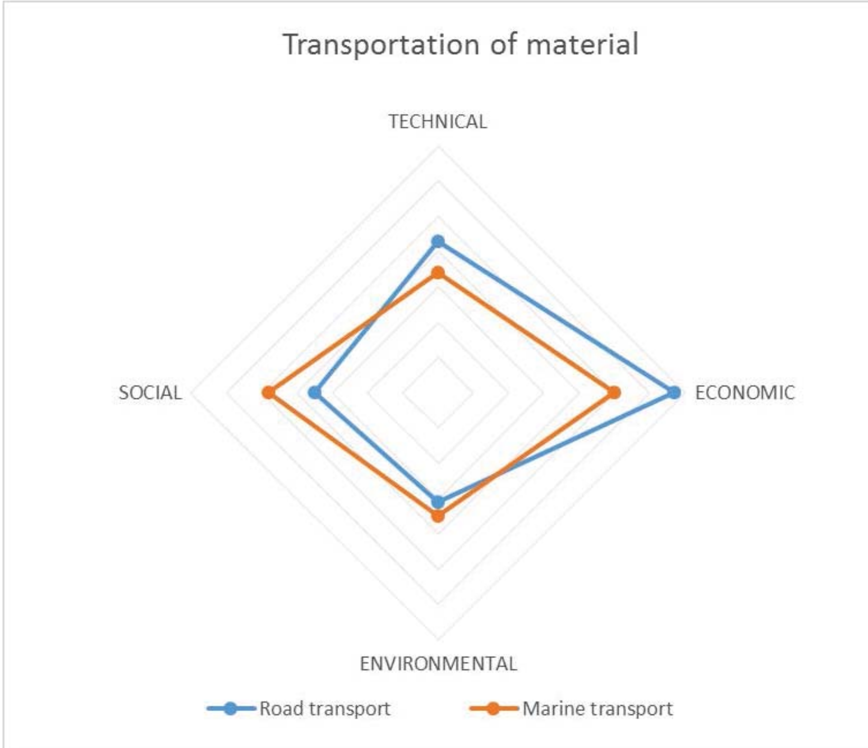

Figure 47 – Comparative analysis – Transportation

2.10.3 MATERIAL RECOVERY

In line with its sustainability approach to the Project, JCCBI wanted an in-depth study of valuation alternatives of the material expected from deconstruction of the existing Champlain Bridge. Although not included in the scope of this EEE study, the recommendations made for valuation of material is presented here to understand their impact on alternatives considered for deconstruction and transportation of material.

Five alternatives were considered:

1. Maintain and adapt elements of the existing Champlain Bridge
   - ie: maintain a pier for peregrine falcon nesting
2. Re-use in situ elements of the existing Champlain Bridge (no transformation)
   - ie: re-use concrete jerseys on JCCBI properties
3. Re-use off-site elements of the existing Champlain Bridge (no transformation)
   - ie: re-use steel beams outside JCCBI properties
4. Recycle in situ material of the existing Champlain Bridge
   - ie: use of crushed concrete on JCCBI properties
5. Recycle off-site material of the existing Champlain Bridge
   - ie: steel material sent to adjacent steel mill

The first alternative was considered the most sustainable option for material valuation. However, this option may have significant impact on the Project schedule and deconstruction methodology, depending on the elements to be maintained and adapted. Furthermore, only a limited amount of material can be valuated this way (approx. 15%). The fifth alternative ranked second, and has the advantage of being able to handle all material within a 50 km radius of the existing Champlain Bridge. The recommendation of the feasibility study is to maintain as many elements of the existing Champlain Bridge as possible in the asset enhancement projects (see 2.10.4), and to recycle off-site the remaining material within the recycling facilities found in the Greater Montreal Area. The four-axis graphic representation below summarises these recommendations.

The assessment of the material recovery options was completed and is shown in Table 34.

Table 34 – Multicriteria analysis grid for material recovery options

ANALYSIS GRID PART 3: MATERIALS RECOVERY																	
SUSTAINABLE DEVELOPMENT COMPONENT	CRITERIA	ASSESSMENT OF OPTIONS															
		WEIGHTING	Retain structures			In situ reuse			Off site reuse			In situ recycling			Off site recycling		
			Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result	Score 1 to 5	Weighted score	Result
TECHNICAL	Volume	3	3	9	41	1	3	28	2	6	21	1	3	31	5	15	46
	Control over the option	2	4	8		5	10		2	4		5	10		3	6	
	Timeline	1	3	3		4	4		3	3		4	4		5	5	
	Transportation	3	5	15		3	9		2	6		4	12		4	12	
	Market availability	2	3	6		1	2		1	2		1	2		4	8	
ECONOMIC	Costs	4	5	20	65	4	16	61	4	16	61	4	16	63	4	16	66
	Jobs	3	4	12		4	12		4	12		4	12		5	15	
	Origin of labour	4	5	20		5	20		5	20		5	20		5	20	
	Risk of overstepping project deadline	2	4	8		4	8		4	8		5	10		5	10	
	Commercial navigation	1	5	5		5	5		5	5		5	5		5	5	
ENVIRONMENTAL	Wayer quality	3	3	9	41	3	9	41	3	9	39	3	9	39	3	9	37
	Greehouse gas emissions	2	4	8		4	8		3	6		3	6		2	4	
	Biodiversity	3	3	9		3	9		3	9		3	9		3	9	
	Contaminated soil and sediment	2	5	10		5	10		5	10		5	10		5	10	
	Consumption of resources/Residual materials	1	5	5		5	5		5	5		5	5		5	5	
SOCIAL	Recreational navigation	1	5	5	65	5	5	57	5	5	57	5	5	49	5	5	45
	Nuisances	4	3	12		3	12		3	12		2	8		2	8	
	Public support	3	4	12		4	12		4	12		4	12		4	12	
	Health and safety	4	5	20		3	12		3	12		4	16		3	12	
	Knowledge/Innovation	4	4	16		4	16		4	16		2	8		2	8	
Total points obtained *			Retain structures		**212**	In situ reuse		**187**	Off site reuse		**178**	In situ recycling		**182**	Off site recycling		**194**

*** see graphical representation of results for visualization by component**

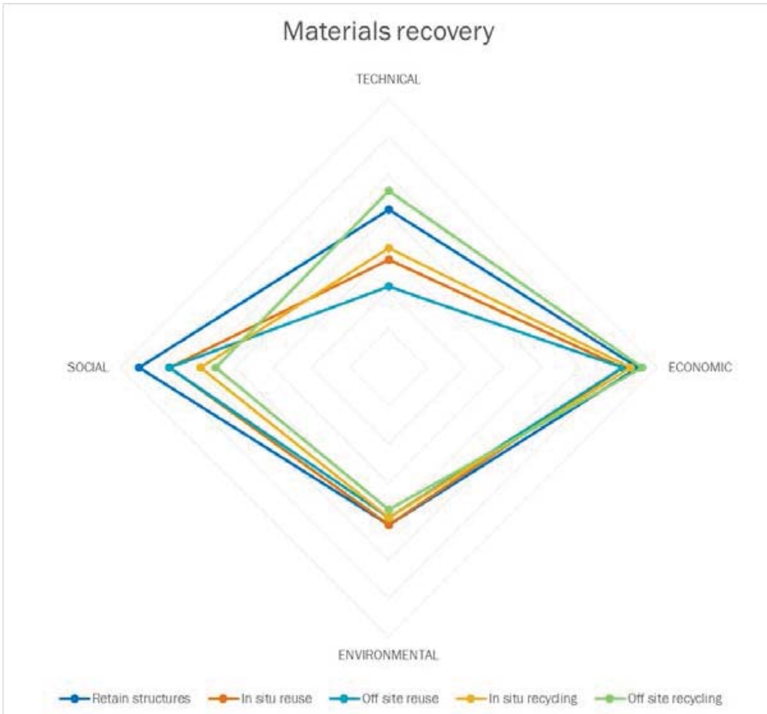

Figure 48 – Comparative analysis – Material recovery

2.10.4 ASSET ENHANCEMENT

The proponent of the Project has expressed the desire to identify various enhancement projects that could take advantage of any of the facilities/components that could be left behind following the implementation of the overall deconstruction Project. A number of such projects have been identified, each one building upon the previous project or series of projects. These include:

1. A network of cycle paths in conjunction with restoration of the natural environment;
2. Option 1 plus a historical and artistic installation;
3. Options 1 and 2 plus development of multifunctional quays and a surfing wave generator;
4. Options 1,2,3 plus development of an urban beach;
5. Options 1,2,3,4 plus development of a climbing wall plus other extreme height sports; and
6. Options 1,2,3,4,5 and development of an elevated pavilion.

Further details of these proposed enhancement projects may be found in Appendix 3.

In conclusion, no option clearly stands out from other options. It should be considered that the benefits from the most complex options are associated with several uncertainties, while the simplest options have less benefits.

The recommendation of the feasibility study is to retain all enhancement options in order to analyse their relationship to the various aspects of the deconstruction of the Champlain Bridge, as well as to consult with stakeholders to better understand their interests and to clarify uncertainties.

These projects will not be included in the consideration of potential environmental effects once the EEE is completed, as JCCBI has been advised by both Transport Canada and the Department of Fisheries and Oceans that such projects will be the subject(s) of separate environmental investigations.

2.11 CONSTRUCTION SCHEDULE

The anticipated schedule for the Project as conceived and described in section 2.10 above is as follows:

2.11.1 RECOMMENDED SCENARIO

The preliminary schedule for the recommended scenario is presented in Figure 49. The total duration of the work is estimated at 36 months spread over 4 years (no work during the winter, except for work over the Seaway).

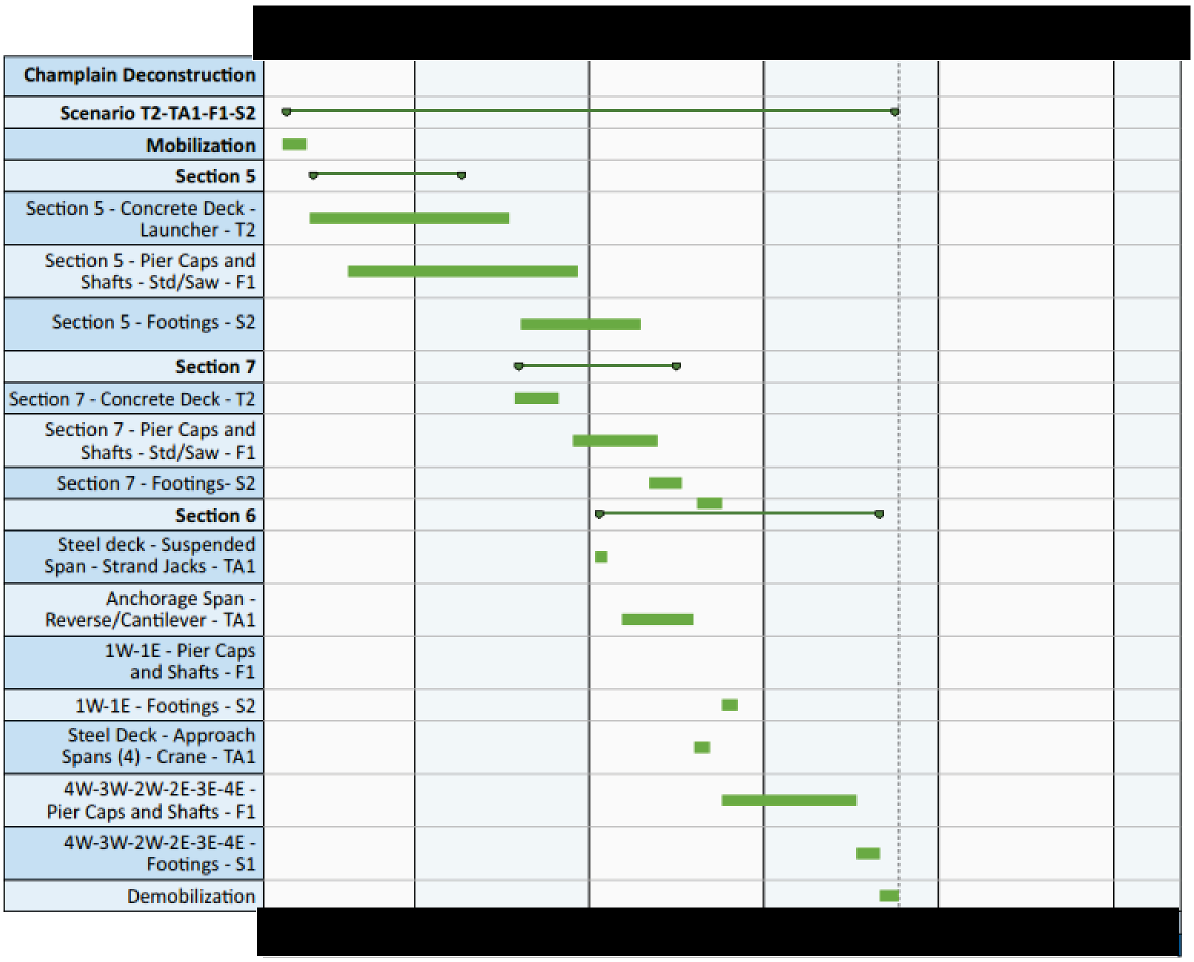

Figure 49 – Work schedule – recommended scenario

2.11.2 SCENARIOS FOOTINGS DEMOLITION USING STANDARD METHOD

Since the demolition of footings using the standard method has a major impact on the work schedule, this option is presented in Figure 50. The total duration of the work is estimated at 50 months spread over 5 years (no work during the winter, except for work over the Seaway).

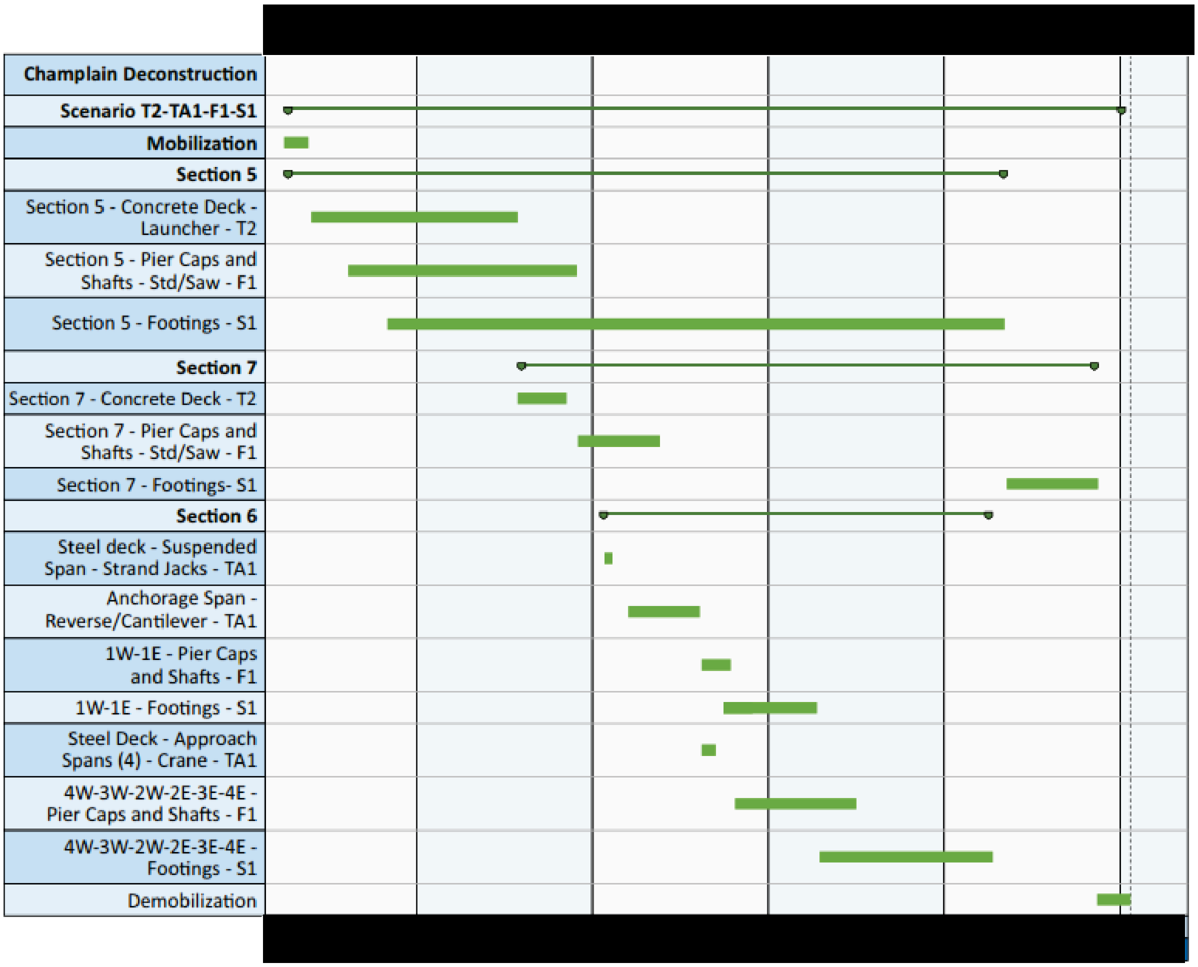

Figure 50 – Work schedule – Option demolition of footings with the standard method

3 ENVIRONMENTAL BASELINE

This presentation of environmental baseline information for selected components of the bio-physical and social environment is based entirely upon existing data and documentation. There exists a sufficient body of information already documented, and there is an ongoing field survey of biological diversity, so that additional field surveys were not considered to be necessary. Key information was obtained from the Environmental Assessment for the new bridge, conducted by Dessau-Cima, reported in 2012-2013, and which is now in the public domain, and from a survey of biodiversity in the federal lands under the jurisdiction of JCCBI being carried out by AECOM in 2016 on its behalf, data of which was made available to PTA by JCCBI.

3.1 GEOLOGY AND SOILS

3.1.1 PHYSIOGRAPHY AND TOPOGRAPHY

The project is located in the St. Lawrence Lowlands and Great Lakes physiographic unit. It consists of a valley bordered to the northwest by the Canadian Shield and to the southeast by the Appalachian Mountain range. Lands on either side of the Champlain Bridge are generally flat and have an elevation ranging from 14 to 21 metres above mean sea level, according to the Google Earth application. An elevation difference of up to 9 metres was measured between the water of the St. Lawrence River and the land with the highest elevation near the west end of the bridge.

3.1.2 REGIONAL GEOLOGICAL CONTEXT – BEDROCK

Regionally, bedrock corresponds to the St. Lawrence Lowlands Province, which generally comprises rocks dating from the Cambrian Period (541 to 485 million years ago) to the Ordovician Period (about 485 to 443 million years ago). According to the Ministère de l'Énergie et des Ressources naturelles (MERN) du Québec website, the St. Lawrence Province or Platform was formed at the end of the Proterozoic Era and during the Paleozoic Era, with the formation of the St. Lawrence rift system. It stretches over an area of more than 30,000 km^2 and lies over the the Grenville Province rocks.

According to the St. Lawrence Lowlands geological map, the rocks in the area of the Champlain Bridge right-of-way mainly consist of black Utica Shale on the Island of Montreal, on Nuns' Island, and on the south shore of the St. Lawrence. However, note that west of Boulevard de La Vérendrye in the Borough of Verdun, the bedrock is made up of Trenton Group rocks of the Tétreauville Formation, namely clayey limestone and shale. East of Boulevard Taschereau in Brossard, the bedrock is made up of Lorraine Group rocks of the Nicolet Formation, namely clayey limestone and shale. An excerpt of the map is presented below in Figure 51.

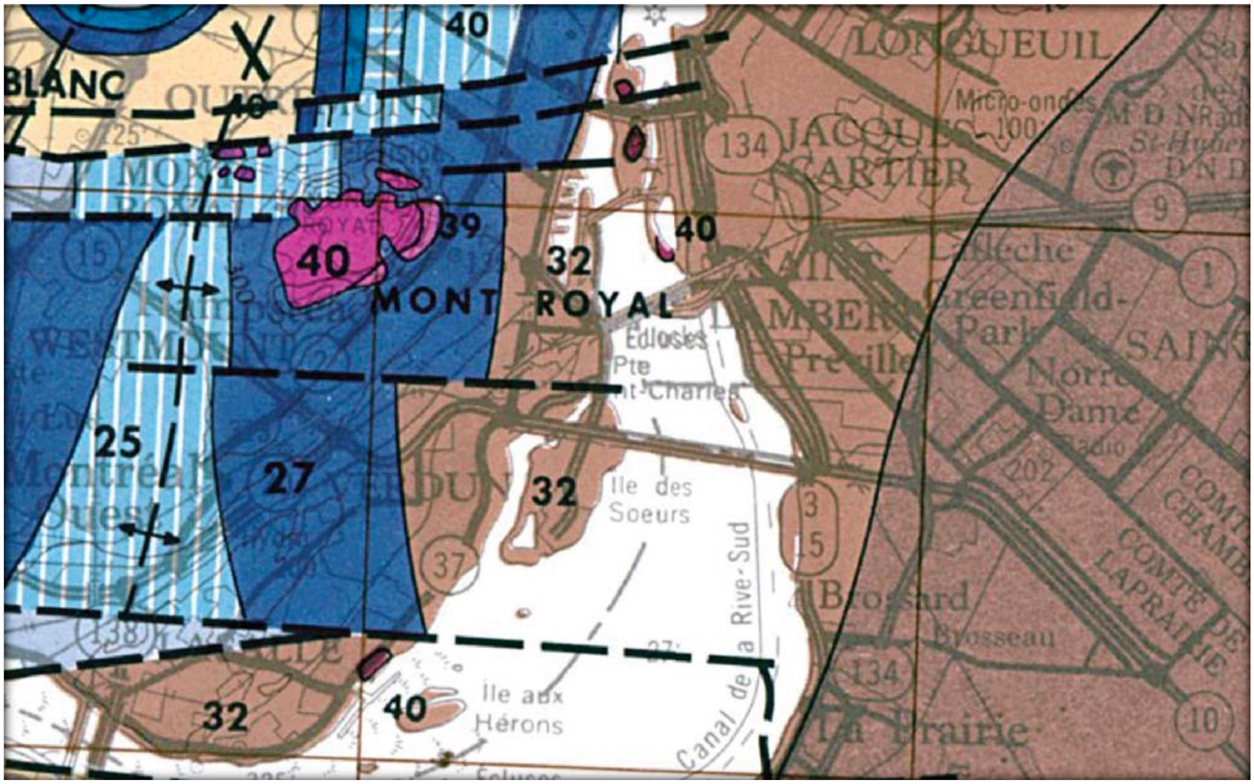

Figure 51 – Geological map of the bedrock

Rock outcrops are very rare or non-existent in the study area. A review of the borehole logs was not part of the current mandate.

3.1.3 REGIONAL GEOMORPHOLOGY AND PALEOGEOGRAPHY

Geomorphological elements, for the most part, are hidden under structures, fill materials and urban infrastructures, and are generally associated with the last quaternary glaciations, the subsequent deglaciation and, more recently, the sedimentation and erosion associated with the St. Lawrence River. Glacial motion eroded the bedrock and reworked former unconsolidated deposits, as is the case for all of southern Quebec in general. Ice scouring, as the ice sheet front advanced and retreated, is at the origin of glacial deposits (till).

Meltwater then submerged a vast territory all the way to what is now Lake Champlain, located to the south, creating the Champlain Sea (13,000 to 10,000 years ago), a postglacial saltwater sea that was deep in some locations. During its transgression (flooding), peak and regression (land emergence), shoreline sediment (from shallow water) and pelagic sediment (deep water) were deposited. According to the geological maps and reports that were consulted and the paleogeography, in the area of the Champlain Bridge right-of-way, the surface deposits are mainly of glacial and post-glacial origin (marine), and, to a lesser extent, fluvial and palustrine origin.

3.1.4 GEOLOGY OF SURFICIAL DEPOSITS – GENERALITY AND THICKNESS

The various types of deposits are discussed in the paragraphs below, from bottom to top (from oldest to most recent) and based on the three sub-sectors that make up the Champlain Bridge right-of-way area (Island of Montreal, Nuns' Island and South Shore).

For the Island of Montreal and Nuns' Island, the description of the various types of deposits is taken from the map entitled "Surficial geology, Montreal Island, Québec," prepared by the Geological Survey of Canada in 1975. For the south shore of the St. Lawrence, the information was taken from the map entitled "Aptitude – Région de La Prairie St-Jean" prepared by the Service de la Géotechnique in 1979-1981 (Dion & Caron).

On the Island of Montreal and Nuns' Island, and based on the map entitled "Drift-thickness contours, Montreal Island, Québec," also created by the Geological Survey of Canada in 1975, the estimated approximate thickness of overburden lying on bedrock is 6 to 15 metres (Figure 52).

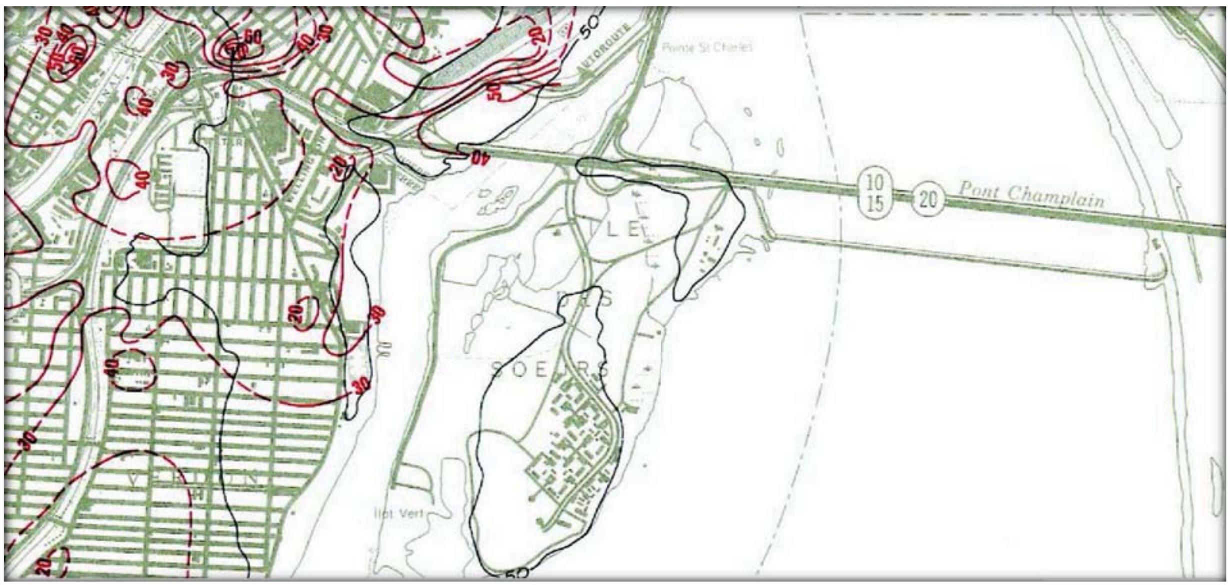

Figure 52 – Drift-thickness contours

On the South Shore, according to the *Dion and Caron* study, the overburden has a total approximate thickness of 7 to 12 metres.

3.1.4.1 Surficial deposits – Montreal Island

For the Island of Montreal sub-sector, till is the dominant surficial deposit on the south side of the Champlain Bridge, as shown on the next page (units 1-3 in Figure 53).

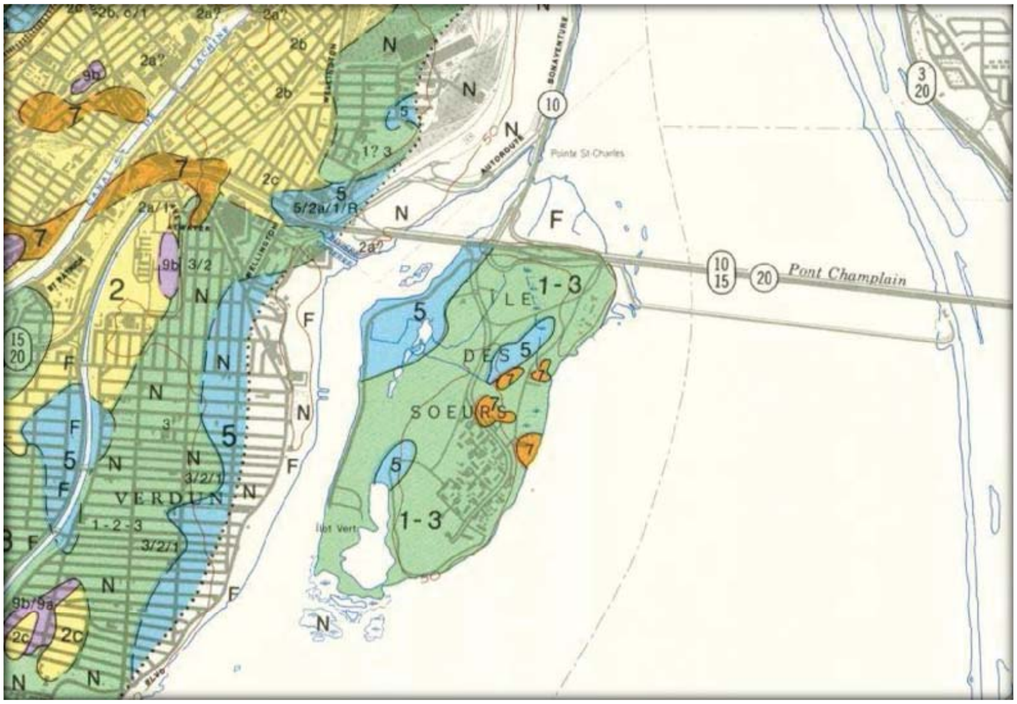

Figure 53 – Overburden, Montreal Island

Two glacial episodes 60,000 to 13,000 years ago, namely the Malone and Fort Covington glacial episodes, left relatively thin layers of till. These tills are generally silty or sandy and contain variable proportions of clay, gravel, cobble and boulders. The Fort Covington till, the more recent of the two, has a generally finer grain size (clay and silt). The till is overlain with Champlain Sea clay that is fossiliferous in some places, in particular on the north side of the Champlain Bridge (unit 5 on the map). West of this enclave of marine clay are fluvioglacial (unit 2) or fluvial (unit 7) deposits with a sand or gravel matrix. Even more recent natural deposits associated with wetland episodes are shown on the map (unit 9), but appear to be located outside the study area. These deposits of peat, organic clay and marl are present, for instance, at the junction of highways 15 and 20 (former Turcot yards).

A large strip bounded by the Bonaventure Expressway and the current St. Lawrence riverbank is covered with fill (shown in white on the map and marked with an F for fill). The type and environmental quality of this fill are discussed further in section 3.1.5.

3.1.4.2 Surficial deposits – Nuns' Island

For the Nuns' Island sub-sector, till is also the dominant surficial deposit on the south side of the Champlain Bridge, as shown in the map in section 3.1.4.1 (units 1-3 on the map). The till is covered with Champlain Sea clay on the west shore of Nuns' Island (unit 5 on the map).

The northern tip of Nuns' Island appears to be also covered with till, as shown on the map. Biogas issues associated with certain fill materials found on Nuns' Island have been documented by others. The biogas issues are discussed in section 3.1.7.

3.1.4.3 Surficial deposits – South Shore

For the sub-sector of the South Shore, till is the dominant surficial deposit on the north side of Highway 10, as shown in the following figure (unit 1B in Figure 54), and the bedrock is found at a depth greater than 6 metres. On the south side of Highway 10, mainly marine clay is found on the surface, in places covered with a layer of sand less than 2 metres thick (unit 4A in the figure). According to the same figure, till is present under the clay unit, more than 6 metres below the surface.

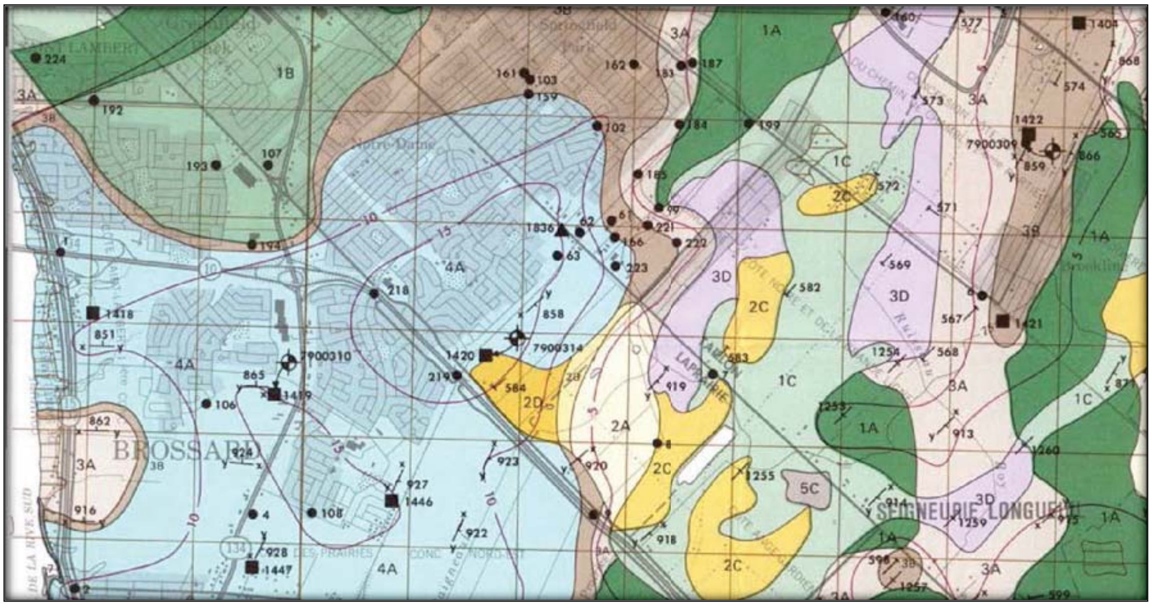

Figure 54 – Overburden, South Shore

3.1.5 FILLING, HISTORY OF SOIL OCCUPANCY AND INCIDENCE OF CONTAMINATION

According to the study prepared by Dessau-CIMA+ (2012), major episodes of backfilling and landfilling occurred on the banks of the St. Lawrence River from 1864 to 1965. This filling occurred over a large area and resulted in thick layers of fill material made up of heterogeneous soils and waste materials, as well as the creation of large parcels of land with a significant environmental liability. The changes to the shoreline over time have been studied by other consultants, including the Centre d'excellence montréalais en réhabilitation de sites (CEMRS), as shown in Figure 55.

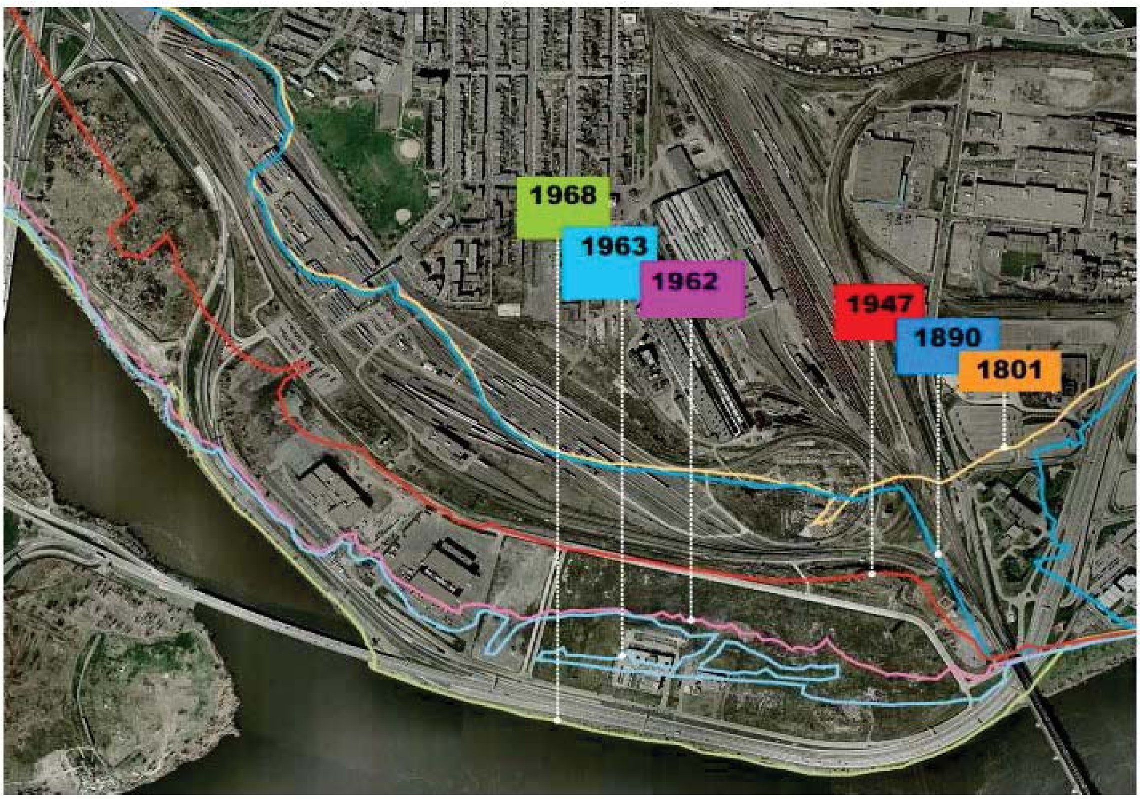

Figure 55 – Changes in fill

The area was then asphalted and used as a parking lot for Expo 67, after which it was redeveloped into a federal government airport along the Bonaventure Expressway (Adacport and STOLport, former GERLED site). This area is now known as the "Parc d'entreprises de la Pointe-Saint-Charles" (or PEPSC).

The map entitled "Incidence de contamination des sols" (Incidence of soil contamination), prepared in 2003 for the City of Montreal's *Service de l'environnement, de la voirie et des réseaux* (Environment, road systems and networks department), indicates a high incidence of soil contamination.

The review of historic aerial photographs and a Phase I site environmental assessment were not part of the current mandate.

3.1.6 LOCAL STRATIGRAPHY AND ENVIRONMENTAL SOIL QUALITY

The information about local stratigraphy and environmental quality of soils was taken from the Dessau-CIMA+ (2012) study, which included a review and compilation of previous studies conducted for JCCBI between 1993 and 2011. Layers of fill material between 4 and 12 metres thick were identified in the area of the Champlain Bridge right-of-way on the Island of Montreal. This heterogeneous fill till contains high proportions of various waste materials that even exceed 50% in volume in some locations. These layers will therefore have to be managed as waste materials for excavation, handling, disposal or valorization work. The waste materials that were observed consist of fragments of brick, concrete, wood, metal, glass, plastic, ash, clinker, coal, and others. High concentrations for certain metals and polycyclic aromatic hydrocarbons (PAHs) are often associated with the above fills and residual materials.

Although several stratigraphic soundings (46 in all) were carried out on the Island of Montreal and the western part of Nuns' Island, there appears to be little available information for the eastern part of Nuns' island and the southern shore of the Champlain Bridge. The analytical results for soil quality show that soils in the B-C range, or with concentrations exceeding the C Criteria of the *Soil Protection and Contaminated Sites Rehabilitation Policy* (1998), are found in most of the soundings. This policy was replaced in July 2016 with the *Guide* d'*intervention — Protection* des *sols et réhabilitation des terrains contaminés* (Action guide on soil protection and the rehabilitation of contaminated sites). The new criteria will therefore have to be considered, along with certain guidelines and procedures with respect to the characterization, excavation and management of materials associated with the Champlain Bridge deconstruction work. Furthermore, the standards in Schedule I of the *Regulation Respecting the Burial of Contaminated Soils* (RESC) and the standards of the *Regulation Respecting Hazardous Materials* (RMD) are also applicable for the management of excavated material. Note that the latter standards were not discussed in the Dessau-CIMA+ (2012) study. No comments can therefore be made on whether or not the residual materials horizons are considered hazardous (leachable, corrosive, others.). Given that excavation areas associated with the future Champlain Bridge deconstruction work are not known at this time, a comprehensive characterization plan cannot be provided at this stage. An environmental management plan for the excavated materials can only be drawn up once these excavation and deconstruction work sites have been properly defined (with respect to surface areas and depth) and characterized, as they may require ground surface and slope profiles to be reconfigured. The creation of a rehabilitation plan, as defined in the *Environment Quality Act*, may prove necessary if triggers are identified (such as maintaining certain contaminants in place). This validation of certain regulatory and legal applications was not done for the present mandate, but will have to be done during subsequent stages.

As part of the project notice prepared for the mass transit metropolitan electric network project that was filed with the BAPE, it was noted that the unfavourable environmental and geotechnical characteristics of the land on the St. Lawrence shoreline in Montreal, including the PEPSC area, may represent a major environmental and technical challenge for the implementation and operation of the project if they are not adequately considered (e.g., presence of contaminated soil and groundwater, biogas, waste materials, free-phase hydrocarbons). Some of these issues and the resulting technical challenges will likely to be applicable during future deconstruction work on the Champlain Bridge.

3.1.7 BIOGAS GENERATION POTENTIAL

The historical landfilling and backfilling are cause for concern for several reasons, including that the organic matter buried under the soil surface has the potential to generate gases originating from decomposition in an anaerobic environment, leading to the formation of methane, carbon dioxide, hydrogen sulphide and other gases (collectively referred to as biogases), some of which are harmful.

The Dessau-CIMA+ (2012) study mentions the potential presence of methane in soils, but all biogases need to be considered, not only methane. The necessary measures will therefore have to be taken to protect the environment as well as the health and safety of workers, roadway users and residents during the Champlain Bridge deconstruction work, in and around former landfill areas.

3.2 HYDROGEOLOGY

This section is based on the information presented in the environmental assessment conducted by Dessau-Cima+ (2012), as well as on the hydrogeological study carried out by Technorem in 2007.

In the study area, groundwater is found in three different hydrogeological units: the excavated material, the till, and the bedrock (Utica Shale). The type, depth and thickness of these units vary, especially for the excavated material. The information obtained shows that the groundwater flows toward the St. Lawrence River. On the Montreal shoreline, the flow is toward the southeast, while on the south shore, it is toward the west.

The hydraulic conductivity of the excavated material is 4.6 x 10-6 m/s on average, a value comparable to the hydraulic conductivity of silty sand (Todd and Mays, 2005). However, the hydrogeological study conducted by Technorem (2007) mentions that there is considerable spatial variability in this conductivity given the changing nature of the deposit. The groundwater flow rate in this unit is in the order of 200 m/year. The static level of the water table is about 6.5 m below the land surface.

The hydraulic conductivity of the till was assessed at 1.2 x 10-6 m/s by Technorem (2007), a relatively high value for a deposit of this type. According to the hydrogeological study, the till thickness ranges from 0 to 4.6 m.

The rock formation is described as a semi-confined aquifer. Recharge occurs in areas with little or no till thickness. The bedrock surface is fractured, but starting at a depth of about 2 metres, the bedrock is considered sound. According to Technorem, the average hydraulic conductivity is about 8.5 x 10-7 m/s.

The Champlain Bridge structure does not appear to affect water flow patterns. Moreover, the rock fill that forms the base of the Bonaventure Expressway has higher hydraulic conductivity, which causes the flow rate to be increased in this area. The land next to the Champlain Bridge is considered to contribute to recharging the groundwater, given that there is no paving in some areas and limited runoff.

3.2.1 HYDROGEOLOGICAL INFORMATION SYSTEM

A search was conducted in a hydrogeological information system (HIS) that lists the wells built since 1967. The search area used corresponds to the one delineated in the environmental assessment done by Dessau-Cima+ (2012). The search area is contained within the perimeter formed by the following coordinates: 611 485E, 5 037 500 N; 610 395E, 5 035 910 N; 619 465E, 5 036 830 N; 619 320, 5 035 065 N (UTM Nad83 zone 18). As water is supplied to the area through the water supply system, the HIS lists only six wells, as shown in Figure 56.

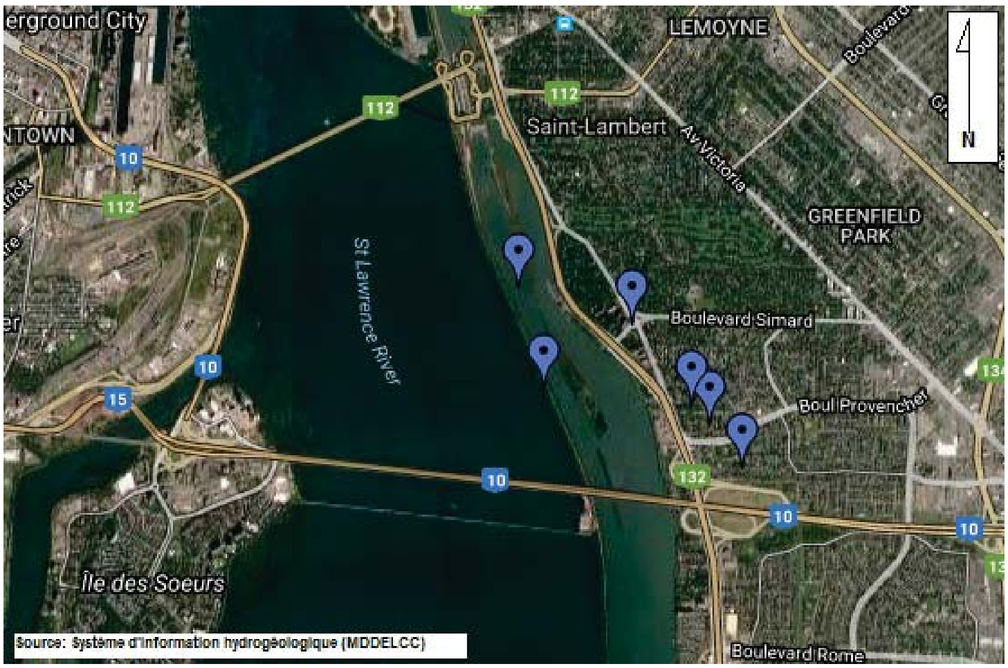

Figure 56 – Location of wells listed in the HIS

No wells were reported on the Montreal Island shore. With respect to the catchment works on the south shore and on the seaway land, the data show that they were all built into the bedrock, at an average depth of 40 m and average flow rate of 21 litres/minute. The water levels measured below the ground surface are found at an average depth of 2.0 m. All the collected data are presented in tabular form in Appendix 4.

3.2.2 GROUNDWATER QUALITY

The groundwater on the Montreal shoreline has been the subject of characterization work since 1993. The results were compared with the criteria in Communauté métropolitaine de Montréal (CMM) By-law 2008-047 on discharges to storm sewers or surface discharges. All the results show that the water contains levels that exceed CMM standards for at least one parameter. Exceedances mainly involve manganese, barium and polycyclic aromatic hydrocarbons (PAHs). No information is available on the quality of the groundwater on Nuns' Island and on the south shore.

It is recommended that a groundwater quality monitoring program be drawn up for the south and north shores, as well as Nuns' Island, to gain more knowledge of the quality of the groundwater before the start of deconstruction work. Quality monitoring should also be carried out during and after deconstruction.

3.3 AQUATIC ENVIRONMENT

The Study Area lies within a geographic designation referred to as the La Prairie Basins. The La Prairie Basins are delineated on the north shore by a line from LaSalle to southwestern Montreal, with a southern boundary from Sainte-Catherine to Saint-Lambert on the south shore. The Greater La Prairie basin (greater basin) and Lesser La Prairie basin (lesser basin) were isolated from one another by the construction of the St. Lawrence Seaway (Robitaille 1997). The Lachine Rapids, although well upstream of the Study Area, are associated with the Study Area because they represent an upstream migratory barrier for some fish species found within the principal Study Area.

The spatial boundaries established for fish habitat in the EA for the construction project (Dessau-Cima+ 2012) are depicted in Drawing 107 (Appendix 1). As stated, some fish and fish habitat information has been drawn from the larger La Prairie region, also known as Priority Intervention Zones 7 and 8.

3.3.1 SURFACE WATER QUALITY

3.3.1.1 Hydrology and Bathymetry

Flow in the greater basin is controlled by several dams in the upper reaches of the system. Average streamflow in the St. Lawrence is 7,060 cubic metres per second (m^3/s), and it can vary from 6,000 to 9,000 m^3/s (Dessau-Cima+ 2012). While flow is variable, in general it is not conducive to the accumulation of fine sediment, which results in a bottom substrate of coarser material (Dessau-Cima+ 2012). The river depth is also variable. Through the main channel depths range between one and nine metres (m) under normal flow conditions. Depths between Nuns' Island and Montreal are generally one to three m with pockets of deeper water (5-15 m) existing to the west and north of Nuns' Island (Dessau-Cima+ 2012).

The lesser basin is a lentic zone (Table 35), and as such is conducive to sediment accumulation (Dessau-Cima+ 2012). To facilitate vessel movement, the St. Lawrence Seaway (Seaway) navigational channel is periodically dredged to maintain a depth of approximately 8.6 m. The depth of the remainder of the lesser basin ranges from 1-3 m (Dessau-Cima+ 2012).

Flow rates and depths from multiple segments of the Study Area were collected and the resulting ranges are presented in Table 35 and indicated in Drawing 104 (Appendix 1).

Table 35 – Depth and Flow Ranges within the Study Area

LOCATION	DEPTH (M)	CURRENT (M/S)
Between Montreal and Nuns' Island	0.78-4.20	0.38-0.80
North of Nuns' Island	0.62-14.82	0.80-0.98
South of Victoria Bridge	1.00-13.69	0.69
Main Channel (greater basin)	0.38-7.75	0.92-1.35
Little basin	0.77-9.66	0.15-1.02

Adapted from AECOM, 2016

3.3.1.2 Water Quality

3.3.1.2.1 Physico-chemical Parameters

Physico-chemical parameters are one component of overall water quality. Provincial criteria have been established by the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC), and federal criteria have been established by the Canadian Council of Ministers of Environment (CCME). Sampling completed in the spring and summer of 2016 (AECOM 2016a) collected water from various locations within the Study Area (Table 36). All parameters measured on the samples were within regulated guidelines except for one pH result from the spring. The pH measurement of 9.13 is marginally above the provincial limit of 9.00, but it is within the CCME guidelines (AECOM 2016a).

Table 36 – Physico-chemical Parameters in Spring and Summer within the Study Area

WATER BODY	SEASON	TEMPERATURE (°C)	DISSOLVED OXYGEN (MG/L)	OXYGEN SATURATION (%)	PH	CONDUCTIVITY (µS/CM)	TURBIDY (NTU)
Provincial Water Quality Criteria for the Protection of Aquatic Life[1]		10-15	6	54	6.0-9.0	N/A	+2[3]
		20-25	5	57-63			
Canadian Water Quality Guidelines for the Protection of Aquatic Life[2]		N/A	6.5	N/A	6.5-9.5	N/A	+2[3]
Greater La Prairie Basin	Spring	16.9-18.3	10.30-13.29	109.4-138.1	8.87-9.13	215-253	2.74-4.55
	Summer	23.5-24.1	9.15-9.49	108.8-111.8	7.76-8.06	264-324	----
Lesser La Prairie Basin	Spring	14.4	12.56	122.3	8.92	239	1.55
	Summer	23.4-23.5	8.70-8.94	102.4-105.2	8.19-8.20	232-329	----

1 MDDELCC, 2016.
2 CCME, 2016.
3 The quality criterion is defined as a maximum average increase of 2 NTU relative to the natural or ambient value (background content not influenced by a point source affecting water turbidity, heavy rainfall or melting) For an exposure greater than 24h.
(Adapted from AECOM, 2016)

The water quality of the St. Lawrence River has been monitored since the 1980s (Stantec 2015b); however, there are gaps in the data that are used to assess the quality of water and therefore to establish what uses are possible (Robitaille 1997). The small number of sampling stations, and therefore their wide distribution, limited the scope of the interpretation that can be made from the results. Plus the limited frequency of visits to the sampling stations in the monitoring networks limited the ability to detect seasonal fluctuations (Ibid.). Additionally, much of the historical data was from a point in time when outfalls drained untreated into the St. Lawrence River. In 1989, the Lesser La Prairie Basin received wastewater from 17 municipalities; however, post July 2012 sewer systems were connected to regional water treatment plants.

Historically, water quality in the lesser basin has been poor due to point-source industrial and nonpoint-source farming inputs, including organic pesticides, that were introduced upstream of the Study Area (Robitaille 1997).

Stantec (2015b) states that, according to analyses of samples from the Study Area, no measured parameters contravened provincial or federal water quality criteria for the protection of aquatic life. The document does not identify the parameters that were analyzed or their results.

3.3.2 SEDIMENT QUALITY

As outlined in Section 3.3.1.1, water flow through much of the greater basin is not conducive to the deposition of sediment. As such, the river substrate is dominated by hard bottom. Where water velocity is higher (Drawing 104, Appendix 1) the substrate is comprised of rock or a mix of rock and cobble. Moderate velocity regimes give a substrate of cobble and gravel while the lesser velocities result in a substrate comprised of coarse sand and small gravel (Dessau-Cima+ 2012).

The lentic flow regime of the lesser basin has resulted in a thick, relatively uniform, layer of fine sediment that have accumulated since the construction of the Seaway dike. Dredging activities in the navigational channel have resulted in a substrate of coarser sediment which is covered by zebra mussels. Shell fragments from zebra mussels have been observed littering the substrate throughout the lesser basin (Dessau-Cima+ 2012)

According to available information, there is little permanent sediment deposition in the greater basin. The only zone in which contaminated sediments have been found is located near the dike and dam of the old LaSalle hydroelectric power station. Data, from the late 1970s, indicate the presence in samples from this location of high concentrations of heavy metals (copper, chromium, mercury, lead and zinc) (Robitaille 1997). Because of the lack of sediment in the greater basin, sampling efforts in 2012 were limited to one location on the Montreal shore north of the Nuns Island Bridge. That sample showed heavy metal contamination (copper, chromium, nickel, lead and zinc) as well as concentrations of polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB) (Dessau-Cima+ 2012).

Twelve samples were collected throughout the lesser basin in 2012. The ranges of hydrocarbon, PCB, and metals results are presented in Table 37 and the range of PAH results are presented in Table 38 (Dessau-Cima+ 2012). Contamination was lowest in samples collected from the navigational channel, likely due to dredging activities.

Table 37 – Metal Concentrations in Sediments from the Lesser Basin

PARAMETER	DETECTION LIMITS (MG/KG)	SAMPLE CONCENTRATION (MG/KG)	CRITERIA[1]				
			≤COE[2]	COE	>COE AND ≤CEF	CEF[3]	>CEF
Mercury	0.05	0.08-0.44	Class 1	0.25	Class 2	0.87	Class 3
Silver	2	<2		-		-	
Arsenic	2	4-7		7.6		23	
Barium	5	90-170		-		-	
Cadmium	0.2	0.4-1.5		1.7		12	
Cobalt	2	11-15		-		-	
Chromium	2	34-63		57		120	
Copper	1	33-92		63		700	
Tin	5	<5-7		-		-	
Manganese	2	440-1200		-		-	
Molybdenum	2	<2		-		-	
Nickel	1	33-53		47		-	
Lead	5	45-190		52		150	
Selenium	10	<10		-		-	
Zinc	5	110-380		170		770	
Vanadium	5	31-45		-		-	

1 Criteria from Environment Canada and the Quebec Ministry of Sustainable Development, the Environment and Parks (MDDEP). Criteria for the Assessment of Sediment Quality in Quebec and Application Frameworks: Prevention, Dredging and Remediation. 39 pages.
2 Concentration of occasional effects.
3 Concentration of frequent effects.
Class 1- [Substance] ≤ COE: sediments may be released in open water;
Class 2- COE < [Substance] ≤ CFE: release in open water may be considered, but toxicity tests are required;
Class 3- [Substance] > CFE: release of sediments in open water is prohibited.
Adapted from Dessau-Cima+, 2012

Table 38 – Organic Compound Concentrations in Sediments from the Lesser Basin

PARAMETER	DETECTION LIMITS (MG/KG)	SAMPLE CONCENTRATION (MG/KG)	CRITERIA[1]				
			≤COE[2]	COE	>COE AND ≤CEF	CEF[3]	>CEF
Hydrocarbons (C10-C50)	100	<100-1700	Class 1	nd	Class 2	nd	Class 3
PCB	0.01	<0.01-0.24		0.079		0.78	
PAH							
Naphthalene	0.01	nd-002		0.12		1.2	
Acenaphthylene	0.003	<0.003-0.14		0.03		0.34	
Acenaphthene	0.003	<0.003-0.16		0.021		0.94	
Fluorene	0.01	<0.01-0.04		0.061		1.2	
Phenanthrene	0.01	<0.01-0.26		0.13		1.1	
Anthracene	0.01	<0.01-0.06		0.11		1.1	
Fluoranthene	0.01	<0.01-0.99		0.45		4.9	
Pyrene	0.01	<0.01-0.80		0.23		1.5	
Benzo(a) anthracene	0.01	<0.01-0.55		0.12		0.76	
Chrysene	0.01	<0.01-0.59		0.24		1.6	
Benzo(b+j+k) fluoranthene	0.01	<0.01-0.83		-		-	
Benzo(e) pyrene	0.01	<0.01-0.48		-		--	
Benzo(a) pyrene	0.01	<0.01-0.49		0.15		3.-2	

PARAMETER	DETECTION LIMITS (MG/KG)	SAMPLE CONCENTRATION (MG/KG)	CRITERIA[1]				
			≤COE[2]	COE	>COE AND ≤CEF	CEF[3]	>CEF
Indeno(1,2,3-cd) pyrene	0.01	<0.01-0.36		-		-	
Dibenz(a,h) anthracene	0.003	<0.003-0.086		0.043		0.2	
Benzo(ghi) perylene	0.01	<0.01-0.38		-		-	
2-Methylnaphthalene	0.01	<0.01-0.03		-		-	
1-Methylnaphthalene	0.01	<0.01-0.01		-		-	
Benzo(c) phenanthrene	0.01	<0.01-0.08		-		-	
3-Methylcholanthrene	0.01	<0.01		-		-	
7,12-Dimethylbenzanthracene	0.01	<0.01		-		-	
Dibenzo (a,i) pyrene	0.01	<0.01-0.05		-		-	
Dibenzo (a,1) pyrene	0.01	<0.01		-		-	
Dibenzo (a,h) pyrene	0.01	<0.01		-		-	
1,3-Dimethylnaphthalene	0.01	<0.01-0.03		-		-	
2,3,5-trimethylnaphthalene	0.01	<0.01-0.02		-		-	

1 Criteria from Environment Canada and Ministère du Développement durable, de l'Environnement et des Parcs du Québec (MDDEP). 2007.
2 Concentration of occasional effects.
3 Concentration of frequent effects.
Class 1- [Substance] ≤ COE: sediments may be released in open water;
Class 2- COE < [Substance] ≤ CFE: release in open water may be considered, but toxicity tests are required;
Class 3- [Substance] > CFE: release of sediments in open water is prohibited.
Adapted from Dessau-Cima+ 2012

Sampling efforts in 1976, 1987, and 2012 show a history of heavy metal and PCB contamination within the lesser basin (Table 39). While exceedances of regulated guidelines continued in the 2012 results, this most recent sampling effort indicated a decrease in contaminant levels in comparison to those from previous analyses. Previous sampling events were compared to other criteria, but for the purposes of this study they were all compared to current day standards.

Table 39 – 1976, 1987, and 2012 Sampling Events Compared to Current Criteria

PARAMETER	SERODES, 1978 (17 SAMPLES)	HARDY ET AL., 1991 (18 SAMPLES)	STUDY FOR THE NEW CHAMPLAIN BRIDGE, 2012 (12 SAMPLES)	MDDEP AND ENVIRONMENT CANADA CRITERIA (MG/KG)				
	MEDIAN (MG/KG)	MEDIAN (MG/KG)	MEDIAN (MG/KG)	≤CEO	CEO	>CEO AND ≤CEF	CEF	>CEF
Mercury	0.46	0.34	0.21		0.25		t	
Arsenic	---	9.82	5		7.6		23	
Cadmium	9	1	1.15		1.7		12	
Chromium	73	105	49		57		120	
Copper	55.3	62.9	57.50	Class 1	63	Class 2	700	Class 3
Nickel	48.4	41.1	41.00		47		-	
Lead	48	137	98.5		52		150	
Zinc	315	392	270		170		770	
PCB (Total)	---	0.651	0.19		0.079		0.78	

Class 1- [Substance] ≤ COE: sediments may be released in open water;
Class 2- COE < [Substance] ≤ CFE: release in open water may be considered, but toxicity tests are required;
Class 3- [Substance] > CFE: release of sediments in open water is prohibited.
(Adapted from: Dessau-Cima+ 2012)

3.3.3 AQUATIC PLANTS

Portions of the substrate within the Study Area have varying cover of aquatic vegetation. Table 40 lists the species of vegetation noted in these areas. A discussion of where aquatic plants exist within the study area are discussed in Section 3.3.5.

Table 40 – Aquatic Vegetation in the Study Area

COMMON NAME	LATIN NAME
Canadian Pondweed	*Elodea canadensis*
Variegated pond-lily	*Nuphar variegata*
Broad-leaved pondweed	*Potamogeton amplifolius*
Sago pondweed	*Stuckenia pectinata*
Perfoliate pondweed	*Potamogeton perfoliatus*
Canadian arrowhead	*Sagittaria rigida*
Softstem bulrush	*Schoenoplectus tabernaemontani*
Water-celery	*Vallisneria americana*

Stantec 2015b

3.3.4 WETLANDS

The project study area has undergone several modifications since the construction of the Nuns' Island causeway bridge and the start of construction of the new St. Lawrence bridge. A few natural habitats have been used to access the St. Lawrence River or to mobilize equipment and materials near the work sites. Although the environmental assessment report for the construction of the new St. Lawrence River bridge (Dessau-Cima+ 2012) contains a detailed description of the natural environments in the local study area, it is preferable to present the data from the most recent plant survey in the area. In 2016, AECOM conducted a biodiversity study on JCCBI land (AECOM 2016b). AECOM was asked to identify and delineate the vegetation units found in the survey area (woodlands, abandoned fields, wetlands and other high-value habitats) using MDDELCC's simplified method (Bazogue et al. 2015). The 174.54-ha survey area corresponded to the boundaries of JCCBI property and a 50-metre strip around it. Special-status plant species and invasive alien plant species (IAPS) were also noted during the study. The special-status species are those covered in the *Species at Risk Act* and the *Act Respecting Threatened or Vulnerable Species*.

The following wetlands were identified and delineated in the survey area:

- Treed swamps with a total surface area of 3.19 ha;
- Marshes with a total surface area of 0.37 ha;
- A 0.21-ha pond.

Wetlands cover about 2% of the plant survey area and are all located southeast of the Brossard Interchange (Drawings 105 and 106 in Appendix 1). A treed swamp dominated by red ash (*Fraxinus pennsylvanica*) and hawthorn (*Crataegus sp.*) is found east of this area, while a wetland complex is found in the western part. The complex is made up of two European reed marshes (*Phragmites australis subsp. australis*), one ashbush of red ash (treed swamp) and one pond.

Several IAPSs were reported in the wetlands. The European reed is the most common and abundant species, but wild chervil (*Anthriscus sylvestris*), Japanese knotweed (*Fallopia japonica*), black buckthorn (*Frangula alnus*), wild parsnip (*Pastinaca sativa*), purple loosestrife (*Lythrum salicaria*), European buckthorn (*Rhamnus cathartica*), reed canarygrass (*Phalaris arundinacea*) and creeping yellow loosestrife (*Lysimachia nummularia*) were also reported in the area. Furthermore, a few species of weeds were observed in the treed swamp to the east. They consist of poison ivy (*Toxicodendron radicans*), Canada goldenrod (*Solidago canadensis*), and rough-stemmed goldenrod (*Solidago rugosa*).

No special-status plant species at the federal and provincial level was noted during the wetlands characterization.

3.3.5 FISH AND AQUATIC HABITATS

3.3.5.1 Fish Species

Robitaille (1997) and Stantec (2015b) identify the presence of 66 and 67 fish species, respectively, in the La Prairie Basins/Lachine Rapids area, but do not provide a list of the specific species. The environmental assessment completed for the construction of the new bridge (Dessau-Cima+, 2012) stated that studies identified 44 species out of a possible one hundred species in an area encompassing 15 km upstream and downstream reaches from the Champlain Bridge. AECOM (2016) completed additional fishing effort and the species identified have been highlighted as well. Of note, AECOM collected the cutlip minnow (*Exoglossum maxillingua*) and round goby (*Neogobius melanostomus*) which were not listed in the Dessau-Cima+ (2012) document but have been added to the below table. Table 41 lists by family, 95 species that have been confirmed to be or are likely to be found within the Study Area. It does not identify the conservation status of any fish species. Fish species conservation status is addressed in Section 3.3.6 (Species at Risk).

3.3.5.2 Macro Invertebrate Species

Two species of mollusks were identified by the Centre de données du patrimoine naturel du Québec (CDPNQ), both of a member of the Unionidae family; the elephantear mussel (*Elliptio crassidens*) and the spike mussel (*Elliptio dilatata*) (Consortium BCDE, 2011). In addition, the zebra mussel (*Dreissena polymorpha*) can be found throughout the St. Lawrence Seaway.

Table 41 – Fish Species Found or Likely to be Found in the Study Area

FAMILY	COMMON NAME	LATIN NAME	PRESENCE		
			GREATER LA PRAIRIE BASIN	LESSER LA PRAIRIE BASIN	AECOM* 2016
Acipenseridae	Lake sturgeon	*Acipenser fulvescens*	X		X
	Atlantic sturgeon	*Acipenser oxyrinchus*			
Amiidae	Bowfin	*Amia calva*	X		
Anguillidae	American eel	*Anguilla rostrata*	X	X	X
Atherinidae	Brook silverside	*Labidesthes sicculus*			
Catostomidae	Copper redhorse	*Moxostoma hubbsi*			X
	River redhorse	*Moxostoma carinatum*			X
	Greater redhorse	*Moxostoma valenciennesi*			X
	Shorthead redhorse	*Moxostoma macrolepidotum*	X	X	X
	Quillback	*Carpiodes cyprinus*			
	White sucker	*Catostomus commersoni*	X	X	X
	Northern sucker	*Catostomus catostomus*	X		

FAMILY	COMMON NAME	LATIN NAME	PRESENCE		
			GREATER LA PRAIRIE BASIN	LESSER LA PRAIRIE BASIN	AECOM* 2016
	Silver redhorse	*Moxostoma anisurum*	X	X	
	Hairlip	*Moxostoma lacerum*			
Centrarchidae	Longear sunfish	*Lepomis megalotis*			
	Bluegill	*Lepomis macrochirus*			
	Rock bass	*Ambloplites rupestris*	X	X	X
	Pumpkinseed	*Lepomis gibbosus*	X	X	X
	Black crappie	*Pomoxis nigromaculatus*	X	X	
	Largemouth bass	*Micropterus salmoides*	X	X	
	Smallmouth bass	*Micropterus dolomieu*	X	X	X
Clupeidae	Alewife	*Alosa pseudoharengus*		X	
	Gizzard shad	*Dorosoma cepedianum*			
	American shad	*Alosa sapidissima*			
Cottidae	Mottled sculpin	*Cottus bairdii*	X		X
	Slimy sculpin	*Cottus cognatus*			X
Cyprinidae	Common shiner	*Luxilus cornutus*	X	X	
	Spotfin shiner	*Cyprinella spiloptera*			
	Silver minnow	*Hybognathus regius*		X	
	Bridle shiner	*Notropis bifrenatus*			
	Emerald shiner	*Notropis atherinoides*		X	
	Golden shiner	*Notemigonus crysoleucas*		X	
	Sand shiner	*Notropis stramineus*			
	Mimic shiner	*Notropis volucellus*		X	
	Blackchin shiner	*Notropis heterodon*			
	Creek chub	*Semotilus atromaculatus*			
	Pearl dace	*Margariscus margarita*		X	
	Blacknose shiner	*Notropis heterolepis*			
	Longnose dace	*Rhinichthys cataractae*	X		X
	Blacknose dace	*Rhinichthys atratulus*			
	Fallfish	*Semotilus corporalis*			
	Spottail shiner	*Notropis hudsonius*	X	X	
	Rosyface shiner	*Notropis rubellus*		X	
	Fathead minnow	*Pimephales promelas*		X	
	Northern redbelly dace	*Chrosomus eos*			
	Bluntnose minnow	*Pimephales notatus*	X	X	X
	Crucian carp	*Carassius carassius*			
	Cutlips minnow	*Exoglossum maxillingua*			X
	Common carp	*Cyprinus carpio*	X	X	X
Cyprinodontidae	Banded killifish	*Funudulus diaphanus*	X	X	
Esocidae	Northern pike	*Esox lucius*	X	X	X
	Muskellunge	*Esox masquinongy*	X	X	
	Redfin pickerel	*Esox americanus americanus*			
	Chain pickerel	*Esox niger*			
	Grass pickerel	*Esox americanus vermiculatus*			
Gadidae	Burbot	*Lota lota*			

FAMILY	COMMON NAME	LATIN NAME	PRESENCE		
			GREATER LA PRAIRIE BASIN	LESSER LA PRAIRIE BASIN	AECOM* 2016
Gasterostedidae	Brook stickleback	*Culaea inconstans*			
	Threespine stickleback	*Gasterosteus aculeatus*			
Gobiidae	Round goby	*Neogobius melanostomus*			X
Hiodontidae	Mooneye	*Hiodon tergisus*			
Ictaluridae	Brown bullhead	*Ameirus nebulosus*	X	X	X
	Stonecat	*Notorus flavus*			
	Channel catfish	*Ictalurus punctatus*		X	
	Tadpole madtom	*Notorus gyrinus*		X	
Lepisosteidae	Longnose gar	*Lepisosteus osseus*			
Osmeridae	American smelt	*Osmerus mordax*		X	
Percichthyidae	White bass	*Morone chrysops*			
	Striped bass	*Morone saxatilis*			X
	White perch	*Morone americana*	X	X	
Percidae	Iowa darter	*Etheostoma exile*	X		
	Rainbow darter	*Etheostoma caeruleum*			
	Fantail darter	*Etheostoma flabellare*			X
	Eastern sand darter	*Ammocrypta pellucida*			
	Walleye	*Sander vitreus*	X	X	
	Sauger	*Sander canadensis*	X	X	
	Channel darter	*Percina copeland*			
	Logperch	*Percina caprodes*	X	X	X
	Yellow perch	*Perca flavescens*	X	X	
	Tesselated darter	*Etheostoma olmstedi*			
	Johnny darter	*Etheostoma nigrum*	X	X	
Percopsidae	Trout-perch	*Percopsis omiscomaycus*			
Petromyzontidae	Silver lamprey	*Ichthyomyzon unicuspis*	X		
	Lamprey	*Petromyzon marinus*			
Salmonidae	Lake whitefish	*Coregonus clupeaformis*			
	Brook trout	*Salvelinus fontinalis*			
	Artic grayling	*Thymallus arcticus*			
	Atlantic salmon	*Salmo salar*			
	Coho salmon	*Onchorhynchus kisutch*			
	Chinook salmon	*Onchorhynchus tshawytscha*			
	Lake trout	*Salvelinus namaycush*			
	Rainbow trout	*Onchorhynchus mykiss*	X	X	
	Sea trout (brown trout)	*Salmo trutta*	X	X	
	Cutthroat trout	*Onchorhynchus clarkii*			
Sciaenidae	Freshwater drum	*Aplodinotus grunniens*			
Umbridae	Central mudminnow	*Umbra limi*	X		

Adapted from Dessau-Cima+ 2012 and AECOM 2016a

3.3.5.3 Invasive Species

The Province of Quebec (MFFP 2016a) has designated four species of fish and three species of mollusks that are present in the province as being exotic species of concern (or potential concern). Of those, one species of mollusk and two species of fish and have been identified within the Study Area. The following provides information on each:

Zebra Mussel - The zebra mussel was first identified in Ontario in 1988 and by 1990 was found in the St. Lawrence River. It has the ability to attach to a variety of substrates and as such can be highly prolific. It has had impacts on various types of infrastructure and native freshwater mussel populations. Because of its high filtration capacity, this species also reduces the amount of phytoplankton and zooplankton available for young fish, native mussels and other aquatic invertebrates (MFFP 2016b). The zebra mussel may invade a variety of waterbodies and habitats, but it generally prefers areas where the substrate is rocky, sandy or dense in aquatic plants, as well as low-gradient streams. In the Study Area, the zebra mussel is predominantly present in the Seaway canal (Dessau-CIMA+ 2012).

Round Goby – the round goby was introduced to the Great Lake system approximately 25 years ago, and has spread through the St. Lawrence River to the Ouelle River, 350 km downstream of the Study Area. It prefers rocky and sandy bottoms and is competitive with other species because of its aggressive habits and its ability to breed several times a season (MFFP 2016c). The round goby can be found throughout the Study Area but prefers habitats around Nuns Island and within the lesser basin (AECOM 2016a).

Rainbow Trout – the rainbow trout, although considered invasive, has been in Quebec since 1893. Since that time, stocking of the species to support a recreational fishery has taken place regularly in the upstream portions of the St. Lawrence River. The rainbow trout can out-compete native brook trout and the rainbow trout is therefore considered undesirable in regions where brook trout are prevalent. Due to the migration of rainbow trout outside of the upper St. Lawrence River region, the Province of Quebec has enacted an Action Plan to prevent the spread of the species to several regions. The Study Area lies within a region that allows the stocking of rainbow trout (MDDELCC 2013).

3.3.5.4 Sport Fishing

Dessau-Cima+ (2012) described sport fishing activity within their study area, defined as 1 km upstream to 1 km downstream of the Champlain Bridge. Boat traffic is banned within the St. Lawrence Seaway; however, fishing areas near des Vélos Park and St. Lawrence Park are identified. There are no available statistics on the number of fishers or the techniques used.

On the St. Lawrence River within the greater basin the only shoreline area where sport fishing is known to occur is along the forested property belonging to the Monseigneur Richard High School near Parc Champion. This site can see between 5 and 10 persons per day who wade fish between May and November. During the summer, the Maison des jeunes Point de Mire arranges wade-fishing sessions involving 5 to 7 young people per week. The fishing methods normally practised in these locations are line (presumably spin) fishing and fly-fishing (Dessau-Cima+ 2012).

The Quebec Marine Association estimates that about a dozen persons a day fish on the ice between January and March within 300 m above and below the Champlain Bridge.

Spin and fly-fishing for sport is also done from small boats. Fishermen navigate the river section, near the banks on the Montreal side and Nuns' Island, and in the lesser basin. Boat fishing in the study area takes place between April and October, but at higher levels in the summer and on weekends. Further, the Maison de jeunes Point de mire arranges fly-fishing trips by boat, starting in May, up until October or November. Three to five people go out in a 16' boat one to three times per week from the Verdun Marina (Dessau-Cima+ 2012).

No information is available regarding the species of fish taken, but the following species are sport fish that according to the Quebec Ministry of Natural Resources and Wildlife, Association des Pêcheurs de Longueuil and the Maison des jeunes Point de Mire (Dessau-Cima+ 2012), have been taken in the past:

- Brown bullhead;
- Brown trout;
- Common carp;
- Muskellunge;
- Rock bass;
- Northern pike;
- Rainbow trout;
- Smallmouth bass;
- Walleye;
- Sturgeon; and
- Yellow perch

Of note, brown trout, rainbow trout, and muskellunge have been stocked in previous years.

3.3.5.5 Aquatic Habitats

Desseau/CIMA+ (2012) used Lavoie and Talbot (1984) (as set forth in Armellin and Mousseau, 1998) to categorize the fish habitat of the Study Area based on four biophysical characteristics; flow velocity, average depth, substrate particles size, and the presence or absence of aquatic vegetation. This resulted in 24 unique habitat types of which 11 can be found within the Study Area (Drawing 107, Appendix 1).

Lavoie and Talbot (1988) established criteria for spawning habitats based on the presence of certain key favourable characteristics in the watercourse. These characteristics, identical to those described above for aquatic habitats, resulted in the identification of six unique fish reproductive habitats or guilds; lotic lithophil, lenthic lithophil, lentic phytolithophil, phytophil, lithopelagophil and pelagophil. The lithopelagophil and pelagophil habitats are not found within the Study Area and will not be discussed further in the document.

Lotic Lithophil Habitat

Lotic lithophil habitat is marked by higher velocity water (30-215 centimeters per second (cm/s)) in water depth that ranges between 0.2 and 7 metres deep and water temperature between 4 and 18 °C. The substrate is comprised of coarse sand, gravel, rock and boulder and vegetation is mainly absent (Roche NCE, 2008). Aquatic habitat types 12, 13, 16, 17, and 20 (Drawing 107, Appendix 1) are grouped in this guild.

Lentic Lithophil Habitat

Lentic lithophil habitat has flow velocities less than 30 cm/s, a depth greater than 0.1 m, and a temperature range of 4-18°C. The substrate is comprised of coarse sand, gravel, and rock and vegetation is mainly absent (Roche NCE 2008). Aquatic habitat types 5 and 9 (Drawing 107, Appendix 1) are grouped in this guild.

Lentic Phytolithophil Habitat

Lentic phytolithophil habitat has flow velocities less than 30 cm/s, a depth under 4 m and a temperature range of 7-24°C. The substrate is comprised of silt, gravel, rock and organic matter. A moderate density of aquatic and/or emergent vegetation is present (Roche NCE 2008). Aquatic habitat types 2 and 4 are grouped in this guild (Drawing 107, Appendix 1).

Phytophil Habitat

Phytophil habitat has flow velocities less than 30 cm/s, a depth under 1.2 m and a temperature range of 4-16°C. The substrate is considered to be organic due to the dense presence of aquatic vegetation (Roche NCE 2008). Aquatic habitat type 4 is in this guild (Drawing 107, Appendix 1).

Aquatic habitat type 10 was not included in a guild. This represents a portion of the St. Lawrence Seaway that is dredged for navigational purposes. It has lentic flow but a depth of 8.6 m from dredging activities. The presence of vegetation would be dependent on the time between dredging events.

Table 42 indicates the fish species utilizing each guild for spawning activities.

Table 42 – Habitat Guild of Fish Species in the Study Area

	GUILD			
COMMON NAME	LOTIC LITHOPHIL	LENTIC LITHOPHIL	LENTIC PHYTOLITHOPHIL	PHYTOPHIL
Lake sturgeon	X			
Bowfin			X	
Round goby	X			
Shorthead redhorse	X			
White sucker	X			
Northern sucker	X			
Silver redhorse	X			
Rock bass			X	
Pumpkinseed			X	
Black crappie			X	
Largemouth bass			X	
Smallmouth bass	X		X	
Mottled sculpin		X		
Common shiner			X	
Silver minnow			X	
Emerald shiner			X	
Cutlip minnow			X	
Golden shiner			X	
Mimic shiner			X	
Pearl dace			X	
Longnose dace			X	
Spottail shiner			X	
Rosyface shiner	X		X	
Fathead minnow			X	
Northern redbelly dace			X	
Common carp			X	
Banded killifish			X	
Northern pike				X
Muskellunge				X

COMMON NAME	GUILD			
	LOTIC LITHOPHIL	LENTIC LITHOPHIL	LENTIC PHYTOLITHOPHIL	PHYTOPHIL
Brown bullhead			X	
Channel catfish	X			
Tadpole madtom	X			
American smelt		X		
White perch		X	X	
Iowa darter			X	
Walleye	X			
Sauger	X			
Logperch		X	X	
Yellow perch			X	
Johnny darter		X		
Silver lamprey	X	X		
Sea trout (brown trout)	X			
Cutthroat trout	X			
Central mudminnow			X	

Dessau-Cima+ 2012

Habitats of the Greater La Prairie Basin

The greater basin is roughly comprised of three regions; the channel between Nuns Island and Montreal Island, the northern and eastern shores of Nuns Island, and the main stem of the river.

The channel between Nuns Island and Montreal Island is defined, for the purposes of this discussion, as the area west of the Clément Bridge. Five habitat types (Drawing 107, Appendix 1) were identified in this area, all with lotic flow. Depths were less than 5 m except for one small area that was greater than 15 m deep. The habitats were all identified as having coarse substrate that had a mix of vegetation and bare areas. The vegetated areas identified by Dessau-Cima+ (2012) were found along the shore of Montreal Island north of the Nuns Island Bridge and expanding across the channel south of the bridge. AECOM's (2016) field studies identified a large vegetated area south of the bridge and the western half of the channel. They also identified a small vegetated area on the northern shore of Nuns' Island north of the bridge.

The section encompassing the northern and eastern shores of Nuns' Island also consists of five habitat types (Drawing 107, Appendix 1); however, with a greater variability than seen in the channel. Immediately west of the Clément Bridge on the north shore of Nuns Island is an area of white-water lotic flow. This area abuts an area of deep (5 to >15 m) water to the north. East of the white-water is an area of lotic flow with shallow water with vegetated coarse substrate. Along the eastern shore of Nuns Island are two small areas of lentic flow that are shallow and vegetated. The majority of this section is lotic flow that is shallow and barren with coarse substrate. AECOM (2016) identified a vegetated area along the eastern shore of Nuns Island south of the ice boom.

The main stem of the river runs from east of Nuns' Island to the dike between the greater and lesser basins. The section is almost entirely lotic, and much of that is comprised of un-vegetated coarse substrate (Drawing 107, Appendix 1). On the western end of the section there is a small area of white-water. On the eastern end of the section, the river exhibits lotic flow with shallow (<5 m) water and coarse substrate, but is vegetated. AECOM (2016) identified a small vegetated area adjacent to the dike and south of the ice boom.

The variety of habitats within the greater basin has created favourable habitats for spawning, feeding, and rearing. The area hosts 33 species spread over 15 families, chiefly the pericdae, cyprinidae, and centrarchidae (Dessau-Cima+ 2012). The characteristics of the greater basin have created favourable spawning habitat for several lotic lithophil species such as walleye and catostomidae. Spawning habitat for phytolithophil species is limited within the greater basin but small areas on the eastern shore of Nuns Island are available (Dessau-Cima+ 2012).

Habitats in the Lesser La Prairie Basin

The lesser basin is a portion of the river that has been isolated from the main stem of the St. Lawrence since the construction of the St. Lawrence Seaway between 1954 and 1959. The lesser basin features a navigable channel dredged along the true right bank of a dike. The fill was used to create islets dividing the Seaway from the remainder of the lesser basin. The sub-surface slopes of the small artificial islands created between the navigable channel and the remainder of the lesser basin provide valuable spawning habitat (Robitaille 1997). The shorelines within the lesser basin are mainly natural with a gentle to moderate slope and vegetated banks (AECOM 2016a).

Four aquatic habitat types are found with the lesser basin (Drawing 107), one of those being the dredged channel of the Seaway (Type 10, Drawing 107, Appendix 1). The channel is colonized, for the most part, by zebra mussels on a gravel substrate (Dessau-Cima+ 2012). Much of the lesser basin is moderately shallow (2-5 m) with fine grained substrate that is free of vegetation (Type 9). A small strip along the right bank of an islet (Type 5) is a shallow area with fine grained substrate and no vegetation. The lone area of vegetated substrate is a strip along the Brossard shore (Drawing 107). This habitat is a favourable spawning zone for many phytolithophil species such as bass, perch and even some members of the carp family (Dessau-Cima+ 2012). During a field survey in 2012 the American eel and the rosyface shiner, both listed species at risk, were identified.

3.3.5.6 Critical Habitat

Many fish that are important ecologically and for sport fishing purposes depend on shallow, lotic water for spawning and nursery purposes. Some of this habitat has a riffled (turbulent) surface that in itself provides overhead cover for fish against predators. This habitat typically has large bottom substrate that may provide lateral cover. Large material also has interstitial spaces for winter sequestering and overhead cover for small fish. The habitat provides spawning, as well as incubation and early rearing (collectively "nursery") habitat. Shallow lotic habitat with laminar (non-turbulent) flow often has a vegetated bottom that holds benthic material (often smaller than the turbulent flow habitat) in place. The vegetation provides overhead as well as lateral cover and spawning and nursery habitat. Lentic water with emergent or submerged vegetation is also used by certain fish species for spawning and nursery purposes, and to provide lateral and overhead cover that is also important for fish survival.

In the case of a bridge with piers, the concrete pier structures themselves can provide lateral cover and shelter from extreme currents. Based on these somewhat general criteria, the following habitat types exist, and would provide important fish habitat in the vicinity of the Champlain Bridge (Drawing 108, Appendix 1):

- Type 2 – shallow water, lentic (slow) flow, coarse substrate, vegetated bottom substrate;
- Type 4 – shallow water, lentic, fine substrate, vegetated bottom;

- Type 12 – shallow water, laminar flow (moving water but non-turbulent), coarse substrate, vegetated bottom;
- Type 16 – moderate depth, laminar flow (moving water but non-turbulent), coarse substrate, vegetated bottom; and
- Type 22 – shallow, turbulent flow with large substrate devoid of plant growth.

The other habitats that are present in the Study Area, Types 5, 9, 10, 13, 17 and 20, are either very deep, non-turbulent and/or devoid of vegetation. Large, mobile and hardy fish often occupy these habitat types, which, in comparison with the other habitat types available, are considered relatively non-sensitive.

CDPNQ has identified 12 distinct fish spawning habitats within an 8 km radius of the Champlain Bridge (Drawing 109, Appendix 1). Three of those habitats lie within the Dessau-Cima+ Study Area. The first wraps around the northern shore of Nuns Island to the ice boom. The area contains white-water, laminar and lentic flow types, and could serve as a spawning and feeding site for rock bass, white sucker, Johnny darter and burbot and feeding site for sunfish and certain species of cyprinids (AECOM 2016a). The second (Drawing 109, #52) is adjacent to the Brossard shore within the lesser basin. This area provides spawning habitat for species such as yellow perch, rock bass, pumpkinseed, Johnny darter, golden shiner and banded killifish (AECOM 2016a). The third area (Drawing 109, #170) is on the eastern shore of a shoal in the lesser basin and serves as a feeding area for longnose sucker, shorthead redhorse, rock bass, pumpkinseed sunfish, yellow perch, golden shiner and banded killifish (AECOM, 2016). This site provides only feeding habitat, and therefore has not been included with other critical habitats identified above. Table 43 provides a summary of the fish breeding areas identified by CDPNQ (2016).

Table 43 – Summary of Fish Reproductive Habitats near the Champlain Bridge

REPRODUCTIVE AREA	BREEDING	SPAWNING	FEEDING	PRESENCE
138	----	----	Northern pike, longnose sucker, pumpkinseed, rock bass, yellow perch, golden shiner, banded killifish	----
139	----	----	Northern pike, Johnny darter, white sucker, rock bass, yellow perch, muskellunge	----
169	----	----	Johnny darter, brown bullhead, banded killifish, bluntnose minnow	----
171	----	----	Johnny darter, smallmouth bass, white sucker, rock bass, logperch, largemouth bass	----
194	rock bass, muskellunge, cutlip minnow, Johnny darter	----	----	----
195	----		Johnny darter, rock bass, muskellunge	----
196	----	cyprinids, suckers	----	Johnny darter, white sucker, rock bass, pumpkinseed, cutlip minnow
218	smallmouth bass	----	----	----
52	----	----	----	Johnny darter, pumpkinseed, yellow perch, rock bass, golden shiner, banded killifish
53	Johnny darter, shorthead redhorse, banded killifish, mooneye		----	pumpkinseed, rock bass, yellow perch, golden shiner, alewife
170	----	----	longnose sucker, shorthead redhorse, pumpkinseed, yellow perch, rock bass, golden shiner, banded killifish	----
433	----	----	rock bass, yellow perch, pumpkinseed, alewife, shorthead redhorse, golden shiner, mimic shiner, bluntnose minnow, banded killifish	----

Adapted from CDPNQ 2016

3.3.5.7 Migratory Movements

Some of the species listed in this section of the St. Lawrence River are known to migrate further upstream in order to reach whitewater spawning sites, including the Lachine Rapids and the Mercier Bridge. These species include lake sturgeon, white sucker, longnose sucker, smallmouth bass, sauger, and walleye (Stantec 2015b). Two species with provincial species at risk status, the American shad (vulnerable) and the American eel (likely to be designated) probably migrate into and through the Study Area. American shad migrate upstream to reach one of the two spawning areas in the area that is located downstream of Carillon in the Ottawa River. For the American eel, juveniles migrate upstream, while adults migrate downstream (Stantec 2015b).

Although migration corridors were not surveyed in the Study Area, upstream migratory movements are generally made on paths where the current velocities are the lowest, with this trajectory occurring along Nuns' Island within the Study Area (Stantec 2015b).

3.3.6 SPECIES AT RISK

A review of federal and provincial species at risk databases was conducted. The province of Quebec noted 14 listed fish species (Table 44) (Ministère des Forêts, de la Faune et des Parcs (MFFP), 2006). In addition, the two bivalves that were previously mentioned (Sect. 3.3.5.2) are listed in Quebec as "Likely to be Designated" (Table 44). Note that bolded species were identified by the CDPNQ (2016) as occurring within 8 km of the Champlain Bridge.

Table 44 – Provincially Listed Aquatic Species

COMMON NAME	SCIENTIFIC NAME	LISTING
Fish		
American shad	*Alosa sapidissima*	Vulnerable
American smelt	*Osmerus mordax*	Vulnerable
American eel	*Anguilla rostrata*	Likely to be designated
Atlantic Sturgeon	*Acipenser oxyrinchus*	Likely to be designated
Bridle shiner	**Notropis bifrenatus**	**Likely to be designated**
Chain pickerel	*Esox niger*	Likely to be designated
Channel darter	*Percina copelandi*	Vulnerable
Copper redhorse	**Moxostoma hubbsi**	**Threatened**
Eastern sand darter	*Ammocrypta pellucida*	Threatened
Lake Sturgeon	**Acipenser fulvescens**	**Likely to be designated**
Grass pickerel	*Esox americanus vermiculatus*	Likely to be designated
Rainbow darter	*Etheostoma caeruleum*	Likely to be designated
River redhorse	**Moxostoma carinatum**	**Vulnerable**
Rosyface shiner	*Notropis rubellus*	Likely to be designated
Bivalves		
Elephantear mussel	***Elliptio crassidens***	**Likely to be designated**
Spike mussel	***Elliptio dilatata***	**Likely to be designated**

The A to Z Species Index (Government of Canada 2016a) names species listed under the federal *Species at Risk Act* (SARA). Seven Quebec-resident fish species were noted and are listed with their designation in Table 45. Note that bolded species were identified by the CDPNQ (2016) as occurring within 8 km of the Champlain Bridge.

Table 45 –Federally Listed Aquatic Species

COMMON NAME	SCIENTIFIC NAME	LISTING
Bridle shiner	***Notropis bifrenatus***	**Special Concern**
Channel darter	*Percina copelandi*	Threatened
Copper redhorse	***Moxostoma hubbsi***	**Endangered**
Eastern sand darter	*Ammocrypta pellucida*	Threatened
Grass pickerel	*Esox americanus vermiculatus*	Special Concern
River redhorse	***Moxostoma carinatum***	**Special Concern**
Striped bass	*Morone saxatilis*	Extirpated (St. Lawrence River population)

AECOM (2016) included the margined madtom (*Noturus insignis*) in its list of species-at-risk identified by the CDPNQ (Appendix 5). It is listed federally as Threatened and provincially as Likely to be Designated (AECOM 2016a). However, the species is not mentioned in other literature (Dessau-Cima+ 2012, Stantec 2015b, AECOM 2016a) as either being present in the area or caught in fishing effort associated with recent environmental assessment programs. CDPNQ lists the logperch as federally Threatened and provincially Vulnerable; however, the species does not appear in either referenced online database.

3.3.7 SUMMARY

The fish community of the Study Area is highly diverse. Although only two invasive fish species were identified as occurring there, many of the other species are probably naturalized in that they were not naturally occurring, were introduced within the past century, and have now become accepted as naturally-reproducing members of the ecosystem. The fish community is dominated by warmwater or cool-water species that tend to spawn in the spring with the progeny hatching and undergoing early rearing or “nursery” type development in the summer. Therefore, this period is considered the major “sensitive” period for the vast majority of the fish species comprising the fish community within the Study Area. There are few coldwater salmonid species represented in the community, species that generally spawn in the fall, with their eggs incubating in the gravel in the winter and spring (i.e. have a fall/winter/spring sensitive period). In addition, there are probably very few individuals of these species present within the Study Area at any time. One of these coldwater species is the invasive rainbow trout. Therefore, temporal mitigation of the fish and fish habitat related effects of any project that potentially affects the Study Area should concentrate on the spring and early summer, the sensitive period for warmwater and cool-water fish species.

3.4 TERRESTRIAL ENVIRONMENT

3.4.1 TERRESTRIAL VEGETATION

As previously mentioned in section 3.3.4 (wetlands), the information on terrestrial vegetation is taken from the most recent plant inventory, conducted by AECOM in 2016 on JCCBI land (AECOM 2016b). It is important to emphasize that close to 80% of the plant survey area is occupied by anthropogenic environments such as road infrastructures, buildings and construction sites for the new bridge. Furthermore, the construction sites are not visible on Drawings 105 and 106 in Appendix 1 since they were created after 2013, which is the year of the satellite image used to map the homogeneous plant units. Lastly, note that the anthropogenic environments are not represented by coloured hatching on Drawings 105 and 106.

The natural terrestrial environments identified in the survey area consist of abandoned fields populated by species typical of these environments. Table 46 presents the distribution of terrestrial environments in the survey area.

Table 46 – **Distribution of terrestrial environments in the survey area**

TYPE OF TERRESTRIAL ENVIRONMENT	AREA (HA)	PROPORTION (%)
Anthropogenic environment	139.33	81.6
Herbaceous field	23.74	13.9
Treed shrubland	7.33	4.3
Shrubland	0.36	0.2
Total	**170.76**	**100**

The tree stratum is dominated by red ash, Eastern cottonwood (*Populus deltoides*), trembling aspen (*Populus tremuloides*), Siberian elm (*Ulmus pumila*) and shagbark hickory. Shagbark hickory is a species likely to be designated as threatened or vulnerable under the *Regulation Respecting Threatened or Vulnerable Plant Species and their habitats*. Shagbark hickory was reported in the treed shrubland located between the treed swamp and Avenue des Tisserand in Brossard. The dominant plant species in the tree layer are Canadian fly honeysuckle (*Lonicera canadensis*), silky dogwood (*Cornus amomum subsp. obliqua*), grayleaf red raspberry (*Rubus idaeus subsp. strigosus*), staghorn sumac (*Rhus typhina*) and riverbank grape (*Vitis riparia*). Lastly, the dominant species in the herb layer are great burdock (*Arctium lappa*), ragweed (*Ambrosia artemisiifolia* and *Ambrosia trifida*), goldenrod (*Solidago sp.*), timothy (*Phleum sp.*) and purple bamboo (*Poaceae sp.*).

During the 2016 biodiversity study, there was special focus on IAPSs and the emerald ash borer problem. A few IAPS specimens were noted in terrestrial environments, and their locations are given in Drawings 105 and 106 in Appendix 1. With respect to the emerald ash borer, signs pointing to the presence of this species were found in the two ash stands on JCCBI property. Given the advanced state of the epidemic, AECOM recommended that all the ash trees be possibly cut down.

No rare ecosystem was identified during the 2012 (Dessau-Cima+ 2012) and 2016 (AECOM) plant surveys. The special-status species are covered in section 3.4.5.

3.4.2 HERPETOFAUNA

A total of 38 species of herpetofauna are found in Quebec, including 20 amphibian species and 18 reptile species (AARQ 2016). Data on reptile and amphibian species presence was obtained from the Atlas of Amphibians and Reptiles of Quebec (AARQ 2016), the CDPNQ (CDPNQ 2016) and previous studies conducted in the Project area.

Twenty-nine species of herpetiles have been reported in the Montreal area (AARQ 2016). This includes seven species of salamanders, ten frog and toad species, five turtle species and seven snakes (Table 47).

Table 47 – Herpetile Species Reported in Montreal Area

COMMON NAME	SCIENTIFIC NAME
Reptiles	
Common Snapping Turtle	*Chelydra serpentina*
Painted Turtle	***Chrysemys picta***
Northern Map Turtle	*Graptemys geographica*
Wood Turtle	*Glyptemys insculpta*
Eastern Spiny Softshell	*Apalone spinifera*
Common Garter Snake	***Thamnophis sirtalis***
Northern Water Snake	*Nerodia sipedon*
Red-bellied Snake	***Storeria occipitomaculata***
Brown Snake	***Storeria dekayi***
Eastern Smooth Green Snake	*Liochlorophis vernalis*
Ring-necked Snake	*Diadophis punctatus*
Eastern Milk Snake	*Lampropeltis triangulum*
Amphibians	
Mudpuppy	*Necturus maculosus*
Eastern Newt	*Notophthalmus viridescens*
Blue-spotted Salamander	*Ambystoma laterale*
Yellow-spotted Salamander	*Ambystoma maculatum*
Northern Two-lined Salamander	*Eurycea bislineata*
Four-toed Salamander	*Hemidactylium scutatum*
Eastern Red-backed Salamander	*Plethodon cinereus*
American Toad	***Anaxyrus (Bufo) americanus***
Tetraploid Gray Treefrog	*Hyla versicolor*
Northern Spring Peeper	*Pseudacris crucifer*
Western Chorus Frog	*Pseudacris triseriata*
Wood Frog	*Lithobates (Rana) sylvaticus*
Northern Leopard Frog	*Lithobates (Rana) pipiens*
Pickerel Frog	*Lithobates (Rana) palustris*
Green Frog	*Lithobates (Rana) clamitans*
Mink Frog	*Lithobates (Rana) septentrionalis*
Bullfrog	*Lithobates (Rana) catesbeianus*

Note: Species in bold font are considered to have potential to occur in or near the Project area.

Targeted field inventories for snakes, turtles and anurans (frogs and toads) were conducted in the Project area in 2012 for the New Bridge for the St. Lawrence Environmental Assessment (Dessau-Cima+ 2012). Three species of snake were identified during these surveys: common garter snake, brown snake and red-bellied snake. Most of the garter snake and brown snake observations were at Nuns' Island, although brown snakes were also observed on the Island of Montreal and the seaway dyke north of Champlain Bridge. Garter snakes and a single red-bellied snake were found at the dyke to the south of Champlain Bridge. No amphibians or turtles were observed during the 2012 surveys, although it was noted that the wetlands would provide potentially suitable habitat.

Additional field survey effort at the Champlain Bridge was undertaken in 2016 for JCCBI, during which targeted surveys for anurans, turtles and snakes were conducted (AECOM 2016a). In addition to the three snake species that were found during the 2012 field surveys, painted turtle and American toad were observed in the Project area. The American toad was heard calling in a swamp dominated by common reed and Pennsylvania ash, while the painted turtle was found in an artificial reptile survey plot between the Bonaventure Expressway and the St. Lawrence River in an area dominated by grasses with some mature trees. All of the snake observations made in 2016 were at artificial survey plots located near the Voie-Maritime Parkway and between the Bonaventure Expressway and the St. Lawrence River.

Habitats

The Project area provides suitable habitat for snakes, particularly along rocky banks of the St. Lawrence River on Nuns' Island and Montreal Island, as well as the seaway dykes both north and south of the bridge. Though no hibernacula were confirmed, the potential for winter hibernacula was identified south of the highway on Montreal Island; snakes favour rock crevices and abandoned burrows that extend below the frost line for overwintering. Suitable habitat for turtles is scarce in the Project area, with no suitable sandy/gravel substrate for nesting and generally rocky shores that do not offer good basking areas (Stantec 2015b), although a painted turtle was found basking during the AECOM (2016) field surveys.

While the Project area offers little suitable habitat for amphibians, wetlands close to the bridge are capable of supporting frogs and toads and at least one species, American toad, is known to be present in the wetland near Avenue Tisserand on the eastern end of the bridge (Stantec 2015b; AECOM 2016a). Salamanders are also likely present in moist to wet areas; no salamanders were observed in the Project area, but no targeted survey effort for these secretive species was undertaken in the 2012 and 2016 surveys.

3.4.3 MAMMALS

Information on mammal species presence in the Project area was obtained from the CDPNQ (CDPNQ 2016) and previous field studies conducted in the Project area (AECOM 2016a; Dessau-Cima+ 2012). As well, a literature review was undertaken to determine which species are likely to occur in the Project area based on their known distributions and habitat requirements.

Approximately 90 species of mammals can be found in the province of Quebec, of which 47 occur in the Eastern Great Lakes Lowlands region (Smithsonian Museum of Natural History 2016; Quebec Biodiversity Website 2016); these are summarized in Table 1 in Appendix 6. However, of these, fewer than half are found in urban environments such as the Project area. While no targeted surveys were conducted in the Project area for the New Bridge for the St. Lawrence Environmental Assessment, observations of mammal presence (individuals and signs of activity including tracks, feces, carcasses, burrows, dens and browse) were recorded during targeted surveys for plants, herpetofauna and birds (Dessau-Cima+ 2012). Evidence of 13 mammal species was recorded during these surveys. Similarly, in the 2016 field surveys conducted by AECOM, incidental observations were made of mammals and their sign; seven species were identified during these surveys. Table 48 summarizes the mammals identified (directly or by their signs) during field studies conducted in the Project area.

Table 48 – Mammal Species Reported in Montreal Area

COMMON NAME	SCIENTIFIC NAME	DETAILS OF OBSERVATIONS
Mammals		
Snowshoe Hare	*Lepus americanus*	Observed during 2016 surveys.
Unidentified Hare or Rabbit (likely Eastern Cottontail or Snowshoe Hare)	*Sylvilagus floridanus* or *Lepus americanus*	Feces found in 2012 surveys, on Montreal Island.
Woodchuck	*Mormota monax*	Burrows found during 2012 and 2016 surveys on Couvee Islands and Dyke, Nuns' Island and Montreal Island.
Eastern Chipmunk	*Tamias striatus*	Observed in 2012 surveys, on Montreal Island.
Gray Squirrel	*Sciurus carolinensis*	Observed during 2012 and 2016 surveys on the South Shore, Couvee Islands and Dyke, Nuns' Island and Montreal Island.
Red Squirrel	*Tamiasciurus hudsonicus*	Observed during 2012 surveys on Nuns' Island.
Beaver	*Castor canadensis*	Browse observed on Couvee Islands and Dyke in 2012, and on the northwest bank of Nuns' Island (north of the temporary bridge) in 2016.
Norway Rat	*Rattus norvegicus*	Observed on river bank during 2016 surveys.
Deer Mouse	*Peromyscus maniculatus*	Nests found on South Shore and Montreal Island in 2012 surveys.
Unidentified Mouse	*Peromyscus sp.*	Observed during 2016 surveys.
Meadow Vole	*Microtus pennsylvanicus*	Observed in 2012 surveys, on Montreal Island.
Muskrat	*Ondatra zibethicus*	Tracks observed during 2016 surveys; individual found on Nuns' Island in 2012 surveys.
Red Fox	*Vulpes vulpes*	Observed on Nuns' Island in 2012 surveys.
Raccoon	*Procyon lotor*	Individual observed on Nuns' Island; tracks seen on South Shore and Montreal Island in 2012 surveys.
American Mink	*Neovison vison*	Observed on Nuns' Island in 2012 surveys.
Skunk	*Mephitis mephitis*	Tracks seen on South Shore and Montreal Island in 2012 surveys.
White-tailed Deer	*Odocoileus virginianus*	Trails observed during 2016 surveys.

Sources: AECOM 2016a and Dessau-Cima+ 2012

Other mammal species with potential to occur in the Project area, based on known habitat preferences and tolerance for urban and semi-urban environments, previously reported sightings in the Montreal area (Dessou-Cima+ 2012) and tolerance for human presence, include the porcupine, ermine, coyote, short-tailed shrew, house mouse, southern flying squirrel, little brown bat and red bat.

Habitats

The available habitat for mammals is limited, and no significant or important mammal habitats have been identified (AECOM 2016a). Only species that are adapted to human presence, and those which are tolerant of fragmented and disturbed habitats, are likely to be present in the Project area. There is insufficient suitable habitat for species with large home ranges and preference for interior forests. As well, the rocky shorelines and relatively strong currents of the St. Lawrence within the Project area are unsuited to semi-aquatic species such as the muskrat and beaver.

3.4.4 AVIFAUNA

More than 200 bird species, including vagrants, have been reported in the Champlain Bridge area (eBird 2016). A review of existing data from various sources was conducted in order to provide supplemental information on migratory bird presence and abundance that may be expected in and near the Project area, including avian species of conservation concern. Data sources consulted include the QBBA (Bird Studies Canada et al. 2016) for information on species potentially nesting in or near the Project area, Audubon Christmas Bird Count website for information on overwintering species in the Project area (National Audubon Society 2016), the CDPNQ (CDPNQ 2016) for information on species of conservation concern as well as sensitive habitats within 8 km of the Project area, and the Important Bird Areas (IBAs) of Canada database (IBA 2016) for information on areas of particular importance for birds. As well, a review of data from past surveys in the Project area was undertaken, including 2012 surveys for the New Bridge for the St. Lawrence Environmental Assessment (Dessau-Cima+ 2012) and 2016 surveys for JCCBI (AECOM 2016a).

3.4.4.1 Breeding Birds

A number of bird species breed in and around the Project area. Of particular note are two species that nest on the Champlain Bridge itself, the Cliff Swallow and Peregrine Falcon. Both of these species are legally protected (the Cliff Swallow by the MBCA; the Peregrine Falcon by SARA) and are known to reuse their nests from year to year. A management plan has been developed to monitor both Peregrine Falcons and Cliff Swallows, as well as their nests (SEF 2015). Elements of this ongoing management plan include behavioral monitoring, nest inventories and identification of suitable mitigation measures to ensure that JCCBI meets its commitments to abide by the MBCA and SARA. These measures include installation of compensatory nest sites to encourage the retention of falcons and swallows that will be displaced upon deconstruction of the Champlain Bridge (SEF 2015).

Information on these and other breeding birds within the Project area was taken from the Quebec Breeding Bird Atlas and previous field studies within the Project area.

Quebec Breeding Bird Atlas

Data from the QBBA were obtained from NatureCounts (Bird Studies Canada et al. 2016). The Project area is located within the atlas square 18XR13. Considerable survey effort was undertaken in this 10 X 10 km atlas square with a total of 90.3 hours, well above the QBBA's target survey effort of 20 hours per square.

Breeding evidence was recorded for a total of 92 species in square 18XR13; of these, 59 were confirmed to be breeding based on observed evidence, a further 16 species were considered to be probable breeders, and the remaining 17 were considered to be possibly breeding. A list of species observed within atlas square 18XR13 during the QBBA is presented in Table 2 in Appendix 6.

2012 Field Surveys for New Bridge EA (Dessau-Cima+ 2012)

Field surveys were conducted in June 2012 within the natural environments of the study area, which for the purpose of the surveys was divided into the following sectors: Brossard Shore, Couvee Islands, Seaway Dyke, Nuns' Island (east), Nuns' Island (west) and Montreal Island. A total of 930 individual birds (including 427 breeding pairs) representing 41 species were seen during these surveys. The most numerous species identified during the inventories, in terms of breeding pairs, accounting for 72% of all birds observed, were Red-winged Blackbird (2.88 pairs/ha), Yellow Warbler (1.91 pairs/ha), Cedar Waxwing (1.11 pairs/ha) and Song Sparrow (0.93 pairs/ha). Two avian species of conservation concern (see Section 3.4.5.4) were observed during the surveys, the Peregrine Falcon and Chimney Swift.

Table 3 in Appendix 6 summarizes the species presence per sector. Species diversity was similar in each of the sectors, with approximately 20 species observed per sector. Avian abundance (number of individuals observed) was highest in Nuns' Island (east and west), while the number of breeding pairs was highest in the Seaway dyke and Nuns' Island (west). The lowest avian abundance and number of breeding pairs was seen in the Brossard Shore sector (Dessau-Cima+ 2012).

2016 Field Surveys for JCCBI (AECOM 2016a)

The 2016 field surveys primarily targeted waterfowl (ducks and geese), although raptors and other aquatic species such as loons, gulls and herons were also surveyed. Boat-based surveys for breeding pairs in the waters surrounding the Champlain Bridge were conducted in the spring (late May to early June), while aerial surveys for waterfowl broods were conducted in late July. No land-based surveys were conducted, although incidental observations of passerines and other landbirds were recorded. The study area for these surveys was limited to 100 m on either side of JCCBI property.

In the spring surveys, a total of 86 individual adult birds (including 25 breeding pairs) were counted representing 13 species; Mallard was the predominant species in the area, comprising more than half of the individuals counted. Five species of waterfowl were observed, including Mallard, American Black Duck, American Wigeon, Blue-winged Teal and Canada Goose. Other species included Osprey, Peregrine Falcon, Double-crested Cormorant, Common Tern, Ring-billed Gull, Spotted Sandpiper, Great Blue Heron, and four unidentified gulls (AECOM 2016a).

Only four species were identified during the summer surveys; once again, the Mallard was the most frequently observed species with 19 non-breeding adults and ten broods counted. Seven Canada Geese and one unidentified duck were observed, and small numbers of Double-crested Cormorant and Great Blue Heron were seen. While no Canada Goose families were observed during the brood surveys, five groups of Canada Geese including 10 adults and 15 young of the year were observed by AECOM personnel during surveys for other taxa (AECOM 2016a).

Non-target species observed during the spring and summer surveys included Yellow Warbler, Cliff Swallow, Tree Swallow, Barn Swallow and an unidentified woodpecker. Cliff Swallows were found to be nesting on the bridge itself, and Tree Swallows were using nest boxes on Nuns' Island; no nesting behaviour was reported for the other species (AECOM 2016a). In addition, species observed during June surveys for other (non-avian) taxa included American Woodcock, Killdeer and Gadwall.

3.4.4.2 Migrating and Wintering Birds

Information on Canadian Wildlife Service (CWS) waterfowl surveys within the St. Lawrence River were obtained from CDPNQ (2016) and Dessau-Cima+ (2012). The Bassin de la Prairie (Nuns' Island) Waterfowl Concentration Area (Habitat No. 02-06-0167; Drawing 110 in Appendix 1) extends southward from the Champlain Bridge along the east coast of Nuns' Island. Spring and fall migration surveys conducted between 1981 and 1997 within this Waterfowl Concentration Area show that the area is frequented by a number of waterfowl species, including diving ducks (Common Goldeneye, Ring-necked Duck, Greater and Lesser Scaup), Common and Red-breasted Mergansers, and dabbling ducks (Mallard, American Black Duck, American Wigeon, Northern Pintail, Gadwall, Green-winged and Blue-winged Teal). Double-crested Cormorant, Great Blue Heron, Canada Goose and Ring-billed Gull have also been observed during these surveys (CDPNQ 2016).

Aerial inventories of the St. Lawrence River were conducted by the CWS during the spring waterfowl migration period in 2004, 2007 and 2008. At least 16 species were observed during the surveys. Excluding a seemingly exceptional count of over 25,000 unidentified gulls observed in 2004, 381 individual birds were counted over the three survey years. The most abundant species (in descending order) were Mallard, Ring-necked Duck, American Wigeon, Double-crested Cormorant, American Black Duck, Common Merganser, Scaup (not identified to species), Gadwall, Canada Goose, Bufflehead, Great Blue Heron, Ring-billed Gull, Great Black-backed Gull, Black Scoter, Hooded Merganser, Common Loon (Dessau-Cima+ 2012).

2012 Fall Migration Surveys for New Bridge EA (Dessau-Cima+ 2012)

A field survey was conducted in October 2012, during the fall migration period, primarily in order to characterize avian use of the Waterfowl Concentration Area east of Nuns' Island. Land-based surveys were conducted from the east and west shores of Nuns' Island and on the Seaway Dyke. A total of 233 individuals, representing 13 species, were observed in the fall survey. Canada Goose was the most numerous, accounting for almost half of the individuals counted. Double-crested Cormorant, Ring-billed Gull and Mallard were also quite abundant, and smaller numbers of Yellow-rumped Warbler, Herring Gull, Great Blue Heron, White-crowned Sparrow, Dark-eyed Junco, Great Black-backed Gull, Gadwall, Belted Kingfisher and Peregrine Falcon were observed. Most of the birds, including all of the Canada Geese, were seen in the Wildlife Concentration Area, south of the ice control structure.

2016 Fall Migration Surveys for JCCBI (AECOM 2016a)

Fall migration surveys of the St. Lawrence River near the Champlain Bridge were conducted in October 2016 from accessible banks and the boom. During these surveys, a total of 77 individual birds representing at least seven species were observed, the most abundant being Mallard, Double-crested Cormorant and Ring-billed Gull. American Wigeon, American Black Duck, Great Black-backed Gull and Peregrine Falcon were also observed, as well as several unidentified gulls and one unidentified duck. During autumn surveys for other (non-avian) taxa, 15 Dark-eyed Juncos were observed in the study area (AECOM 2016a).

Audubon Christmas Bird Counts

Christmas Bird Count (CBC) data from 1931 to 2015 were obtained from the National Audubon Society (2016) for the Montreal count circle, which includes the Project area, and the results are summarized in Table 4 in Appendix 6. Over 180 taxa have been observed during at least one count year, and approximately 40 species are regularly seen on the count (i.e., observed on more than half of the 80 CBCs conducted between 1931 and 2015), including several waterfowl species wintering in areas of open water within the St. Lawrence River.

Habitats

The Project area is located within Breeding Conservation Region (BCR) 13: Lower Great Lakes/St. Lawrence Plain. This BCR, and in particular the St. Lawrence River, is of critical importance to the thousands of dabbling ducks and diving ducks that congregate in the area during migration. In the winter months, large numbers of American Black Duck, Mallard, Common Goldeneye and Common Mergansers overwinter in the greater Montreal region (Lepage et al. 2015). Habitats within the Project area itself are for the most part urban, and the species diversity seen in the area (as outlined in the previous section) reflects this, with urban-associated species particularly well represented. Around the Champlain Bridge, terrestrial habitat consists mainly of herbaceous fields and eastern cottonwood poplar stands, with some black locust stands, red ash stands and staghorn sumac fields (Dessau-Cima+ 2012). There is limited wetland habitat along the river and next to the ramps of Highway 10 on the south shore of the St. Lawrence (Dessau-Cima+ 2012).

The Champlain Bridge itself provides nesting habitat for certain cliff-nesting bird species that are tolerant of urban environments, most notably the Peregrine Falcon and Cliff Swallow, which are protected by SARA and the MBCA, respectively. In the AECOM 2016 surveys, Peregrine Falcons were observed at section 6 of the Champlain Bridge, including the nest box located on the 1E pile. Piles 3E and 2W and the 67 pole of the boom also have Peregrine Falcon nest boxes, while Cliff Swallows nest at several locations along the bridge span (Drawing 110 in Appendix 1; SEF 2015).

The St. Lawrence River provides habitat for waterfowl and other bird species associated with aquatic environments; the water and islands therein are important nesting, staging and wintering areas for several species. The area between Montreal and Nuns' Island in particular is frequented by waterfowl in the breeding season due to its relatively calm waters, and aquatic vegetation and shrubs suitable for nesting, and during the fall migration period, this area provides feeding and resting habitat for large numbers of waterfowl (AECOM 2016a). A designated Waterfowl Concentration Area, the Bassin de la Prairie (Nuns' Island) (Habitat No. 02-06-0167; Drawing 110 in Appendix 1), extends southward from the Champlain Bridge along the east coast of Nuns' Island.

Areas of particular importance to the survival of bird species may be given the designation of Important Bird Area (IBA). The IBA program is coordinated by BirdLife International, and administered in Canada by the Canadian Nature Federation and Bird Studies Canada (IBA 2016). The criteria used to identify important habitat are internationally standardized and are based on the presence of species at risk, species with restricted range, habitats holding representative species assemblages, or a congregation of a significant proportion of a species' population during one or more season. These criteria are used to identify sites of national and international importance. Two IBAs are situated within 10 km of the Project area: the Îles de la Couvée IBA and the Île aux Hérons Migratory Bird Sanctuary IBA. Both of these IBAs are also designated migratory bird sanctuaries (MBSs), which means that they are protected under federal Migratory Bird Sanctuary Regulations. These regulations include rules and prohibitions regarding the taking, injuring, destruction or disturbance of migratory birds or their nests or eggs in the sanctuaries; as well, hunting of listed species under the Act is not permitted in any Migratory Bird Sanctuary (ECCC 2016a).

The Îles de la Couvée IBA, on the south shore of the St. Lawrence Seaway in the Canal de la Rive Sud between the Champlain and Victoria bridges, includes four artificial elongate islands ranging in size from 0.36 to 0.94 km². The islands were created from deposition of dredged material from the canal. These islands are largely unvegetated, apart from a few poplar trees and sparse herbaceous vegetation on one of the islands (IBA 2016). This IBA is notable for a large Ring-billed Gull colony, which at its peak supported over 28,000 breeding pairs comprising 1 – 3% of the species' global population. In recent years, this colony has been decreasing in size, most likely due to the presence of red foxes on the island; a 2006 survey identified less than 10,000 pairs, and there have been no reports of Ring-billed Gulls nesting anywhere in the sanctuary since 2009. During surveys conducted in 2012 on the two southernmost islands (Dessau-Cima+ 2012), no breeding gulls were observed; however, evidence of successful reproduction (fledged young being fed by their parents) on islets just outside the IBA was noted by the surveyors. Today, the site supports small numbers of Red-winged Blackbird and songbirds including Yellow Warbler, Savannah Sparrow and Song Sparrow (ECCC 2016b). Small numbers of Herring Gulls also nest in the IBA, and Common Terns formerly nested there (IBA 2016).

The Île aux Hérons Migratory Bird Sanctuary IBA is located within approximately 2 km of the southern tip of Nuns' Island in the Rapides de Lachine section of the St. Lawrence River, and includes five main islands (Île au Diable, Les Sept Soeurs, Île aux Chèvres, Île a Boquet, Île aux Hérons) and several smaller unnamed islands. The IBA also encompasses the water around the islands, part of the Boquet peninsula, a dam, as well as Île Rock (Îles aux Sternes) which is just outside of the Migratory Bird Sanctuary boundaries. Vegetation on the islands is dominated by giant St. John's wort, panicled dogwood, staghorn sumac, basswood, white elm, and slippery elm. The islands are of low relief, with soils consisting of a thin layer of till covered by alluvial material and some outcrops. The Rapides de Lachine section of the river is shallow, with the exception of two deeper trenches near Île aux Hérons, and the river remains ice-free during most winters (IBA 2016). This IBA has been designated as such because it provides nesting habitat for nationally significant numbers of Black-crowned Night Heron (an average of 420 pairs, believed to be over 10% of the Canadian population), Great Blue Heron (over 330 nests, approximately 1% of the Canadian population of the *herodias* subspecies) and Great Egret (two pairs comprising 1% of the Canadian population) (IBA 2016). The Great Blue Heron numbers in this IBA declined substantially in past years, falling from 910 birds in 1999 to 48 in 2001; however, the numbers of nesting Great Egrets and Black-crowned Night Herons have been increasing (ECCC 2016b). Chimney Swift, a species at risk, has also been observed in large numbers within this IBA (IBA 2016). As well, Common Terns and Ring-billed Gulls nest on Îles aux Sternes, and Little Gulls have tried to breed on this island, although successful breeding has not been reported (IBA 2016). Mallards, American Wigeon, Gadwall, American Black Duck, Red-winged Blackbird and Yellow Warbler also breed in this IBA (ECCC 2016b). During migration, several waterfowl species frequent the Île aux Hérons Migratory Bird Sanctuary IBA including Common Goldeneye, American Black Duck, Mallard, Green-winged Teal, Blue-winged Teal, and smaller numbers of Horned Grebe (IBA 2016, ECCC 2016b). Barrow's Goldeneye have been observed here, including an uncommonly large flock of 40 in 1977. Large wintering flocks of Red-breasted Mergansers also occur at this IBA (IBA 2016).

Two additional sites of wildlife interest were identified in the CPDNQ report, both of which overlap with the above-mentioned areas: Les secteurs d'eau vive du fleuve Saint-Laurent and Les îlots, la digue et les herbiers de la Voie maritime. From west to east, Les secteurs d'eau vive du fleuve Saint-Laurent includes Dorval, Bushy and Dixie Islands; the îles aux Chèvres and îles aux Hérons within the Lachine rapids; Nuns' Island; and the Le Moyne Channel between the islands of Sainte-Hélène and Notre-Dame. Several islands in this area are used by waterfowl for resting, feeding and nesting, and the downstream portion of Dixie and Bushy Islands are used as a waterfowl nocturnal gathering area. They are areas of waterfowl concentration during migration, and the rapids provide ice-free areas for waterfowl in winter months (MEF 1994; CDPNQ 2016). Les îlots, la digue et les herbiers de la Voie maritime is located on the South Shore of the St. Lawrence River, La Prairie Basin and includes islets, dykes, seagrass beds and banks of the south shore of the Seaway Canal. The seaway islands provide high and low prairie habitats suitable for nesting waterfowl, and the islets are used for nesting by colonial birds such as Ring-billed Gulls. The seagrass beds near the islets and on the south bank of the canal provide suitable nesting and feeding habitat for waterfowl and other bird species (MEF 1994; CDPNQ 2016).

3.4.5 SPECIES AT RISK

3.4.5.1 Terrestrial vegetation

As part of the 2016 biodiversity study, the CDPNQ mentioned that there were three occurrences of species at risk within a 2-km radius from the mid-point of the Champlain Bridge (Table 49; Appendix 4). Note, however, that these occurrences date back more than 50 years.

Table 49 – Plant species identified by the CDPNQ within a 2-km radius from the mid-point of the Champlain Bridge

COMMON NAME	SCIENTIFIC NAME	PROVINCIAL STATUS	FEDERAL STATUS
Normal sedge	*Carex normalis*	Likely to be designated	None
American water-willow	*Justicia americana*	Threatened	Threatened
Peachleaf willow	*Salix amygdaloides*	Likely to be designated	None

Neither these species nor any species covered by the federal *Species at Risk Act* or the provincial legislation on threatened or vulnerable species were observed during the plant surveys conducted in 2012 and 2016. However, three species likely to be designated as threatened or vulnerable were noted in the local study area:

- St. Lawrence water-horehound (*Lycopus americanus var. laurentianus*): this species was reported in 2012 on the two small islands located north of section 5 of the Champlain Bridge (Drawing 105, Appendix 1)
- Rough water-horehound (*Lycopus asper*): a few individuals were reported on the banks of the seaway under the Champlain Bridge (Drawing 106, Appendix 1)
- The shagbark hickory north of Avenue des Tisserand in Brossard (Drawing 106, Appendix 1)

Although these species are not officially protected by Quebec legislation, it is recommended that their habitat not be disrupted, or at least that mitigation measures be implemented to minimize the impacts of the project activities on these species.

3.4.5.2 Herpetofauna

Of the 38 species of herpetofauna that are found in Quebec (AARQ 2016), more than half are considered to be of conservation concern by the federal and/or provincial governments. Twelve reptile species and seven amphibian species in Quebec have been listed by the provincial Ministère des Forêts, de la Faune et des Parcs (MFFP), including four Vulnerable species, four Threatened species and a further eleven “Likely to be designated as Threatened or Vulnerable” species (Table 50). Nine terrestrial reptile species and three amphibian species are listed under SARA and/or are considered by COSEWIC to be of concern, including six Threatened species, one Endangered species and five species of Special Concern (Table 50). However, the potential presence of many of these species in the Project area can be ruled out based on their known distributions and habitat preferences.

A search of the CDPNQ database was requested as part of JCCBI bridge study (AECOM 2016a) in order to determine whether reptile and amphibian species of conservation concern had been reported within an 8 km radius of the Project area. The results of this database search indicated that eight herpetofauna species of conservation concern had been reported within 8 km of the study area, including two frog species (western chorus frog and pickerel frog), two turtle species (northern map turtle and eastern spiny softshell) and four snakes (brown snake, eastern smooth green snake, ring-necked snake and eastern milk snake) (Table 50). According to the CDPNQ report (CDPNQ 2016), the records of milk snake, eastern smooth green snake, eastern spiny softshell and pickerel frog are all more than 25 years old and are considered 'historical', with the exception of one 2003 observation of an eastern spiny softshell which was likely released from captivity; therefore, the presence of these species is considered unlikely. Although map turtles have been observed on Nuns' Island as recently as 2003 (CDPNQ 2016), sandy beaches or sandbars that would provide suitable nesting habitat for the species (MacCulloch 2002) are not present in the Project area and the rocky shorelines are not suitable basking habitat; nonetheless, they may feed in the area. Western chorus frog is considered to be potentially present in wetland areas, but they were not heard during either the 2012 or 2016 surveys (AECOM 2016a; Dessau-Cima+ 2012). Similarly, ring-necked snakes are considered to have potential to occur in the Project area, but they have not been detected despite considerable survey and capture effort for snakes at the Champlain Bridge (AECOM 2016a; Groupe Hemispheres 2014; Dessau-Cima+ 2012).

Despite targeted survey effort for herpetiles within the Project area, including frogs, turtles and snakes (AECOM 2016a; Dessau-Cima+ 2012), only one herpetofauna species of conservation concern, the brown snake, has been found in the Project area (Drawing 110 in Appendix 1). The brown snake is considered "likely to be designated as threatened or vulnerable" under provincial legislation, but does not have special status under SARA or COSEWIC. Within Quebec the species has a very limited range, restricted essentially to the Montreal area (AARQ 2016). Brown snakes are often associated with human habitation, and are secretive in nature, found under logs, stones, discarded boards and other litter, or burrowing in the soil; in the winter months, they hibernate underground (MacCulloch 2002; Harding 1997). A management plan has been developed and implemented to attempt to reduce the impact on brown snakes associated with the construction of the New Bridge (Groupe Hemispheres 2014); this plan includes capture and relocation of snakes in the Project area to areas of suitable habitat unaffected by the Project, prevention of recolonization of the Project area by brown snakes, and associated monitoring and follow-up studies. Relocation was undertaken from two sites of known brown snake presence, one at the northern tip of Nuns' Island, and the other along the seaway dyke north of the Champlain Bridge (Drawing 110 in Appendix 1). A total of 166 snakes were relocated from the two sites, including 129 brown snakes, 29 garter snakes and 8 red-bellied snakes.

Table 50 – Reptile and Amphibian Species of Conservation Concern in Quebec

COMMON NAME	SCIENTIFIC NAME	PROVINCIAL STATUS	FEDERAL STATUS	
			SARA SCHEDULE 1 LISTING	COSEWIC ASSESSMENT
Reptiles				
Blanding's Turtle (Great Lakes / St. Lawrence population)	*Emydoidea blandingii*	Threatened	Threatened	Threatened
Brown Snake	*Storeria dekayi*	Likely to be designated		
Eastern Milk Snake	*Lampropeltis triangulum*	Likely to be designated	Special Concern	Special Concern
Eastern Musk Turtle	*Sternotherus odoratus*	Threatened	Threatened	Threatened
Eastern Ribbonsnake (Great Lakes population)	*Thamnophis sauritus*	Likely to be designated	Special Concern	Special Concern
Northern Map Turtle	*Graptemys geographica*	Vulnerable	Special Concern	Special Concern
Northern Water Snake	*Nerodia sipedon*	Likely to be designated		
Ring-necked Snake	*Diadophis punctatus*	Likely to be designated		
Smooth Greensnake	*Opheodry vernalis*	Likely to be designated		
Snapping Turtle	*Chelydra serpentina*		Special Concern	Special Concern
Spiny Softshell	*Apalone spinifera*	Threatened	Threatened	Threatened
Spotted Turtle	*Clemmys guttata*	Likely to be designated	Endangered	Endangered
Wood Turtle	*Glyptemys insculpta*	Vulnerable	Threatened	Threatened
Amphibians				
Allegheny Mountain Dusky Salamander (Great Lakes / St. Lawrence population)	*Desmognathus ochrophaeus*	Threatened	Threatened	Threatened
Boreal Chorus Frog	*Pseudacris maculata*	Likely to be designated		
Four-toed Salamander	*Hemidactylium scutatum*	Likely to be designated		
Northern Dusky Salamander	*Desmognathus fuscus*	Likely to be designated		
Pickerel Frog	*Lithobates (Rana) palustris*	Likely to be designated		
Spring Salamander	*Gyrinophilus porphyriticus*	Vulnerable	Special Concern	Non-active
Western Chorus Frog (Great Lakes / St. Lawrence - Canadian Shield population)	*Pseudacris triseriata*	Vulnerable	Threatened	Threatened

3.4.5.3 Mammals

Twenty species of terrestrial mammals are considered to be of conservation concern by the federal and/or provincial governments. Eighteen mammal species in Quebec have been listed by the provincial Ministère des Forêts, de la Faune et des Parcs (MFFP), including two Vulnerable species, two Threatened species and a further fourteen "Likely to be designated as Threatened or Vulnerable" species (Table 51). Ten species are listed under SARA and/or are considered by COSEWIC to be of concern (Table 51). However, the potential presence of many of these species in the Project area can be ruled out based on their known distributions and habitat preferences. A search of the CDPNQ database was requested as part of JCCBI bridge study (AECOM 2016a) in order to determine whether mammal species of conservation concern had been reported within an 8 km radius of the Project area. The results of this database search indicated that no mammalian species of conservation concern had been reported within 8 km of the study area.

Given the highly disturbed nature of the habitat within the Project area, no mammalian species of conservation concern are considered to have potential to occur, with the possible exception of bats. No suitable habitat for maternity roosts or hibernacula is present within the Project area; however, bats often feed over watercourses and wetlands, and so may be present. Bats are most active between sunset and sunrise, and species either migrate southward in the late summer to fall months or retreat to hibernacula, only to return in late spring. Of the seven bat species potentially present in the Project area (Table 51), the eastern red bat and little brown myotis are most likely to be found in urban habitats. The other species, if present, are unlikely to occur outside the wooded habitats within the study area. Due to their nocturnal habits, bats are most readily detected using acoustic survey methods; however, this type of survey is difficult to do in loud environments (such as cities) due to the auditory interference. Therefore, surveys of the area have not been undertaken to date, and the potential presence of bats in the Project area cannot be ruled out.

Table 51 – Mammal Species of Conservation Concern in Quebec

COMMON NAME	SCIENTIFIC NAME	PROVINCIAL STATUS	FEDERAL STATUS	
			SARA SCHEDULE 1 LISTING	COSEWIC ASSESSMENT
Mammals				
Caribou (Atlantic-Gaspésie population)	*Rangifer tarandus*	Threatened	Endangered	Endangered
Caribou (Boreal population)	*Rangifer tarandus*	Vulnerable	Threatened	Threatened
Eastern Cougar	*Puma concolor*	Likely to be designated		
Eastern Red Bat	*Lasiurus borealis*	Likely to be designated		
Eastern Small-footed Myotis	*Myotis leibii*	Likely to be designated		
Eastern Wolf	*Canis sp. cf. lycaon*		Special Concern	Threatened
Gaspé Shrew	*Sorex gaspensis*	Likely to be designated		Not at Risk
Harbour Seal (Lacs des Loups Marins subspecies)	*Phoca vitulina mellonae*	Likely to be designated		Endangered
Hoary Bat	*Lasiurus cinereus*	Likely to be designated		
Least Weasel	*Mustela nivalis*	Likely to be designated		
Little Brown Myotis	*Myotis lucifugus*		Endangered	Endangered
Long-tailed Shrew	*Sorex dispar*	Likely to be designated		
Northern Myotis	*Myotis septentrionalis*		Endangered	Endangered
Polar Bear	*Ursus maritimus*	Vulnerable	Special Concern	Special Concern
Rock Vole	*Microtus chrotorrhinus*	Likely to be designated		
Silver-haired Bat	*Lasionycteris noctivagans*	Likely to be designated		
Soutern Bog Lemming	*Synaptomys cooperi*	Likely to be designated		
Southern Flying Squirrel	*Glaucomys volans*	Likely to be designated		Non-active
Tri-colored Bat	*Perimyotis subflavus*	Likely to be designated	Endangered	Endangered
Wolverine (Eastern population)	*Gulo gulo*	Threatened	Endangered	Non-active
Woodland Vole	*Microtus pinetorum*	Likely to be designated	Special Concern	Special Concern

3.4.5.4 Avifauna

Forty-five bird species are considered to be of conservation concern by the federal and/or provincial governments (Table 52). A total of 31 bird taxa (species, populations or subspecies) in Quebec have been listed by the provincial Ministère des Forêts, de la Faune et des Parcs (MFFP), including seven Vulnerable species, eight Threatened species and a further 16 “Likely to be designated as Threatened or Vulnerable” species (Table 52). Twenty-six bird taxa are listed under SARA; nine species are listed as Threatened, eight as Endangered, and nine as species of Special Concern. An additional nine species are not listed by federal or provincial governments, but are considered to be of concern by COSEWIC (Table 52). However, the potential presence of many of these species in the Project area can be ruled out based on their known distributions and habitat preferences.

A search of the CDPNQ database was recently requested as part of JCCBI bridge study (AECOM 2016a) in order to determine whether avian species of conservation concern had been reported within an 8 km radius of the Project area. The results of this database search indicated that there had been a total of 22 reports of seven bird species of conservation concern within 8 km of the study area. Of these, the records for three of the species are listed in the CDPNQ report (CDPNQ 2016) as ‘extirpated’ (Grasshopper Sparrow and Yellow Rail) or ‘historical’ (Red-headed Woodpecker); therefore, the presence of these species is considered unlikely in the Project area. The remaining four species, Peregrine Falcon, Chimney Swift, Bald Eagle and Least Bittern, are considered to have potential to occur in suitable habitats.

Additionally, the Barn Swallow, Common Nighthawk and Eastern Wood-pewee have been observed during the QBBA in the 10 km X 10 km Atlas square 18XR13 (Bird Studies Canada et al. 2016), and seven species of conservation concern have been observed on at least one occasion during the Montreal Christmas Bird Count between 1931 and 2015: Barrow’s Goldeneye, Evening Grosbeak, Harlequin Duck, Horned Grebe, Red Crossbill and Rusty Blackbird (National Audubon Society 2016). The eBird database (eBird 2016) has records of Red-necked Phalarope in the Champlain Bridge area.

The Red Crossbills observed on the Christmas Bird Count are unlikely to be the *percna* subspecies, which is largely restricted to insular Newfoundland and Anticosti Island (COSEWIC 2016). Further, they are obligate cone feeders, and no suitable feeding habitat is present in the Project area. Evening Grosbeaks are also primarily found in coniferous forests, and are unlikely to occur in the habitats within the Project area (Gillihan and Byers 2001). Rusty Blackbirds are found in forested wetlands (Avery 2013), and again, unlikely to occur in the Project area due to a lack of suitable habitat.

Least Bittern has been reported to nest on the southern end of Nuns’ Island (CDPNQ 2016). This species nests in freshwater and brackish marshes with dense, tall growths of aquatic or semiaquatic vegetation such as cattails (Poole et al. 2009); the emergent vegetation in the wetlands of the Project area is dominated by *Phragmytes* (Dessau-Cima+ 2012) and do not provide suitable habitat for Least Bitterns.

Table 52 – Avian Species of Conservation Concern in Quebec

COMMON NAME	SCIENTIFIC NAME	PROVINCIAL STATUS	FEDERAL STATUS	
			SARA SCHEDULE 1 LISTING	COSEWIC ASSESSMENT
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	Vulnerable		
Bank Swallow	*Riparia riparia*			Threatened
Barn Owl	*Tyto alba*	Likely to be designated		
Barn Swallow	*Hirundo rustica*			Threatened
Barrow's Goldeneye (Eastern pop.)	*Bucephala islandica*	Vulnerable	Special Concern	Special Concern
Bicknell's Thrush	*Catharus bicknelli*	Vulnerable	Threatened	Threatened
Bobolink	*Dolichonyx oryzivorus*			Threatened
Buff-breasted Sandpiper	*Tryngites subruficollis*			Special Concern
Canada Warbler	*Cardellina canadensis*	Likely to be designated	Threatened	Threatened
Caspian Tern	*Sterna caspia*	Threatened		
Cerulean Warbler	*Setophaga cerulea*	Threatened	Special Concern	Endangered
Chimney Swift	*Chaetura pelagica*	Likely to be designated	Threatened	Threatened
Common Nighthawk	*Chordeiles minor*	Likely to be designated	Threatened	Threatened
Eastern Meadowlark	*Sturnella magna*			Threatened
Eastern Whip-poor-will	*Antrostomus vociferus*	Likely to be designated	Threatened	Threatened
Eastern Wood-pewee	*Contopus virens*			Special Concern
Eskimo Curlew	*Numenius borealis*		Endangered	Endangered
Evening Grosbeak	*Coccothraustes vespertinus*			Special Concern
Golden Eagle	*Aquila chrysaetos*	Vulnerable		
Golden-winged Warbler	*Vermivora chrysoptera*	Likely to be designated	Threatened	Threatened
Grasshopper Sparrow	*Ammodramus savannarum*	Likely to be designated		Special Concern (*pratensis* ssp.)
Harlequin Duck (Eastern pop.)	*Histrionicus histrionicus*	Vulnerable	Special Concern	Special Concern
Henslow's Sparrow	*Ammodramus henslowii*		Endangered	Endangered
Horned Grebe (Magdalen Islands pop.)	*Podiceps auritus*	Threatened	Endangered	Endangered
Leach's Storm-petrel	*Oceanodroma leucorhoa*	Likely to be designated		
Least Bittern	*Ixobrychus exilis*	Vulnerable	Threatened	Threatened
Loggerhead Shrike *migrans* ssp.	*Lanius ludovicianus migrans*	Threatened	Endangered	Non-active

COMMON NAME	SCIENTIFIC NAME	PROVINCIAL STATUS	FEDERAL STATUS	
			SARA SCHEDULE 1 LISTING	COSEWIC ASSESSMENT
Louisiana Waterthrush	*Parkesia motacilla*	Likely to be designated	Special Concern	Threatened
Nelson's Sparrow	*Ammodramus nelsoni*	Likely to be designated		
Olive-sided Flycatcher	*Contopus cooperi*	Likely to be designated	Threatened	Threatened
Peregrine Falcon *anatum/tundrius* ssp.	*Falco peregrinus anatum/tundrius*	*anatum*: Vulnerable *tundrius*: Likely to be designated	Special Concern	Special Concern
Piping Plover *melodus* ssp.	*Charadrius melodus melodus*	Threatened	Endangered	Endangered
Red Crossbill *percna* ssp.	*Loxia curvirostra percna*		Endangered	Threatened
Red Knot *rufa* ssp.	*Calidris canutus rufa*	Likely to be designated	Endangered	Endangered
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Threatened	Threatened	Threatened
Red-necked Phalarope	*Phalaropus lobatus*			Special Concern
Red-shouldered Hawk	*Buteo lineatus*		Special Concern	Not at Risk
Roseate Tern	*Sterna dougallii*	Threatened	Endangered	Endangered
Rusty Blackbird	*Euphagus carolinus*	Likely to be designated	Special Concern	Special Concern
Sedge wren	*Cistothorus platensis*	Likely to be designated		
Short-eared Owl	*Asio flammeus*	Likely to be designated	Special Concern	Special Concern
Wood Thrush	*Hylocichla mustelina*			Threatened
Yellow Rail	*Coturnicops noveboracensis*	Threatened	Special Concern	Special Concern

Barrow's Goldeneye and Harlequin Duck are sea ducks that breed in the north and overwinter in areas of open water in Eastern Canada (Eadie et al. 2000; Robertson and Goudie 1999), and may potentially be present near the Project area during the winter months. Horned Grebe and Red-necked Phalarope typically winter in more marine environments, including coastal bays and estuaries (Stedman 2000; Rubega et al. 2000), but may occur very infrequently in the Project area.

There is a Bald Eagle nest within a few kilometres of the Project site in the Île aux Hérons Migratory Bird Sanctuary IBA (CDPNQ 2016). Bald Eagles may feed in and around the St. Lawrence year-round, including within the Project area; however, they are unlikely to breed near the Champlain Bridge due to a lack of suitable nest trees. Similarly, the Barn Swallow, Eastern Wood-pewee and Common Nighthawk, which are aerial insectivores (Brown and Brown 1999; McCarty 1996; Brigham et al. 2011), could potentially feed around the St. Lawrence River, including around the Project area. Barn Swallow was observed during 2016 field surveys (AECOM 2016a). Common Nighthawk and Eastern Wood-pewee were not observed, although as a crepuscular species, the probability of detecting the Common Nighthawk during morning breeding bird surveys is relatively low. Therefore, these species are considered to have potential to be found near the Champlain Bridge during the breeding season, but it is unlikely that they would nest in the Project area.

The two species with the greatest potential to nest in close proximity to the Project are the Peregrine Falcon, which is known to nest on the Champlain Bridge, and the Chimney Swift, which has been found on Montreal Island to the west of the bridge (Drawing 110 in Appendix 1) and, based on available habitat, has potential to nest closer to the Project area.

Peregrine Falcons nest on cliffs, both natural and artificial (e.g. bridges and buildings), typically situated in open habitats suitable for foraging (COSEWIC 2007a). They generally reuse their nesting sites from year to year, and have been known to use artificial nesting boxes. The locations of known Peregrine Falcon nests on the Champlain Bridge are depicted on Drawing 110 in Appendix 1. A management plan has been developed to monitor both Peregrine Falcons and Cliff Swallows, as well as their nests, and to mitigate the effects of the activities around the new bridge construction and Champlain Bridge deconstruction on these species (SEF 2015). Specific measures for Peregrine Falcon nests outlined in the report include scheduling the work to avoid the falcon's nesting season where possible, and deactivating nest boxes that would be within 100 m of work areas by blocking the entrance prior to the nesting season.

Chimney Swifts historically nested in hollow trees and cave walls; however, since the arrival of European settlers in North America, they have adapted to new available habitats and primarily nest in chimneys. Chimney Swifts, like swallows and nightjars, are aerial insectivores, spending most of the daylight hours in flight feeding on insects, often close to bodies of water (COSEWIC 2007b). There is no suitable nesting habitat on the Champlain Bridge itself; however, a breeding pair was observed on Montreal Island approximately 1 km to the west of the Champlain Bridge, near the western end of the new Pont Nuns' Island (Drawing 110 in Appendix 1) and there is potential for habitat closer to the bridge, e.g. on Nuns' Island (Dessau-Cima+ 2012).

3.5 ATMOSPHERIC ENVIRONMENT

3.5.1 CLIMATE AND LOCAL METEOROLOGICAL CONDITIONS

3.5.1.1 Climate

The closest Environment and Climate Change Canada (ECCC) climate stations to the CBDP for which 1981 to 2010 Canadian Climate Normals (Government of Canada 2016b) data are currently available are:

- Montreal/St-Hubert A – Climate ID: 7027320 (Québec; 45 °31'N 73 °25'W);
- Montreal/Pierre Elliott Trudeau Intl A – Climate ID: 7025250 (Québec; 45 °28'N 73 °45'W); and
- Iberville – Climate ID: 7023270 (Québec; 45 °20'N 73 °15'W).

One station, Ste Genevieve ECCC station, was closer than the Iberville station to the CBDP but was excluded from this climate overview as to not over-represent the area west of the CBDP where the Pierre Elliott Trudeau International Airport (Trudeau A) station is located. The 1981 to 2010 Canadian Climate Normals are the most recently published values by the Government of Canada (GC) and are used in this climate overview. All data provided as part of this Climate Normals set are based on a minimum of 20 years of data with the exception of visibility which is based of 15 years of data (Government of Canada 2016c).

The CBDP site is located near the centroid of these three stations. Multiple stations were selected rather than one (where available) to give an indication of uniformity over an expanded study area.

3.5.1.2 Temperature

Mean monthly temperature estimates were developed for the CBDP site, by taking the average of the historical measurements from the closest ECCC climate stations; the calculated mean temperatures for the CBDP site are:

- Annual mean temperature of 6.5˚C;
- Mean summer high temperature estimated as 26.0˚C in July; and
- Winter mean low temperature estimated as -14.4˚C in January.

Average monthly temperatures from ECCC climate stations and the on-site station are provided in Table 53.

Table 53 – Mean Monthly Temperature (˚C)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE
St-Hubert A	-10.4	-8.2	-2.5	5.7	12.9	17.9	20.6	19.5	14.7	7.9	1.5	-5.8	6.2
Trudeau A	-9.7	-7.7	-2	6.4	13.4	18.6	21.2	20.1	15.5	8.5	2.1	-5.4	6.8
IBERVILLE	-9.7	-7.9	-2.1	6.2	13	18.5	20.9	19.8	15.3	8.6	2.2	-5.1	6.6
Average*	**-9.9**	**-7.9**	**-2.2**	**6.1**	**13.1**	**18.3**	**20.9**	**19.8**	**15.2**	**8.3**	**1.9**	**-5.4**	**6.5**

*Average of ECCC climate stations at Montreal/St-Hubert A, Montreal/Trudeau A, and Iberville

3.5.1.3 Precipitation

Mean monthly precipitation estimates were developed for the CBDP site, by taking the average of the historical measurements from the closest ECCC climate stations, as shown in Table 54. The mean annual precipitation for the Project site is estimated at 1040.9 millimetres (mm).

Table 54 – Mean Monthly Precipitation (mm)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
St-Hubert A	75.8	61.9	71.6	82.7	81.7	87.3	96.8	88.3	84.5	87	104.3	88.8	1010.6
Trudeau A	77.2	62.7	69.1	82.2	81.2	87	89.3	94.1	83.1	91.3	96.4	86.8	1000.3
Iberville	81.6	66.3	71.6	90.8	99.2	97.5	111.3	103.1	95.2	103.6	102.8	88.9	1111.9
Average*	**78.2**	**63.6**	**70.8**	**85.2**	**87.4**	**90.6**	**99.1**	**95.2**	**87.6**	**94.0**	**101.2**	**88.2**	**1040.9**

*Average of ECCC climate stations at Montreal/St-Hubert A, Montreal/Trudeau A, and Iberville

Table 55 provides the extreme daily precipitation recorded for the entire historical dataset at each station (since St-Hubert 1928, Trudeau A 1941, Iberville 1963).

Table 55 – Extreme Daily Precipitation (mm)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL MAXIMUM*
St-Hubert A	37.3	33	52.3	45.7	49	77.7	92	74.4	73.6	67.3	106.0	58.7	**106.0**
Trudeau A	47.0	43.4	42.8	48.2	45.6	66.5	63.6	73.8	81.9	80.5	93.5	51.4	**93.5**
Iberville	38.1	33.6	42.8	52.6	52.8	50.8	84.6	65.6	61.8	66.0	99.2	67.0	**99.2**
Maximum*	**47.0**	**43.4**	**52.3**	**52.6**	**52.8**	**77.7**	**92.0**	**74.4**	**81.9**	**80.5**	**106.0**	**67**	**106.0**

*Maximum of ECCC climate stations at Montreal/St-Hubert A, Montreal/Trudeau A, and Iberville

The ECCC's intensity-duration-frequency (IDF) dataset provides information as to the expected return period of rainfall events. Based the McGill, Quebec station, which is the closest ECCC station with IDF data, Table 56 displays what rainfall events can be statistically expected

Table 56 – IDF Rainfall Events (mm)

STATION	EVENT RETURN PERIOD					
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
McGill, QC	50.2	64.5	74.0	85.9	94.8	103.6

*McGill (ID: 7025280) was the nearest station to the site that had an IDF dataset from 1906-1992

3.5.1.4 Evaporation

Monthly mean lake evaporation statistics data were available for the Trudeau A station in Québec (ID: 7025250). The total annual lake evaporation was on average 21.5 mm and the monthly evaporation can be found in Table 57.

Table 57 – Lake Evaporation (mm)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Trudeau A	0.0	0.0	0.0	0.0	4.2	4.6	4.6	3.8	2.6	1.7	0.0	0.0	21.5

3.5.1.5 Wind

Wind statistics from the 1981 to 2010 Canadian Climate Normals database were available for the St-Hubert A and Trudeau A climate stations. The prevailing wind direction for the region was predominantly from the west in winter, the west in the spring, the southwest in summer, and west during the fall. A summary of the prevailing wind directions can be seen in Table 58.

Table 58 – Prevailing Wind Direction

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE
St-Hubert A	W	W	W	N	S	SW	SW	SW	S	W	W	W	W
Trudeau A	W	W	W	W	SW	SW	SW	SW	W	W	W	W	W

The mean annual wind speed at the St-Hubert station was 15.0 kilometres per hour (km/hr) and the maximum wind gust speed on record was 145 km/hr. The mean annual wind speed at the Trudeau A station was 14.4 km/hr and the maximum wind gust speed on record was 161 km/hr. Mean and maximum wind data are provided in Table 59 and Table 60.

Table 59 – Monthly Average Wind Speed (km/h)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL AVERAGE
St-Hubert A	16.9	16.1	16.4	16.5	15.1	14.1	12.8	11.9	13.1	14.7	15.9	15.9	15.0
Trudeau A	16.0	15.5	15.6	15.9	14.6	13.2	12.4	11.8	12.6	14.2	15.3	15.6	14.4

Table 60 – Maximum Wind Gust Speed (km/h)

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL MAX.
St-Hubert A	113	145	137	122	113	105	113	109	100	105	130	113	145
Trudeau A	117	138	161	106	103	111	126	105	97	117	113	103	161

The McTavish station (Climate ID: 7024745) was the nearest station with hourly wind data however the Trudeau A station's historical wind data (Climate ID: 702S006 for the most recent 5 year) was used instead due to the possible influence of the Mount Royal topography on the McTavish wind measurements resulting in the possibility of it not being representative of the CBDP. Graphical depictions of the total wind rose and diurnal differences at the Trudeau A station over the most available 5 years (January 2012 - December 2016) are given as Figure 57.

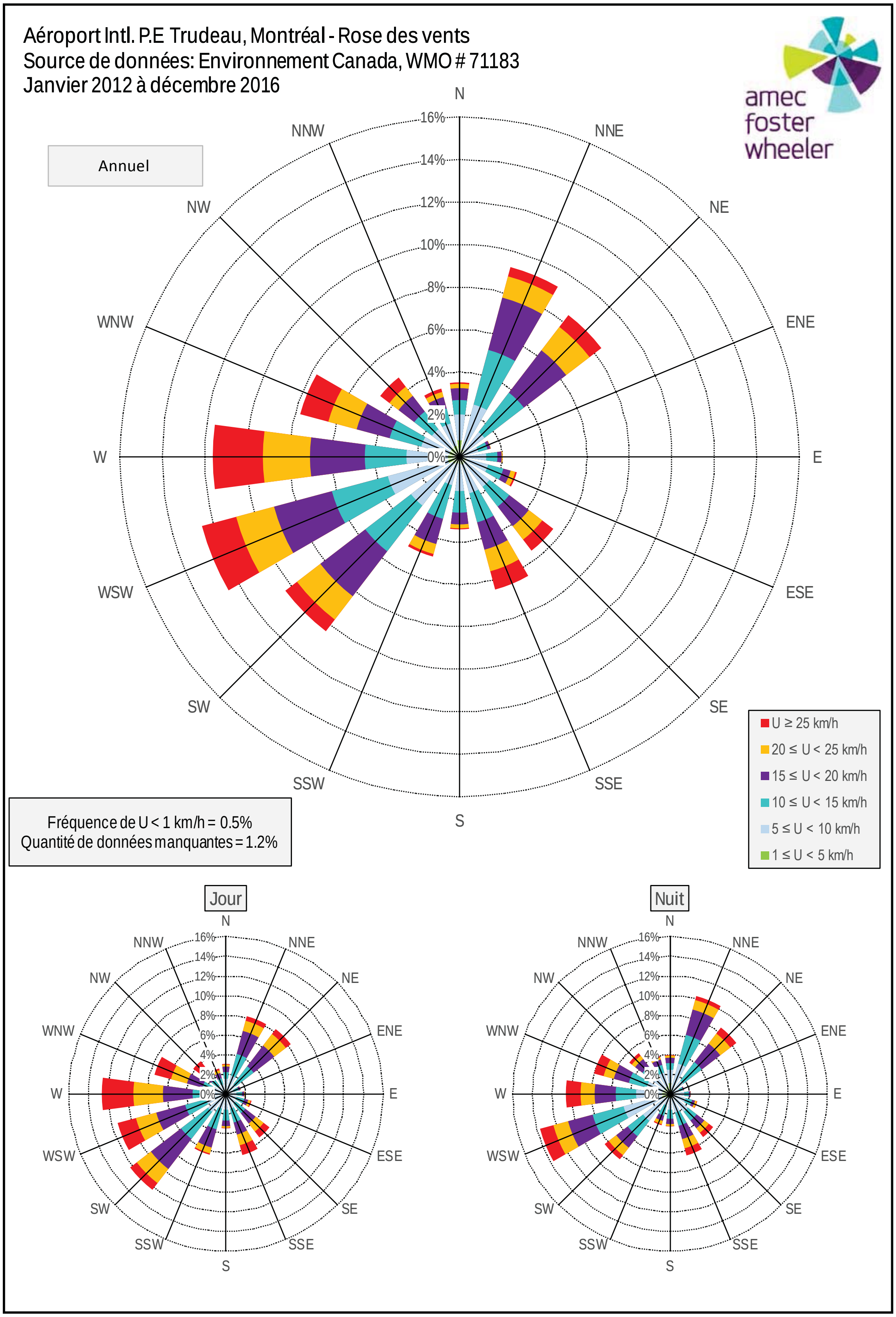

Figure 57 – Montreal/Pierre Elliott Trudeau Intl Wind Rose (2012 - 2016)

3.5.1.6 Visibility

The visibility dataset gives the distance at which objects of suitable size could be seen and identified. Visibility may be impeded by weather related factors such as dust, precipitation, fog, or haze. The St-Hubert and Trudeau A Stations recorded visibility as part of their 1981-2010 normals datasets. Visibility was < 1 km for an average of less than 1% of the recorded hours. On average, visibility was the poorest during the winter and early spring months and best during the summer months at both stations as seen in Table 61.

Table 61 – Visibility (hours with)

STATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
St-Hubert A	< 1 km	10.7	11	13.1	4.6	2.9	2.2	1.5	4.1	4.2	7.9	6.9	13.1	82.2
	1 to 9 km	180.7	133.6	115.6	71	56.3	62.6	67.7	84.1	70	79.5	116	144.3	1181.4
	> 9 km	552.5	534.1	615.2	644.5	684.8	655.2	674.8	655.8	645.8	656.6	597.2	586.6	7503.1
Trudeau A	< 1 km	7.6	6.8	9.1	3.3	1.3	0.8	0.2	0.8	1.8	4.9	4.3	7.1	47.9
	1 to 9 km	145.7	113.7	90.7	56.8	36.5	39.5	36.5	49.2	42.4	60.1	98.5	136.6	906.3
	> 9 km	590.7	556.3	644.3	659.9	706.2	679.7	707.3	694	675.8	679	617.3	600.3	7810.6

3.5.2 AMBIENT AIR QUALITY

The Champlain Bridge is located in an area which is influenced by anthropogenic sources of air emissions from the City of Montreal and surrounding areas located to the west and the Municipality of Brossard and other surrounding municipalities located to the east. In 2015, Statistics Canada identified Greater Montreal as the second most populous city in Canada with a population of 4,027,100. The Champlain Bridge is one of the busiest crossings in Canada, with a current annual estimated traffic of 40 - 50 million commuters and $20 Billion in international trade, and is considered a key component of the continental gateway corridor, as referenced in the Value for Money assessment for the New Champlain Bridge Corridor Project (Government of Canada, 2015).

The immediate area in the vicinity of the western bridge exit on Nuns Island consists of commercial buildings (Honeywell, Bell Canada etc.) and residential towers and houses. The land use in the immediate area near the eastern Brossard bridge exit and along the St-Lawrence shoreline Route 132 is mainly residential. Air quality in these areas is also impacted by volatile organic compounds (VOCs) from organic matter biodegradation from ponds and marshes near Verdun and Nuns Island, and also from the south shore during the summer months. In addition these areas are also impacted by the new bridge construction activities. There is also cargo and vessel movements through the St. Lawrence Seaway and maritime traffic in the corridor located on the south shore side underneath the bridge. In 2015, the St-Lawrence seaway traffic report indicated that 2529 vessel transits were recorded in the Montreal-Lake Ontario section.

The Champlain Bridge is approximately 3.2 kms long by 24 m wide and consists of two main structural systems, prestressed girders for each of the approach spans and steel trusses over the seaway. All steel trusses have been extensively painted over time (constructed between 1957 and 1962) and is likely that lead based paint is present on most of the trusses. The bridge girders rest on reinforced concrete hammerhead piers with the footings resting on bedrock. The pier heights range from 4.5 to 28 m. The bridge decking consists of a combination of precast post-tensioned prestressed girders and orthotropic steel deck. The bridge decking is covered with layers of asphalt. The Champlain Bridge deconstruction will produce an estimated 253,031 tonnes of concrete; 17,567 tonnes of steel; and 11,764 tonnes of asphalt.

The deconstruction project will require the use of mobilization areas that will be located on either or both shores near the bridge exits. Although not chosen yet, possible locations include: an area along the road leading to the Champlain Bridge Ice Control Structure on Nuns Island; the base of pier 1W on the St. Lawrence Seaway dike; and two mobilization areas on the Brossard side, one near axes 6E and 9E and another inside the highway onramps. For the Brossard side it is noted that a residential area is located less than a km from either location. These mobilization areas will be used to store deconstruction equipment; to dismantle large steel pieces of the bridge; and be used as an intermediate area to store materials from the bridge demolition. These areas are likely to generate particulate matter (PM) emissions from the traveling of heavy duty vehicles over unpaved areas and unloading and piling of demolition materials and dismantling of materials. Emissions from vehicle use will include Particulate Matter less than 2.5 Micron ($PM_{2.5}$), Nitrogen Oxides (NO_x), Sulfur Dioxide (SO_2), Carbon Monoxide (CO) and Total Volatile Organic Carbon (TVOC) emissions from diesel and gasoline fired engines. Other potential emissions may result from the handling of demolition materials. These emissions may include particulate and metals (lead and mercury) from the loading/unloading, dismantling and piling of painted steel trusses; particulate and Polyaromatic Hydrocarbon (PAH) emissions from the dumping/transfer and piling of asphalt; and particulate including silica from the handling of concrete materials. It should be noted that it appears the mobilization area(s) will be used to dismantle large sections of painted steel and depending on the type of activities used for dismantling, lead particulate may be generated; cutting with torch will produce lead fume and cutting with an excavator with shears will generate particulate and lead.

The types of emissions generated by the deconstruction of the bridge itself will depend on the types of deconstruction activities used along with the approach to be used to access the bridge for deconstruction.

Some of the proposed scenarios for access include: by the deck; by land; by barge or by temporary jetty.

A recommended scenario was developed that includes the unlaunching of the concrete deck; use of cranes/cantilever/hoisting for the steel deck; conventional demolition techniques/sawing for the piers; and controlled explosion for the footings.

Deconstruction preparatory work will include the removal of asphalt, rails and span expansion joints. The construction equipment used to remove these materials will generate $PM_{2.5}$, NO_x, SO_2, CO and TVOC emissions from diesel and gasoline fired engines. Particulate and PAH emissions may be generated during the removal of the asphalt.

After the preparatory work is undertaken, the most likely scenario for removing the concrete girders will be using a launching gantry. In some cases, in areas close to shore, conventional demolition methods may be used instead of a launching gantry. Since the unlaunching method picks up the large sections of the deck, this method will generate minimal emission compared to conventional demolition techniques. However, some sawing of the middle slab and crossbeams is required before they are picked up by the launching gantry and this activity will generate particulate and silica emissions.

The most likely scenario for removal of the steel suspended bridge spans will be to use a strand jack to lower large intact sections of the bridge and transport this section by barge to one of the mobilization areas for dismantling. Steel anchor and approach spans will likely be removed using a crane. The use of this method will result in minimal emissions being generated since large sections are kept intact. Some lead fume emissions would be generated if the spans are cut using torches.

Removal of concrete on piers and footings will be performed using standard demolition techniques including demolition by hydraulic and pneumatic hammers, shear-type jaws for concrete breaking and sawing. Demolition equipment including cranes for higher elevations will be used to drop concrete pieces onto the ground or on a jetty. Excavators will be used to pick up debris which will be then transported to nearby mobilization sites or directly hauled away by barge or truck. This activity will generate particulate and silica emissions.

Concrete footings will be removed using a combination of explosives under water, excavators to remove components and placed on temporary jetties or barges and then transport to the mobilization area for processing. It is possible that the use of explosives may generate particulate and silica emissions, however, since it appears the use of explosives will be underwater, the moisture content in the concrete and blanket of water should minimize emissions.

It must be noted that all of the above activities will require the use of diesel and gasoline fueled heavy equipment that will generate $PM_{2.5}$, NOx, SO_2, CO and TVOC emissions.

Based on the above review of the project, the key air quality parameters identified for the CBDP include:

- Particulate Matter ($PM_{2.5}$ and PM);
- Nitrogen Oxides (NO_x) as Nitrogen Dioxide (NO_2);
- Carbonyls as Carbon Monoxide (CO);
- Sulphur Dioxide (SO_2);
- Volatile Organic Compounds (VOC's),
- Trace metals such as Lead and Mercury. And
- PAHs

The current air quality at the CBDP area is expected to be representative of a large city with periodic exceedances to some of the above referenced parameters considered not an uncommon event. The existing anthropogenic sources in the CBDP area will also produce emissions parameters that overlap with the expected emissions parameters to be generated from the Champlain Bridge deconstruction activities. As a result, the assessment of possible impacts from these activities will be complex with the collection of baseline data an important exercise that will allow the project to understand existing levels prior to deconstruction activities being performed.

3.5.2.1 Monitoring Networks

Background air quality for the CBDP area was estimated using information from Infrastructure Canada on-site Air Quality Monitoring stations (Government of Canada 2016d) and from data obtained from the ECCC National Air Pollution Surveillance Program (NAPS) (Government of Canada 2013). The NAPS program plays an important role in the monitoring and assessment of Canadian ambient air. It was initiated in 1969 to monitor and assess the quality of ambient (outdoor) air in the populated regions of Canada. According to the ECCC's official Website, *"NAPS is managed using a cooperative agreement among the provinces, territories and some municipal governments. In 1969, eight provinces -- Nova Scotia, New Brunswick, Quebec (which involves the MDDELCC), Ontario, Manitoba, Saskatchewan, Alberta and British Columbia -- joined the program. In the first annual data report 36 monitoring sites reported to the Canada-wide database. Today there are 286 sites in 203 communities located in every province and territory."* Air quality data for criteria air pollutants such as SO_2 CO, NO_2, O_3 and PM are measured at approximately 300 stations in 200 communities in throughout the country. Depending on the parameter, measurements are recorded either on an hourly or a daily basis.

In the province of Quebec, Regulation is based on the Air quality guidelines and criteria of the MDDELCC. The guidelines and criteria were designed for the assessment of air quality measures and for study of projects generating emissions of air contaminants that are submitted for approval to the MDDELCC. The criteria are reference thresholds used by the Ministry as part of an assessment or the issuing of an administrative act under the Quebec's Law on Environment Quality (LQE).

The guidelines and criteria have been established in order to protect human health and minimize the nuisances and the effects of contaminants on the environment. They were established from studies and literature reviews conducted by such agencies as the Environmental Protection Agency (United States), the world Organization of health and Health Canada.

The following table summarizes guidelines and criteria used in this project. Columns indicate the contaminant CAS number (Chemical Abstract Service), type of reference (norme or criteria), the initial concentration (CI) and the limit value (VL).

Table 62 –Guidelines and Criterea

N° CAS	NAME	TYPE OF REF. VALUE	VL (µG/M³)	CI (µG/M³)	VL (µG/M³)	CI (µG/M³)	VL (µG/M³)	CI (µG/M³)
630-08-0	Carbone Monoxide	Norme	1 hr: 34 000	1 hr: 2 650	8 hr: 12 700	8 hr: 1 750	--	--
7446-09-5	Sulphur Dioxide	Norme	4 min: 1 050	4 min: 150	24 hr: 288	24 hr: 50	1 yr: 52	1 yr: 20
10028-15-6	Ozone	Norme	1 hr: 160	1 hr: 130	8 hr: 125	8 hr: 120	--	--
10102-44-0	Nitrogen Dioxide	Norme	1 hr: 414	1 hr: 150	24 hr: 207	24 hr: 100	1 yr: 103	1 yr: 30
--	Total Particles	Norme	24 hr: 120	24 hr: 90	--	--	--	--
--	Fine particles	Norme	24 hr: 30	24 hr: 20	--	--	--	--

Infrastructure Canada

In order to facilitate the Bridge's Environmental Assessment process, Infrastructure Canada installed air quality stations at each end of the new Champlain Bridge construction (Nuns Island and in Brossard on the south shore) in 2015. The measurements are available for four averaging periods, 1 hr, 3 hr, 8 hr and 24 hr, depending on contaminant monitored. These two stations will remain on site for duration of the construction phase, which is scheduled to be completed in 2018. The location of air quality monitoring Stations installed by infrastructure Canada are shown in Figure 58.

Figure 58 – Air Quality monitoring Station at Nuns Island and Brossard

NAPS

1-hr and 24-hr average concentrations of the target air quality parameters are also measured by the NAPS in the Montreal area. Stations operating within a reasonable distance from the deconstruction site are listed in Table 63.

Table 63 – ECCC NAPS Network / MDDELCC Air Quality Monitoring Stations

NAPS ID	LOCATION	LATITUDE (N)	LONGITUDE (W)	APPROXIMATE DISTANCE TO SITE (KM)	MONITORED PARAMETERS
050103	Montreal, QC	45.6413	-73.4994	20	NO, NO_2, O_3, $PM_{2.5}$, SO_2
050109	Montreal, QC	45.5027	-73.6639	10	CO, NO, NO_2, O_3, $PM_{2.5}$
050115	Montreal, QC	45.5008	-73.5753	4.5	NO, NO_2, O_3, SO_2
050116	Montreal, QC	45.4717	-73.5722	2.5	NO, NO_2, O_3, $PM_{2.5}$
050119	Longueuil, QC	45.5221	-73.4881	7.0	NO, NO_2, O_3, $PM_{2.5}$
050121	Brossard, QC	45.4430	-73.4686	6.3	NO, NO_2, O_3, $PM_{2.5}$, SO_2
050126	Montreal, QC	45.4267	-73.9292	31	NO, NO_2, O_3, $PM_{2.5}$
050128	Montreal, QC	45.4681	-73.7411	16	CO, NO, NO_2, O_3, $PM_{2.5}$
050133	Montreal, QC	45.6019	-73.5420	15	NO, NO_2, O_3, $PM_{2.5}$ SO_2
050134	Montreal, QC	45.5427	-73.5718	9.0	NO, NO_2, O_3, $PM_{2.5}$, SO_2
050135	Montreal, QC	45.5934	-73.6373	16	NO, NO_2, O_3, $PM_{2.5}$

National Pollutant Release Inventory (NPRI)

In the area mainly concentrated on the Montreal Island, there are many industries in the Southwest of the island near the Lachine Canal and the old port. There are several plants located in the Griffintown area and Verdun near the Champlain Bridge. Air release data reported to Environment Canada's National Pollutant Release Inventory (NPRI) helps to characterize the emissions (in tonnes) typically released by industry in the area.

NPRI's data have been extracted for the industries located with a 5 km radius of the project centre (Figure 59)

Figure 59 – NPRI Reporting Facilities in a 5 km radius from the CBDP

The following table contains information from NPRI data from 2015 which is the latest reporting year available. All the information comes from the open data from the Government of Canada's Website (Government of Canada 2016e).

Table 64 – Summary of 2014 reported NPRI data for industries near Champlain Bridge on Montreal Island

COMPANY NAME	NAICS	ANNUAL AIR EMISSIONS (TONS)						
		PM_{10}	$PM_{2.5}$	PM	NO_2	SO_2	VOC	CO
O-I CANADA CORP./ PLANT #34	4449	36.8	31.53	40.49	386.39	284.97	19.77	88.8
CANADA MALTING CO LTD.	6692	9.7	4.0	--	--	--	--	--
CLIMATISATION ET CHAUFFAGE URBAINS DE MONTRÉAL	8504	0.97	0.87	--	73.49	4.93	--	29.76
P & H MILLING GROUP/ FARINE DOVER	8716	3.09	2.53	--	--	--	--	--
VITERRA INC./ PORT OF MONTREAL	8775	14.45	6.03	54.28	--	--	--	--
ADM AGRI-INDUSTRIES/ ADM MILLING CO.	10252	41.306	20.617	41.785	--	--	--	--
ARDENT MILLS ULC/ MONTREAL FLOUR PLANT	10369	1.614	0.272	6.374	0.514	--	0.04	0.431
LAFARGE CONSTRUCTION & MATERIALS (CONCRETE)	25029	1.1	0.914	--	--	--	--	--
CANADIAN ROYALTIES INC./ PROJECT NUNAVIK NICKEL	27059	0.782	0.787	6.84	68.5	--	--	--

O-I Canada Corp. is the nearest reporting company to the CBDP and this company reports emissions for a number of the parameters measured by the NAPS and Infrastructure Canada networks; the plant is located near the Nuns Island Bridge right near Highway 10 in an important industrial area on the Montreal Island. Particulate matter releases were reported by each company in the 5 km radius but predominant sources included the O-I Canada Corp., Viterra Inc., and ADM Agri-Industries.

3.5.2.2 Air Quality Monitoring on Champlain Bridge

As previously mentioned, in addition to ECCC/MDDELCC's monitoring stations located throughout the country, data is also available from the Infrastructure Canada on-site monitoring program. The objective of the Infrastructure Canada monitoring program is to ensure that the requirements related to air quality set out in the Project Agreement are respected by the private partner, Signature on the St. Lawrence Group (SSL). Specific air-quality thresholds identified in Montréal's Regulation 90 respecting air quality and the Quebec Clean Air Regulation for Project Work will be respected throughout the construction period in Montreal and Brossard, near the various sensitive areas, based on wind direction and the type of work being done. Air quality monitoring stations were set up on the northern part of the Nuns Island, the south shore in Brossard, and have been monitoring since June 2015; these two (2) stations are located within 2 km of the new Champlain Bridge worksite. Based on potential emissions that may be generated from the new bridge construction and the Champlain Bridge deconstruction work, the following parameters are being monitored throughout construction and deconstruction period to identify any impacts to air quality in sensitive areas surrounding the construction/deconstruction site:

- Particulate matter ($PM_{2.5}$ and PM)
- Nitrogen Oxide (NO)
- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Ground-Level Ozone (O_3)
- Carbon Monoxide (CO)

Note that the December 2016 values were not available at the time of reporting.

3.5.2.3 Particulate Matter

The following tables display results for particulate matter concentrations measured at Nuns Island in 2015-2016 and Brossard Stations in 2016. The tables present the available maximum 1-hr and 24-hr average concentrations measured each month for $PM_{2.5}$ and PM. The tables also include regulatory guidelines from Infrastructure Canada. It is important to specify that the Infrastructure Canada 2015 data is only available for the Nuns Island station from June to December.

Table 65 – PM Concentrations (µg/m³) – Nuns Island 2015

AAQC (µG/M³)	AVERAGING PERIOD	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
300	1 hr	465	615	620	260	329	379	272
120	24 hr	49	90	72	60	82	95	80

Note: Nuns Island Station began measurements in June 2015

A review of the PM results for Nuns Island in 2015 indicates that the 1 hour AAQC was exceeded most months of the year. There were no exceedances to the 24 hour AAQC.

Table 66 – PM Concentrations (µg/m³) – Nuns Island 2016

AAQC (µG/M³)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
300	1 hr	411	332	294	621	661	270
120	24 hr	95	105	138	150	192	115
AAQC (µg/m³)	Averaging Period	July	Aug	Sept	Oct	Nov	Dec
300	1 hr	332	368	270	495	279	--
120	24 hr	103	82	75	88	120	--

A review of the PM results for the Year 2016 for Nuns Island indicates that the 1 hour AAQC was exceeded most months of the year. The 24 hour AAQC was exceeded in March, April and May and was at the AAQC level in November.

Table 67 – PM Concentrations (µg/m³) - Brossard 2016

AAQC (µG/M³)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
300	1 hr	--	--	996	665	847	537
120	24 hr	--	--	319	165	189	136
AAQC (µG/M³)	AVERAGING PERIOD	JULY	AUG	SEPT	OCT	NOV	DEC
300	1 hr	460	386	183	123	314	--
120	24 hr	165	69	75	70	120	--

Note: Brassard began measurements in March 2016

A review of the PM results for the Year 2016 for Brossard indicates that the 1 hour AAQC was exceeded most months of the year. The 24 hour AAQC was exceeded in March, April, May, June, July and was at the AAQC level in November.

Table 68 – $PM_{2.5}$ Concentrations (µg/m³) – Nuns Island 2015

AAQC (µG/M³)	AVERAGING PERIOD	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
35	3 hr	20	26	22	26	21	27	28
30	24 hr	12	18	14	18	13	19	21

Note: Nuns Island Station began measurements in June 2015

A review of the $PM_{2.5}$ results for the Year 2015 for Nuns Island indicates there were no exceedances to the 24 hour AAQC.

Table 69 – $PM_{2.5}$ Concentrations (µg/m³) – Nuns Island 2016

AAQC (µG/M³)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
35	3 hr	39	22	42	23	31	25
30	24 hr	29	13	26	14	21	14
AAQC (µg/m³)	Averaging Period	July	Aug	Sept	Oct	Nov	Dec
35	3 hr	19	20	14	24	34	--
30	24 hr	15	17	11	14	25	--

A review of the $PM_{2.5}$ results for the Year 2016 for Nuns Island indicates that the 3 hour AAQC was exceeded in January and March. There were no exceedances to the 24 hour AAQC.

Table 70 – $PM_{2.5}$ Concentrations (µg/m³) – Brossard 2016

AAQC (µG/M³)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
35	1 hr	--	--	56	30	36	40
30	24 hr	--	--	30	18	25	19
AAQC (µG/M³)	AVERAGING PERIOD	JULY	AUG	SEPT	OCT	NOV	DEC
35	1 hr	33	26	75	19	26	--
30	24 hr	22	21	21	12	19	--

Note: Brassard began measurements in March 2016

A review of the $PM_{2.5}$ results for the Year 2016 for Brossard indicates that the 3 hour AAQC was exceeded in March, May, June, and September. The 24 hour was at the AAQC level in March.

Regarding particulate matter, the results may also be visualized in time series plot for $PM_{2.5}$ on a daily basis (24-hr average concentrations). Figure 60 illustrates the trend of particles concentrations for 2015 and 2016 on a 24 hour basis. It is important to note that 2015 data is only available at the Nuns Island station and from June to December.

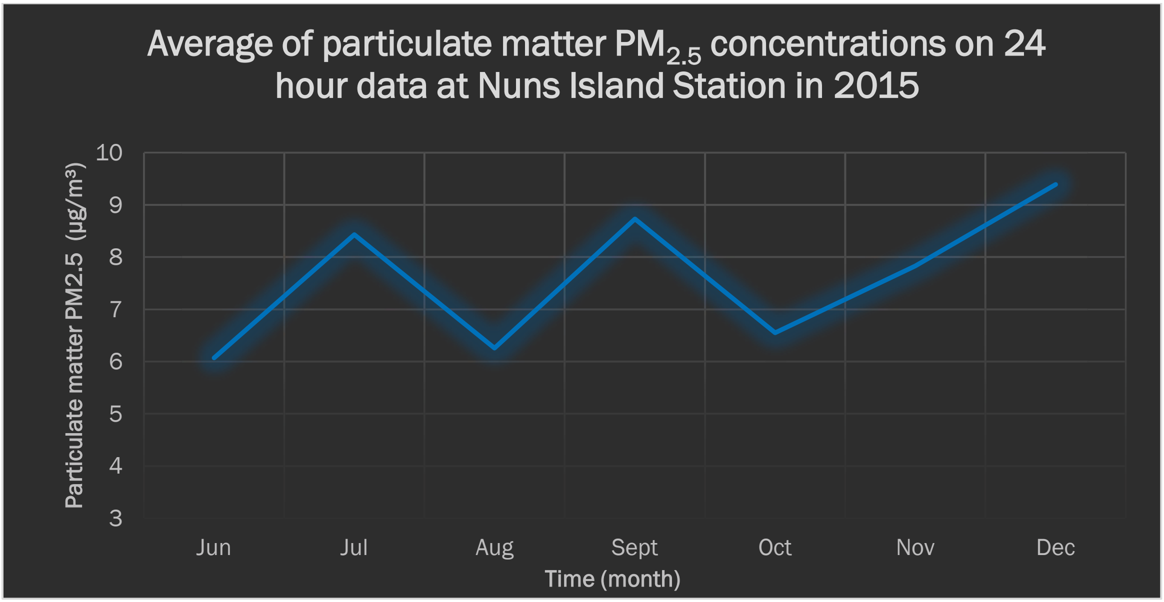

Figure 60 - Available data recorded at Nuns Island Station in 2015

In the same way, data was monitored in Nuns Island and Brossard during the year 2016. The following figure shows values collected from both stations at the two bridge ends.

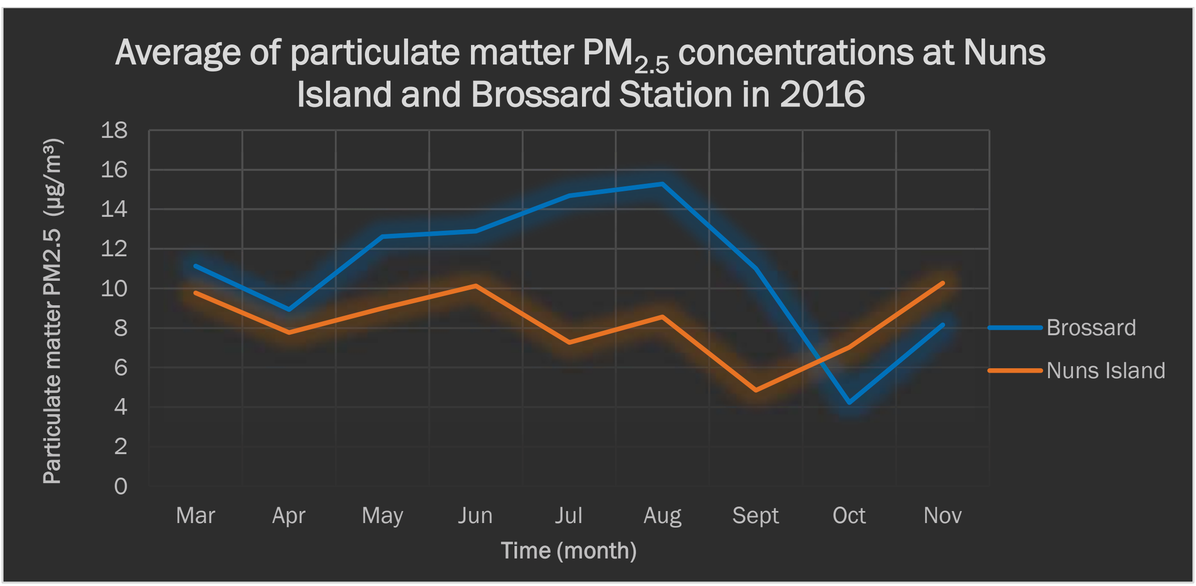

Figure 61 - Available data recorded at both Nuns Island and Brossard stations in 2016

Information presented in Figure 61 show that both curves follow the same trend but the particle concentrations are lower at the Nuns Island station than at the Brossard station. Also, particulate matter ($PM_{2.5}$ on a 24 hour basis) tends to be higher during the summer months and lower in the spring and fall.

3.5.2.4 Nitrogen Oxides

Nitrogen oxides (measured as NO_2) are monitored on-site at both the Nuns Island and Brossard air quality stations. Ambient highest concentrations of NO_2 measured are presented in Table 71, Table 72, and Table 73. These chemical species are considered as background concentrations.

Table 71 – NO_2 Concentrations (ppb) – Nuns Island 2015

AAQC (PPB)	AVERAGING PERIOD	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
213	1 hr	30	35	26	37	39	33	30
106	24 hr	14	15	13	16	21	24	20

Note: Nuns Island Station began measurements in June 2015

A review of the NO_2 results for the Year 2015 for Nuns Island indicates there were no exceedances to the 1 hour or 24 hour AAQC.

Table 72 – NO_2 Concentrations (ppb) – Nuns Island 2016

AAQC (PPB)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
213	1 hr	42	43	46	37	39	29
106	24 hr	29	16	27	19	22	16
AAQC (PPB)	**AVERAGING PERIOD**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
213	1 hr	25	30	22	34	43	--
106	24 hr	14	14	16	17	20	--

A review of the NO_2 results for the Year 2016 for Nuns Island indicates there were no exceedances to the 1 hour or 24 hour AAQC.

It is observed that on a year round basis, concentrations of NO_2 tends to be higher during winter months. The same pattern in Table 73 can be observed for year round 2016 data monitored at the Brossard station.

Table 73 – NO_2 Concentrations (ppb) – Brossard 2016

AAQC (PPB)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
213	1 hr	--	--	49	33	41	37
106	24 hr	--	--	30	21	24	22
AAQC (PPB)	**AVERAGING PERIOD**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
213	1 hr	31	33	43	32	39	--
106	24 hr	19	20	27	22	26	--

Note: Brossard began measurements in March 2016

A review of the NO_2 results for the Year 2016 for Brossard indicates there were no exceedances to the 1 hour or 24 hour AAQC

Figure 62 shows that average Nitrogen Dioxide measured as NO_2 in 2015 was in fact lower during the summer months. From August, concentrations started to ramp up to about 11 ppb. Average concentrations of NO_2 were about 9 ppb during the month of June and July.

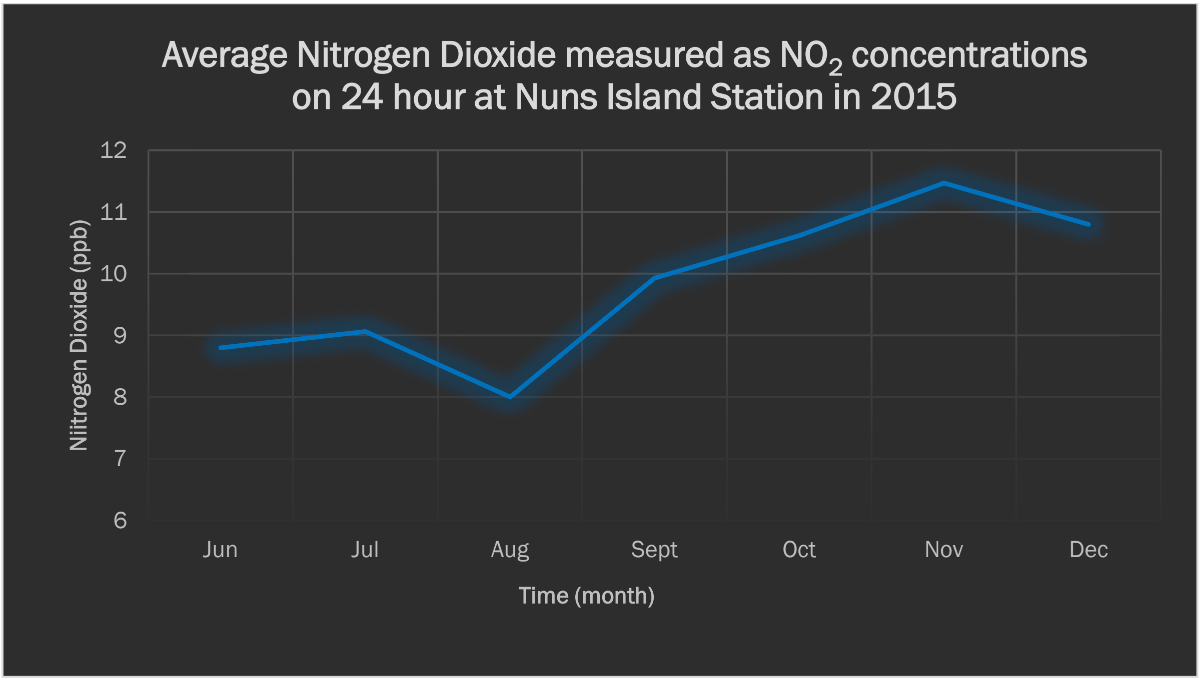

Figure 62 - Available data recorded at Nuns Island Station in 2015

Tends of NO_2 concentrations were also lower during the summer months in 2016, compared to spring and fall as it is presented on Figure 63. In fact, both curves follow the same trend, but NO_2 concentration was higher in September.

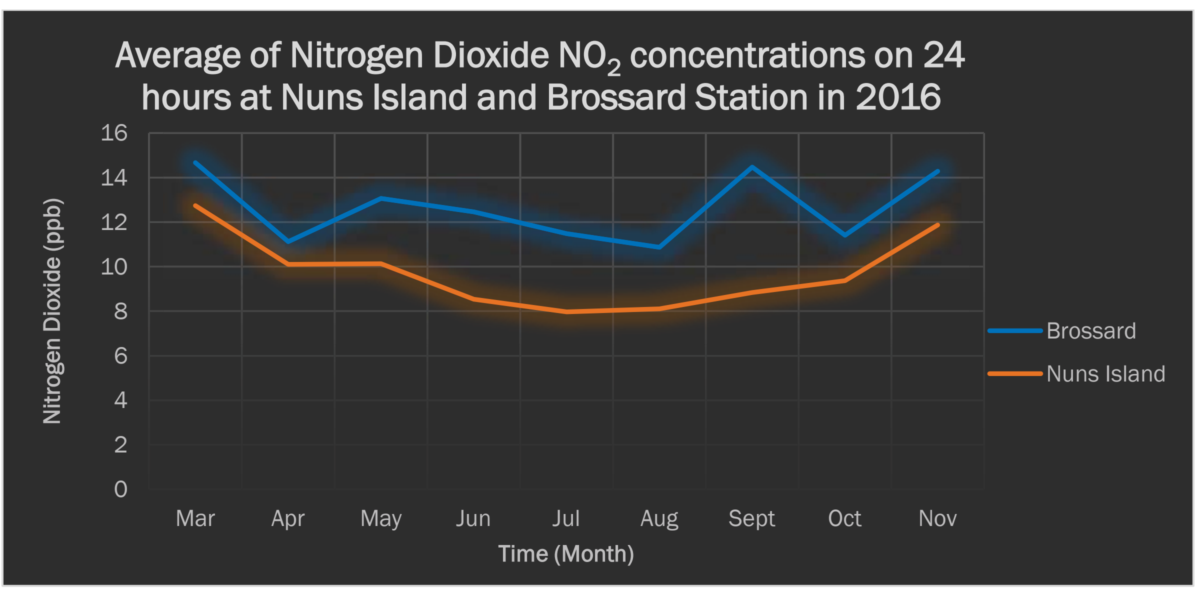

Figure 63 - Available data recorded at both Nuns Island and Brossard stations in 2016

3.5.2.5 Sulphur Oxides

Ambient SO_2 concentrations measured at Nuns Island and Brossard are presented in Table 74, Table 75, and Table 76. The values were measured in ppb in both 2015 and 2016 and are considered as background concentrations.

Table 74 – SO_2 Concentrations (ppb) – Nuns Island 2015

AAQC (PPB)	AVERAGING PERIOD	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
496	1 hr	19	13	9	23	6	27	14
99	24 hr	4	4	8	3	2	10	4

Note: Nuns Island Station began measurements in June 2015

A review of the SO_2 results for the Year 2015 for Nuns Island indicates there were no exceedances to the 1 hour or 24 hour AAQC.

Table 75 – SO_2 Concentrations (ppb) – Nuns Island 2016

AAQC (PPB)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
496	1 hr	19	6	8	15	10	10
99	24 hr	3	1	3	3	2	2
AAQC (PPB)	**AVERAGING PERIOD**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
496	1 hr	16	10	12	11	12	--
99	24 hr	2	2	3	3	2	--

A review of the SO_2 results for the Year 2016 for Nuns Island indicates there were no exceedances to the 1 hour or 24 hour AAQC.

Table 76 – SO_2 Concentrations (ppb) – Brossard 2016

AAQC (PPB)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
496	1 hr	--	--	5	6	6	5
99	24 hr	--	--	2	2	2	1
AAQC (PPB)	**AVERAGING PERIOD**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
496	1 hr	1	0	2	3	4	--
99	24 hr	0	0	0	1	1	--

Note: Brassard began measurements in March 2016

A review of the NO_2 results for the Year 2016 for Brossard indicates there were no exceedances to the 1 hour or 24 hour AAQC.

According to Table 75 and Table 76, concentrations Sulphur Oxides measured as SO_2 at the Brossard station tend to be lower than those measured at the Nuns Island station.

3.5.2.6 Ground level Ozone

Ambient O_3 concentrations measured in ppb at Nuns Island and Brossard Infrastructure Canada Stations are presented in the following tables. Values are maximum monthly 1 and 24 hour in 2015 and 2016.

Table 77 – O_3 Concentrations (ppb) – Nuns Island 2015

AAQC (PPB)	AVERAGING PERIOD	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
82	1 hr	54	51	66	63	40	38	33
25	24 hr	34	40	41	49	34	28	31

Note: Nuns Island Station began measurements in June 2015

A review of the O_3 results for the Year 2015 for Nuns Island indicates there were exceedances to the 24 hour AAQC during all of the months when data was collected. There were no exceedances to the 1 hour AAQC.

Table 78 – O_3 Concentrations (ppb) – Nuns Island 2016

AAQC (PPB)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
82	1 hr	34	41	45	48	61	63
25	24 hr	31	39	37	37	37	47
AAQC (PPB)	AVERAGING PERIOD	JULY	AUG	SEPT	OCT	NOV	DEC
82	1 hr	57	76	59	36	33	--
25	24 hr	38	44	33	26	31	--

A review of the O_3 results for the Year 2016 for Nuns Island indicates there were exceedances to the 24 hour AAQC during all of the months when data was collected. There were no exceedances to the 1 hour AAQC.

Table 79 – O_3 Concentrations (ppb) - Brassard 2016

AAQC (PPB)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
82	1 hr	--	--	42	42	56	65
25	24 hr	--	--	37	37	37	37
AAQC (PPB)	AVERAGING PERIOD	JULY	AUG	SEPT	OCT	NOV	DEC
82	1 hr	48	62	46	41	35	--
25	24 hr	37	37	35	33	31	--

Note: Brassard began measurements in March 2016

A review of the O_3 results for the Year 2016 for Brossard indicates there were exceedances to the 24 hour AAQC during all of the months when data was collected. There were no exceedances to the 1 hour AAQC.

3.5.2.7 Carbonyls (Carbon Monoxide)

In the same way, ambient CO concentrations also measured at Nuns Island and Brossard Infrastructure Canada Stations are presented in Table 80, Table 81, and Table 82. Table 80 presents peak CO concentrations measured in ppm from June to December 2015. It is noted that values follow the same order of magnitude throughout the months.

Table 80 – CO Concentrations (ppb) – Nuns Island 2015

AAQC (PPM)	AVERAGING PERIOD	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
30	1 hr	0.4	0.8	0.9	0.6	0.4	0.6	0.5
11	8 hr	0.5	0.5	0.8	0.4	0.3	0.4	0.3

A review of the CO results for the Year 2015 for Nuns Island indicates there were no exceedances to the 1 hour or 8 hour AAQC

Table 81 – CO Concentrations (ppb) – Nuns Island 2016

AAQC (PPM)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
30	1 hr	0.8	0.5	0.5	0.4	0.6	0.5
11	8 hr	0.7	0.4	0.4	0.4	0.4	0.4
AAQC (PPM)	**AVERAGING PERIOD**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
30	1 hr	0.2	0.3	0.3	0.3	0.8	--
11	8 hr	0.1	0.2	0.1	0.2	0.6	--

A review of the CO results for the Year 2016 for Nuns Island indicates there were no exceedances to the 1 hour or 8 hour AAQC

Table 82 – CO Concentrations (ppb) – Brossard 2016

AAQC (PPM)	AVERAGING PERIOD	JAN	FEB	MAR	APRIL	MAY	JUNE
30	1 hr	--	--	1.2	0.4	0.6	0.7
11	8 hr	--	--	0.7	0.4	0.4	0.5
AAQC (PPM)	**AVERAGING PERIOD**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
30	1 hr	0.3	0.4	0.5	0.5	0.8	--
11	8 hr	0.3	0.3	0.4	0.4	0.6	--

Note: Brassard began measurements in March 2016

A review of the CO results for the Year 2016 for Brossard indicates there were no exceedances to the 1 hour or 8 hour AAQC.

3.5.2.8 Background Air Quality from the nearest Stations in the area

Background Air Quality is not only monitored on-site as shown in Table 83. Nearby ECCC NAPS Stations including those located on Montreal Island, the south Shore in Brossard, and Longueuil, can provide information useful in comparing differences between the site and populated areas nearby.

Table 83 shows ECCC/NAPS Stations in the region around the site. For representative reasons, the three nearest stations are considered in order to compare Air Quality. For practical considerations, distance from the Stations nearby to Champlain Bridge is measured from the old tollgate building remaining on the bridge deck on Nuns Island. The three nearest identified stations are 050109, 050121 and 050134 located in Montreal, Mount-Royal and Brossard respectively. These are the three (3) nearest Stations where all pollutants are commonly monitored in the area. There are closer Stations to the site but not all the same pollutants are monitored which would create difficulties when making comparisons. Table 83, Table 84, and Table 85 are annual summaries of the available monthly highest 24-hr average concentrations (2015) from the nearest stations from the site. The information comes from ECCC/NAPS Data Products.

Table 83 – Background Air Quality from 050109 ECCC's NAPS Station at 10 km from site for 2015

MONTH	$PM_{2.5}$ (µG/M³)	NO_2 (PPB)	SO_2 (PPB)	O_3 (PPB)	CO (PPM)
January	12	20	1.0*	17	0.3
February	11	21	1.5*	18	0.3
March	10	19	0.5*	24	0.3
April	5	13	0.5*	27	0.3
May	9	14	0.7*	28	0.3
June	6	11	0.5*	22	0.2
July	9	13	0.2*	22	0.3
August	8	11	0.3*	20	0.3
September	11	13	0.9*	21	0.3
October	6	12	0.7*	15	0.2
November	N/A	N/A	0.8*	N/A	N/A
December	N/A	13	0.5*	15	0.2

*Data from other nearest Station (050133)

Table 84 – Background Air Quality from 050121 ECCC's NAPS Station at 6 km from site for 2015

MONTH	$PM_{2.5}$ (µG/M³)	NO_2 (PPB)	SO_2 (PPB)	O_3 (PPB)
January	12	9	0.8	26
February	11	9	0.8	28
March	8	6	0.6	35
April	4	5	0.4	34
May	8	5	0.6	36
June	5	5	0.3	27
July	10	4	0.4	28
August	8	3	0.3	25
September	10	5	0.5	27
October	5	5	0.4	21
November	6	6	0.3	19
December	7	N/A	0.2	17

Table 85 – Background Air Quality from 050134 ECCC's NAPS Station at 9 km from site for 2015

MONTH	$PM_{2.5}$ (µG/M³)	NO_2 (PPB)	SO_2 (PPB)	O_3 (PPB)
January	N/A	15	0.8	21
February	10	15	0.8	21
March	9	14	0.6	27
April	7	8	0.3	29
May	11	7	0.6	32
June	5	7	1.0	25
July	11	8	0.7	28
August	7	7	0.7	24
September	9	10	1.3	26
October	6	10	1.0	18
November	8	12	1.2	16
December	8	11	0.7	14

Unfortunately, for most parameters measured at the onsite locations, a direct comparison with the NAPS locations could not be performed since the reported averaging periods are not the same between the onsite and NAPS locations. However, a comparison of Graph 2: Available $PM_{2.5}$ Data Recorded at both Nuns Island and Brossard stations with the $PM_{2.5}$ monthly data for the NAPS stations indicates that the $PM_{2.5}$ levels appear to be generally higher at the Brossard onsite location compared to all other NAPS and onsite locations. In addition, the O_3 monthly results for all NAPS locations located within the city also suggest that levels are periodically elevated when compared to available regulatory values.

3.5.2.9 Other Recommended Parameters

Based on an assessment of the expected emissions from the Champlain Bridge deconstruction project, there are some parameters, lead, mercury and PAHs, identified that are not currently being monitored in the existing baseline programs. In order to facilitate the Bridge's Environmental Assessment process, Infrastructure Canada, in 2015 and 2016, Air Quality monitoring stations were installed at Nuns Island and the south shore of Montreal in order to follow the same contaminants measured by the ECCC/NAPS program. Based on other emissions parameters that could be generated during the deconstruction project, it is recommended that these stations be upgraded to include lead, mercury and PAHs. In addition to the previously mentioned parameters, it is recommended that the project consider performing occupational hygiene monitoring for silica emissions in areas where large amounts of concrete is being demolished or handled. If hygiene monitoring produce results that are elevated, consideration should be given to monitoring silica at the appropriate onsite monitoring locations.

3.5.3 GREEN HOUSE GASES

3.5.3.1 Canadian and Quebec Initiatives

Canada recognizes the challenges in addressing climate change and the urgent need for action at all levels. Canada also recognizes that climate change presents an opportunity to innovate and to take a leadership position in the low-carbon economy. To this end, the Government of Canada will provide national leadership and partner with the provinces and territories to address climate change both domestically and internationally to make the transition towards a clean economy. Over the last year, Canada has seen a number of significant advancements in its approach to climate change.

Climate change is also an important issue for the province of Québec. Various impacts are anticipated due to the forecasted changes to the province's climate: increased frequency and intensity of extreme weather events in the south (which includes flooding, heavy rain, and drought), which can affect security and public safety as well as agricultural production; gradual disappearance of annual sea ice as well as the accelerated melting of permafrost in the Arctic, which will both affect the way of life of Aboriginal people and ecosystems as well as the instability of buildings and infrastructure; other effects from climate change may also lead to consequences for logging, recreation, and other sectors of industry. Therefore, the Government of Québec has been, and strives to continue to be, a leader in the fight against climate change.

Quebec originally set an ambitious goal of reducing its GHG emissions to 20% below 1990 levels by the year 2020, as indicated in the document "2013-2020 Climate Change Action Plan". This target has since been superseded as noted below. As well, in 2008, Québec became a member of the Western Climate Initiative (WCI). This organization represents a group of US states and Canadian provinces, who wish to adopt a common approach to the fight against climate change, including reducing pollution formed as a result of GHGs, encourage investment in clean-energy technologies that create green jobs, and reduce dependence on imported oil. A significant part of the goal of the WCI was particularly centered on the development and implementation of a North American cap and trade system of GHG emissions rights (MDDEFP, n.d.; WCI; 2013).

The WCI led to the development of the Western Climate Initiative, Inc. (WCI, Inc.) in November of 2011. The WCI, Inc. is a non-profit corporation that provides administrative and technical services to support the implementation of state and provincial greenhouse gas emissions trading programs. Québec continues to work in conjunction with British Columbia, Ontario, Manitoba, and California through the WCI to develop and harmonize their emissions trading program policies.

In October 2015, Canadians elected a new federal government. Canada's new federal government has made a number of commitments related to climate change. These include working with Canada's provinces and territories to establish a pan-Canadian framework for addressing climate change, including carbon pricing, as well as investments in clean energy technology, infrastructure, and innovation, and a Low-Carbon Economy Trust Fund to support provinces and territories in achieving emissions reductions and transforming their economies towards a low-carbon future.

In December 2015 at the Paris Climate Conference, Parties under the UNFCCC agreed to a historic new agreement to address climate change. Collectively, the countries of the world agreed to strengthen the global response to limit global average temperature rise to well below 2 degrees Celsius, as well as to pursue efforts to limit the increase to 1.5 degrees. Canada was pleased to play a role in moving the negotiations forward.

Climate Change initiatives that the Federal Government and Quebec have been involved with include the following:

- In April 2015, the Province of Quebec hosted a Climate Change Summit with all provincial and territorial premiers. The summit was convened to discuss mitigation opportunities and to enhance provincial cooperation on climate change; it resulted in a declaration supported by all 13 provinces and territories committing to a transition to a low-carbon economy.
- In December 2015, at the 21st Conference of the Parties, Ontario, Manitoba and Quebec signed a Memorandum of Understanding signaling their intentions to share information and link their cap-and-trade programs. This effort will strengthen and expand the coverage of the Western Climate Initiative. Quebec and California are currently the only two members of the WCI that have implemented cap-and-trade systems and linked them to create North America's largest carbon market. At the Paris Conference the Memorandum of Understanding was recognized as an important initiative by the Secretary-General of the Organization for Economic Co-operation and Development. It should be noted that carbon market revenues for Quebec have been estimated at CA$3.3 billion for the 2013 to 2020 period and that these revenues are entirely reinvested in mitigation and adaptation measures in the province.
- In addition, in December 2015, British Columbia (BC) and Quebec joined the International Zero Emission Vehicle Alliance and announced they will strive to make all new passenger vehicles in their jurisdictions zero-emissions vehicles by no later than 2050.
- In November 2015, Quebec adopted a 2030 target of a 37.5% reduction below 1990 levels, based on the outcomes of a public consultation process on climate change targets.
- In late November 2015, Manitoba released its Climate Change and Green Economy Plan establishing new GHG emission reduction targets, and signaled its intent to develop a new cap-and-trade program for large emitters. Manitoba has also indicated that it will link its system with the cap-and-trade systems of Ontario, Quebec and California as part of the Western Climate Initiative.
- In August, at the 39th annual conference of New England Governors and Eastern Canada Premiers, Canada's Atlantic Provinces (New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador) and Quebec adopted a resolution with six US states to reduce regional GHG emissions by 35-45% below 1990 levels by 2030.

Other carbon pricing policies are in place or announced at the provincial and territorial level that target emissions reductions across a range of sectors. In Quebec, 85% of provincial emissions are currently capped, and this cap is set to reduce by an average of 4% per year to help achieve Quebec's GHG emission reduction target of 20% below 1990 levels by 2020. Ontario has announced that it intends to join Quebec and California for its carbon pricing system. Likewise, the Province of Manitoba has announced that it will also develop a cap-and-trade system linked with these jurisdictions.

3.5.3.2 GHG emissions

Greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) can be emitted from a number of natural and anthropogenic sources. Emissions from biogenic or other sources generally exhibit little variation from one year to the next.

Total GHG emissions are normally reported as CO_2-equivalents (CO_2e). This is accomplished by multiplying the emission rate of each compound by the global warming potential (GWP) relative to CO_2. CO_2e considers the global warming potential of the three main greenhouse gases: CO_2, CH_4 and N_2O. The global warming potential of these gases are as follows: CO_2 = 1.0, CH_4 = 21 and N_2O = 310. Therefore, the carbon dioxide equivalency factor (CO_2e) is equal to ((CO_2 mass x 1.0) + (CH_4 mass x 21) + (N_2O mass x 310)).

The Québec total GHG emissions, expressed in kilotonnes of CO_2e, were estimated at 89,100 in 1990, having ranged from a high of 93,600 in 2004 to a low of 81,800 in 2012, and stand at 82,700 in 2014, the most recent data available from the National Pollutant Release Inventory (NPRI) database. Of this most recent Quebec total, 33,700 is attributable to the transportation sector, with 24,700 of that coming from cars, trucks and motorcycles. Environment and Climate Change Canada data for that same year indicate that point source emitters in the Montreal area were responsible for a total of 1,934 kilotonnes of CO_2e. To put this into a Canadian perspective, the total GHG emissions for the country as a whole were 732,000 kilotonnes of CO_2e for 2014.

The vehicles, heavy equipment and other fossil fuel combustion driven equipment which will be involved in the deconstruction of, and transportation of materials from, the Champlain Bridge can be expected to contribute GHGs to the provincial total over the period of the work. However, it can be safely assumed that this contribution will be minor compared to that emitted on a daily basis from vehicular traffic on the adjacent new bridge and other local sources, and negligible with respect to the provincial totals. And of course these Project emissions will be time-limited; they will cease once the Project is completed.

3.6 ACOUSTIC ENVIRONMENT

Within the limited scope of this preliminary environmental effects evaluation (EEE), a review was undertaken of publicly available noise data in the vicinity of the existing Champlain Bridge, to determine if that data was sufficient to establish acoustical limits for the upcoming deconstruction activities. Two sectors were considered for this review: Nuns' Island and the City of Brossard.

Figure 64 – Locations of the sectors for the publicly available noise data

The following publicly available documents were consulted:

- Transport Canada (March 2013). New Bridge for the St. Lawrence. Environmental Assessment. Part I, Sections 1 to 4
- Signature on the St. Lawrence (June 8, 2015). Public Information Session – Elgar Community Centre, Nuns' Island
- Signature on the St. Lawrence (October 14, 2015). Public Information Meeting – New Champlain Bridge Corridor Project – Centre socioculturel de Brossard
- Signature on the St. Lawrence (February 3, 2016). Noise management: Meeting of the Verdun/Sud-Ouest Good Neighbourly Relations Committee, New Champlain Bridge Corridor Project

There does exist a baseline acoustic survey which was taken on Nuns' Island prior to the start of construction of the new bridge. However, the acoustic data recorded by that survey is not in the public domain, and thus could not be made available to this evaluation.

The content of the documents listed above was compared to requirements found in the most widely cited guidelines for noise management on and around construction sites in Quebec Province:

- Transport Québec (2008-10-30). *Mesures d'atténuation environnementales temporaires,* tome 2, chapter 9
- *Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction industriel* (MDDELCC)
- *Politique du Ministère des Transports, de la Mobilité durable et de l'Électrification des transports (MTMDET) pour les bruits de chantier*

To be representative, the data in the existing documentation must comply with these basic requirements:

1. The ambient or reference noise level must be determined during two non-consecutive 24 hour periods;
2. The ambient or reference noise level data must be gathered during week days;
3. A 3 to 5 dBA must be added to the LAeq levels obtained during the 11 pm to 7 am time period as a night time noise target;
4. A 5 dBA must be added to the LAeq levels obtained during the 7 pm to 11 pm time period as an evening noise target.

Transport Canada 2013 document is aimed largely at assessing the noise levels resulting from operation of the new Champlain Bridge. The data is thus is not presented in a manner suitable to assess construction site noise levels (day/evening/night), and data was not produced during two non-consecutive 24 hour periods.

Signature sur le Saint-Laurent 2015 and 2016 documents are produced for management of construction noise around the new Champlain Bridge work site. However, the publicly available reports show limits on the following requirements:

- Exact methodology to identify reference noise levels missing (2 non-consecutive 24 hour periods, date of data collection, location);
- Gaps in data to establish noise limits in Brossard;
- Exact positioning of construction noise monitoring stations missing;
- No information on noise equipment used.

Considering the gaps in the Transport Canada and Signature sur le Saint-Laurent documents, it is impossible to extrapolate reference noise levels and acoustical limits for the upcoming deconstruction activities, and to assess noise impact of the deconstruction options considered. It is recommended to undertake a noise measurement campaign in compliance with MTMDET and MDDELCC guidelines to identify representative noise levels and acoustical limits in the most sensitive areas of Nuns' Island and Brossard. Furthermore, JCCBI suggests that the City of Brossard has indicated its concern regarding noise impact of the project on its territory, thus reinforcing the need for such a study.

4 ENVIRONMENTAL EFFECTS EVALUATION

4.1 METHODOLOGY OF EEE

4.1.1 GENERAL APPROACH

The key steps in the methodology of this partial EEE as described in this document include the following:

- Project description
- Review of available documentation
- Description of the bio-physical and socio-economic environment (partial in this case)
- Identification of VECs (also partial, based upon description above)

4.1.2 VALUED ECOSYSTEM COMPONENTS (VECS)

Valued ecosystem components are typically defined as being components of the environment that are valued on the basis of their ecological, scientific, cultural, economic, health or aesthetic importance. The purpose of identifying VECs is to help focus the environmental effects evaluation, and any subsequent monitoring or follow-up programs, on those aspects of the environment (natural and socio-economic) that are valued, and which have a meaningful potential to be affected by project development.

VECs can include elements of both the natural and socio-economic environments. Natural environment VECs can be a particular habitat, an environmental feature, a particular assemblage of plants or animals, a particular plant or animal species, or an indicator of environmental health. Socio-economic VECs can be natural environment VECs that have socio-economic significance; or they can be specific socio-economic elements such as properties, infrastructure, heritage features, or economic or cultural activities, traditional or otherwise.

In addition, for an ecosystem component to qualify as a VEC, it must be known to occur in the project area, and there must be a reasonable expectation that the VEC could be meaningfully affected by the development or operation of the Project.

VECs are defined on the basis of their meeting one or more of the following criteria and considerations:

- Area of Notable Biological Diversity;
- Significant Habitat for Locally Important Species;
- Significant Habitat for Uncommon, Rare or Unusual Species;
- Important Corridor or Linkage for Fish and/or Wildlife Movement;
- Species at Risk (Endangered, Threatened, Special Concern);
- Indicator of Environmental Health
- Component is of Economic Significance;
- Component is of Recreational Significance
- Component is of Educational or Scientific Interest;
- Component is of Provincial, National or International Significance;
- Significant Cultural or Heritage Feature; and
- Significant Public Concern.

Table 86 presents the list of VECs that have been identified from both the environmental disciplines investigated in Section 3 above as well as some more speculative suggestions based on other project experiences. (These latter VECs are to be confirmed or discarded as the full EEE process proceeds.)

Table 86 – Selection of Valued Ecosystem Components

POTENTIAL VECS	SELECTION CRITERIA												
	RELEVANT FOR SITE/STUDY AREA & POTENTIAL FOR PROJECT-ENVIRONMENT INTERACTIONS	AREA OF NOTABLE BIOLOGICAL DIVERSITY	SIGNIFICANT HABITAT FOR LOCALLY IMPORTANT SPECIES	SIGNIFICANT HABITAT FOR UNCOMMON, RARE OR UNUSUAL SPECIES	IMPORTANT CORRIDOR OR LINKAGE FOR FISH AND/OR WILDLIFE MOVEMENT	SPECIES AT RISK (ENDANGERED, THREATENED, SPECIAL CONCERN)	INDICATOR OF ENVIRONMENTAL HEALTH	COMPONENT IS OF ECONOMIC SIGNIFICANCE	COMPONENT IS OF EDUCATIONAL OR SCIENTIFIC INTEREST	COMPONENT IS OF PROVINCIAL, NATIONAL OR INTERNATIONAL SIGNIFICANCE	SIGNIFICANT CULTURAL OR HERITAGE FEATURE	POTENTIAL PUBLIC CONCERN	COMPONENT IS OF RECREATIONAL SIGNIFICANCE
Air quality	√						√		√	√		√	
Acoustic environment	√						√		√	√		√	√
Fish and fish habitat	√	√	√	√	√	√	√		√	√		√	√
Sport fishing	√						√	√		√	√	√	√
Herpetofauna	√			√		√	√		√			√	
Mammals	√												
Avifauna	√	√	√	√	√	√	√		√	√		√	√
Species at Risk	√	√		√			√		√	√		√	
Shipping in the Saint Lawrence Seaway	√				√			√		√		√	
Recreational navigation – Saint Lawrence River	√				√			√		√		√	√
Vehicular traffic (local roads)	√							√		√		√	
Human Health and Safety	√						√	√		√		√	
Business and job opportunities	√							√		√		√	
First Nation Interests	√							√	√	√	√	√	
Local heritage features	√								√	√	√	√	√

The next step would ordinarily be to define the potential interactions between these VECs and the various project activities. Such determinations would be based on expert judgement of the collective team members, based upon experience with other industrial developments. Only those project-environment interactions would be identified for which there is a reasonable expectation that the VEC could be meaningfully affected by the development or operation of the Project. The spatial and temporal boundaries will be established for each VEC for purposes of effects evaluation. Then the interactions would be discussed in terms of the potential effect levels, application of mitigation and impact management measures as well as the significance of the residual effects.

However, that detailed interaction step is beyond the scope of this assignment. It is expected that these considerations will take place at a later stage of the overall Project.

4.1.2.1 VEC Selection

4.1.2.1.1 Air Quality

Air quality is a constant concern for regulators and the public at large, with particular emphasis these days on particulate matter and GHGs. This concern is exemplified by the air quality monitoring program carried out at the two stations associated with the construction of the new bridge. The deconstruction of the Champlain Bridge can be expected to contribute to emissions to the atmosphere of a number of parameters from the heavy equipment, barges, trucks and other combustion sources, as well as from the deconstruction of the piers and footings. In addition, the reduction of steel elements could release other paraameters such as mercury and lead. Therefore a comprehensive evaluation of these emissions will constitute an important VEC and a significant part of the overall EEE once it is carried to completion.

4.1.2.1.2 Acoustic Environment

The deconstruction activities can be expected to raise a certain amount of noise associated with particular methods. Noise will be emitted by heavy equipment and by trucks, as well as by the deconstruction of the piers and footings, and the reduction of steel elements using saws. The closest residential areas may be affected by this noise, and the thus it is an important VEC to be considered in the eventual EEE.

4.1.2.1.3 Herpetofauna

Reptiles and amphibians, including their habitat, were identified as a VEC in consideration of the potential environmental effects of Project components and related activities on herpetile species and their habitats in the Project site. As discussed in Section 3.4.2, the Project site and surrounding habitats support a number of herpetile species. For the purposes of this environmental field study, herpetiles and their habitat include the following components:

- Herpetile species and their habitat that may potentially be impacted by Project activities, including critical habitat as identified under the Canadian *Species at Risk Act* (SARA).
- Herpetile species at risk and species of conservation concern as listed by the federal and provincial authorities.
- Designated Areas which include environmentally sensitive areas identified by federal and provincial authorities or non-government organizations as protected or managed.

4.1.2.1.4 Mammals

Mammals and their habitat were identified as a VEC in consideration of the potential environmental effects of Project components and related activities on mammals and their habitats in the Project site. As discussed in Section 3.4.3, the Project site and surrounding habitats support a number of mammal species. For the purposes of this environmental field study, mammals and their habitat include the following components:

- Mammal species and their habitat that may potentially be impacted by Project activities, including critical habitat as identified under the *Canadian Species at Risk Act* (SARA).
- Mammal species at risk and species of conservation concern as listed by the federal and provincial authorities.
- Designated Areas which include environmentally sensitive areas identified by federal and provincial authorities or non-government organizations as protected or managed.

4.1.2.1.5 Avifauna

Avifauna, including their habitat, has been selected as a VEC in consideration of the potential environmental effects of Project components and related activities on avian species and their habitats in the Project site. The majority of bird species in Canada are protected federally under the *Migratory Birds Convention Act*, while others are provincially under the *Act respecting the conservation and development of wildlife*. Avian SAR are further protected by the federal *Species at Risk Act* as well as the provincial *Act Respecting Threatened or Vulnerable Specie*s. For the purposes of this assessment, birds and bird habitat include all resident and migratory birds which utilize habitat within the boundaries of the Project.

4.1.2.1.6 Fish and Fish Habitat

Fish species, including their habitat, have been selected as a VEC in consideration of the potential environmental effects of Project components and related activities. The *Fisheries Act* gives federal protection to fish of commercial, recreational, or Aboriginal (CRA) importance and the fish that support those fisheries from serious harm. The *Fisheries Ac*t defines fish as fish, shellfish, crustaceans, marine animals and any parts thereof. Species at risk further protected by the federal *Species at Risk Act* as well as the provincial *Act Respecting Threatened or Vulnerable Species*.

4.1.2.1.7 Sport Fishing

It has been established that sport fishing takes place from the shore and from boats in areas in the vicinity of the Champlain Bridge. It is virtually inevitable that at some time there will be potential for interference from the Project activities with this locally important recreational pastime. Therefore it has been selected as a VEC for consideration in the eventual EEE.

4.1.2.1.8 Species at Risk

The consideration of Species at Risk is a given for almost any EEE or EIA carried out at this time, in order to ensure that all necessary precautions are taken to protect such species should they or their habitat be identified withinthe study area of a project. Several species listed as being of conserevation concern in Quebec are known to frequent the area of the bridge. Therefore this category of species is selected as a VEC for the eventual EEE.

4.1.2.1.9 Shipping in the St. Lawrence Seaway

The free and unrestricted passage of ships through the Seaway is a critical link in the Canadian economic activity, and the maintenance of such passage is a major conern of the St. Lawrence Seaway Management Corporation. This issue is one which will have to be integrated into the deconstruction schedule, and therefore it is a VEC for consideration in the EEE.

4.1.2.1.10 Vehicular Road Traffic

The description of the transportation options demonstrates that there will be a certain amount of truck traffic involved in the project activities. This truck traffic will necessarily transit through some residential neighbourhoods, and thus such issues as timing and noise levels may have to be considered. Therefore this is selected as a VEC for consideration in the eventual EEE.

4.1.2.1.11 Other potential VECs

There are a number of potential VECs which it can be safely anticipated will become apparent as the EEE study proceeds. In particular, these are all in the realm of socio-economic issues which have not yet been investigated in terms of basline conditions as part of this study. Nonetheless, it is important to draw attention to such potential issues, and they can be considered at this time as speculative VECs. These VECs would include the habitual use of the St. Lawrence River by recreational craft, human health and safety issues for workers and for the general public, business and job opportunitiesw associated with the Project, possible First Nations interests, and local heritage and visual features. Many of these have been addressed in the Environmental Assessment for the new bridge (Dessau-Cima+, 2012), and similar considerations may well be necessary as part of the eventual EEE.

5 RECOMMENDATIONS

It may be premature to offer recommendations at this time, due to the partial nature of the EEE conducted to date. However, there are a few observations which may be offered as a result of the baseline investigations carried out as part of this study.

- It would be prudent to establish a more comprehensive air quality monitoring program in order to establish baseline conditions regarding some potential emissions from the deconstruction activities which currently are not being measured. Specifically, these include lead, mercury, PAHs, and silica.
- Conduct a proper noise measurement campaign in compliance with MTMDET and MDDELCC guidelines, to identify representative noise levels and acoustical limits in the most sensitive areas of Nuns' Island and Brossard.
- The fish habitat survey in the upstream portion of the river to the ice control structure,as recommended by DFO, should be carried out during the late spring/summer period in 2017, to complement the existing fish habitat information.
- Define the areas of contaminated soils and develop a rehabilitation plan as appropriate. Where deconstruction activities take place in those areas in which organic wastes have historically been buried, monitoring of biogas components should be carried out. If necessary, protective measures may be implemented to ensure the health and safety of deconstruction workers and nearby residents
- Design a groundwater monitoring plan to be implemented before and during deconstruction activities

- Finally, there remain several environmental and social studies still to be carried out in order round out the full slate of considerations which make up a thorough EEE. These are the hydrology investigations, the archaeological studies, and the socio-economic studies, all to establish the baseline conditions and possibly to identify additional VECs. As well the stakeholder consultations, which were partially conducted as part of this work, will need to be completed, and possibly expanded. For example, consultations with the Kahnawake Mohawk Council have not been included in the list compiled to date. These consultations may raise issues/VECs which have not yet been anticipated.

6 LIST OF SUPPORTING DOCUMENTS

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Appendix 1

Drawings

JCCBI PROPERTY LINE

NOTES :

- THE INFORMATION ON THIS MAP IS REFERENCED FROM AECOM 2016: INVENTAIRE DE LA BIODIVERSITÉ SUR LE TERRITOIRE DE LA SOCIÉTÉ-FLORE, REPORT SUBMITTED TO THE JACQUES CARTIER AND CHAMPLAIN BRIDGES INC. PRELIMINARY REPORT.
- THE LOCATIONS ARE APPROXIMATE.

SCALE: 1:30 000

0 500 1 000 1 500 2 000m

PLAN BACKGROUND :
GOOGLE EARTH, 2016
(SATELLITE IMAGE : 2013)

REFERENCE DRAWING:
CARTE B-1

Sceaux / Seals:

Préparé par:
Prepared by:

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts JACQUES CARTIER + CHAMPLAIN Bridges
Canada

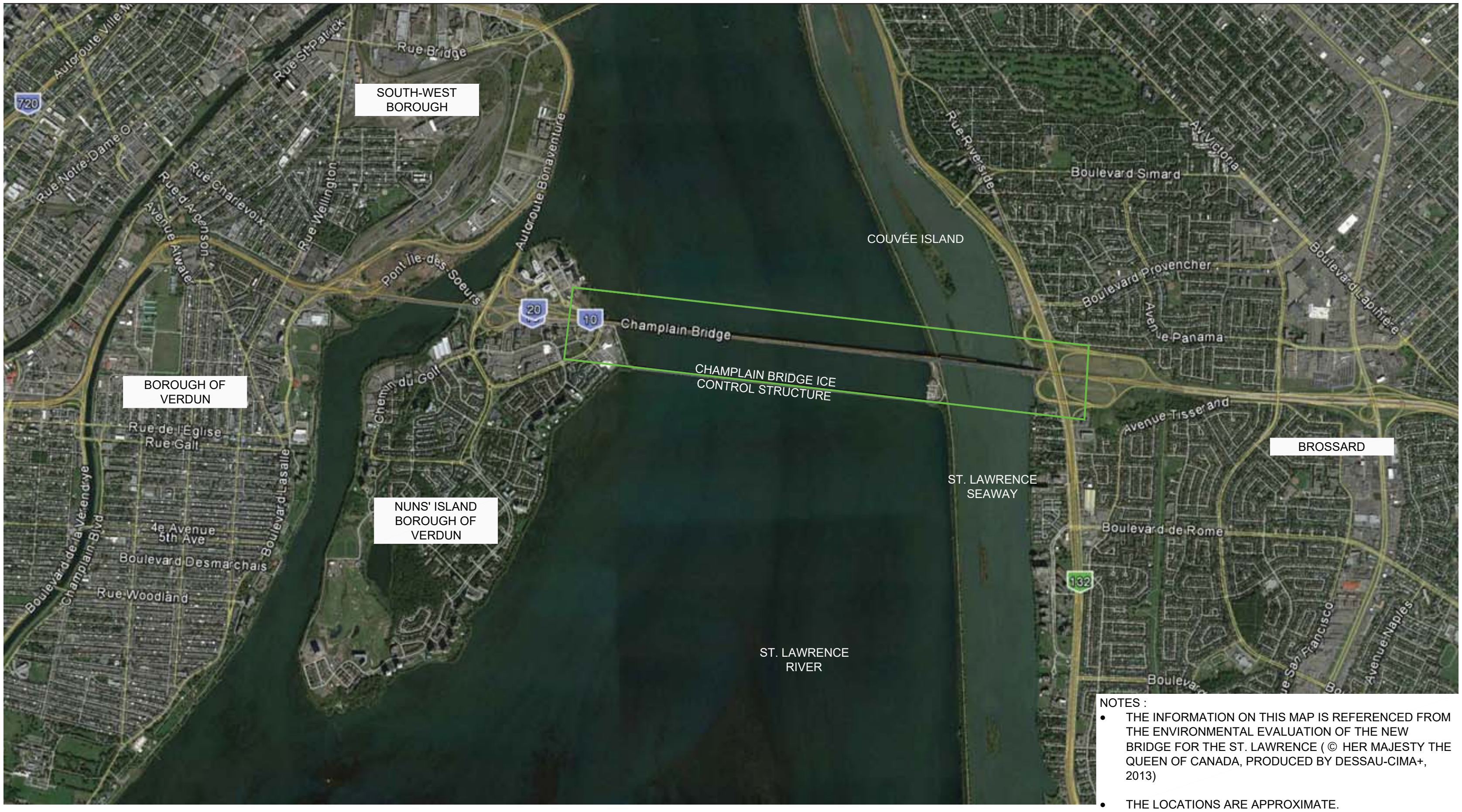
FEASIBILITY STUDY - DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE
ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

LOCATION OF THE JCCBI PROPERTY

Échelle / Scale	1:30 000	Date	2017-02-08
Dessiné / Drawn	[redacted]	Vérifié / Checked	[redacted]
Conçu / Designed		Approuvé / Approved	
No Contrat / Contract No.	62453		
No Dessin / Drawing No	125859-0101	Rév. / Rev.	0

2016-12-09

PROJECT STUDY AREA



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GOOGLE EARTH, 2016
(SATELLITE IMAGE : 2013)

REFERENCE DRAWING:
068-P-0000810-110-GO-D-0044-00

Sceaux / Seals

Préparé par / Prepared by:

Parsons
Tetra Tech
Amec Foster Wheeler

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Canada

FEASIBILITY STUDY - DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

LOCATION OF THE PROJECT STUDY AREA

NOTES :
- THE INFORMATION ON THIS MAP IS REFERENCED FROM THE ENVIRONMENTAL EVALUATION OF THE NEW BRIDGE FOR THE ST. LAWRENCE (© HER MAJESTY THE QUEEN OF CANADA, PRODUCED BY DESSAU-CIMA+, 2013)
- THE LOCATIONS ARE APPROXIMATE.

SCALE: 1:30 000

0 500 1 000 1 500 2 000m

Échelle / Scale: 1:30 000	Date: 2017-02-08
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Conçu / Designed: [redacted]	Approuvé / Approved: [redacted]
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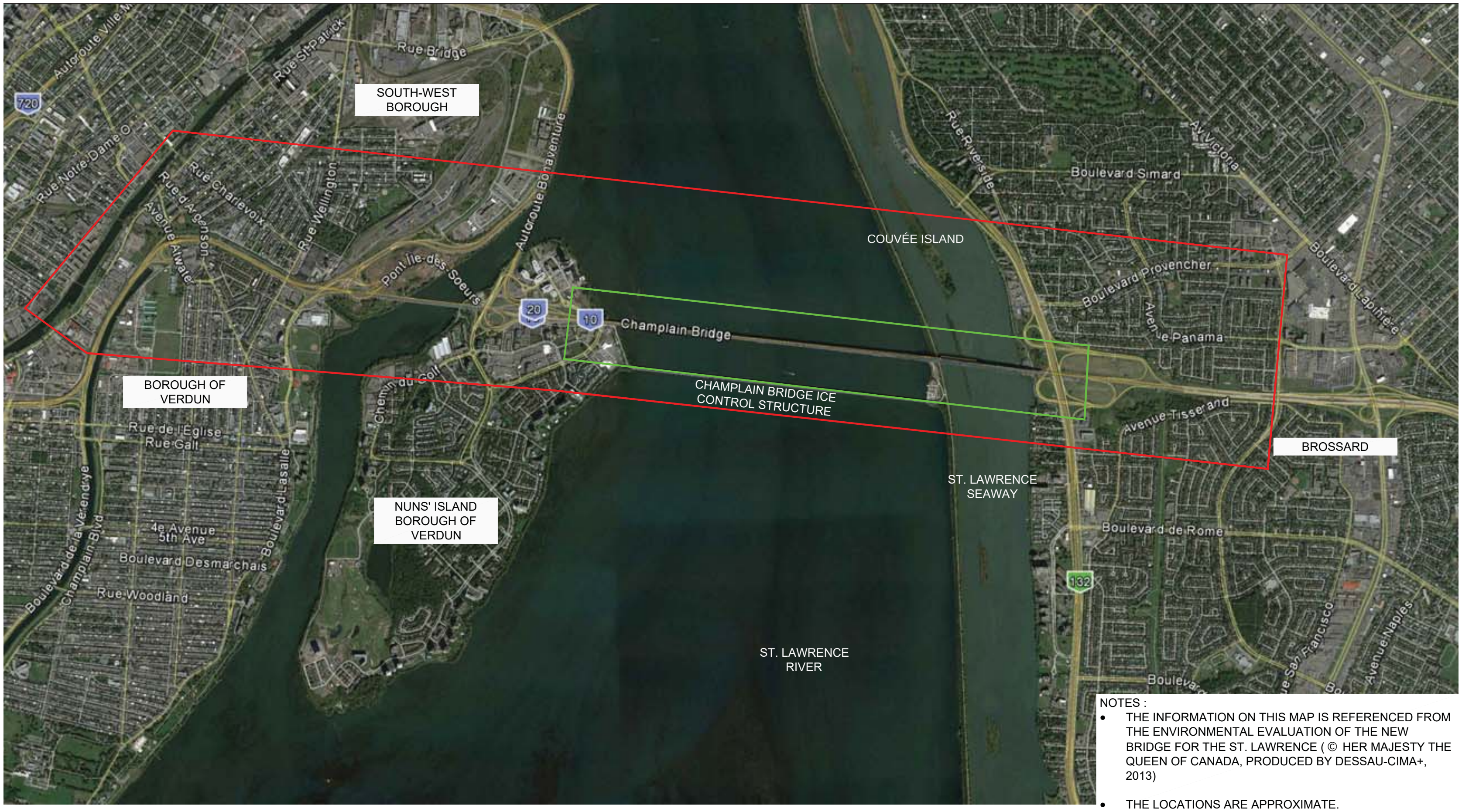
2016-12-09



STUDY AREA
PROJECT STUDY AREA

PLAN BACKGROUND : GOOGLE EARTH, 2016 (SATELLITE IMAGE : 2013)

REFERENCE DRAWING: 068-P-0000810-110-GO-D-0044-00

NOTES :

- THE INFORMATION ON THIS MAP IS REFERENCED FROM THE ENVIRONMENTAL EVALUATION OF THE NEW BRIDGE FOR THE ST. LAWRENCE (© HER MAJESTY THE QUEEN OF CANADA, PRODUCED BY DESSAU-CIMA+, 2013)
- THE LOCATIONS ARE APPROXIMATE.

SCALE: 1:30 000

0 500 1 000 1 500 2 000m

Prepared par / Prepared by: Parsons, Tetra Tech, Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY - DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

LOCATION OF THE STUDY AREA

Échelle / Scale	1:30 000	Date	2017-02-08
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Conçu / Des		Approuvé	
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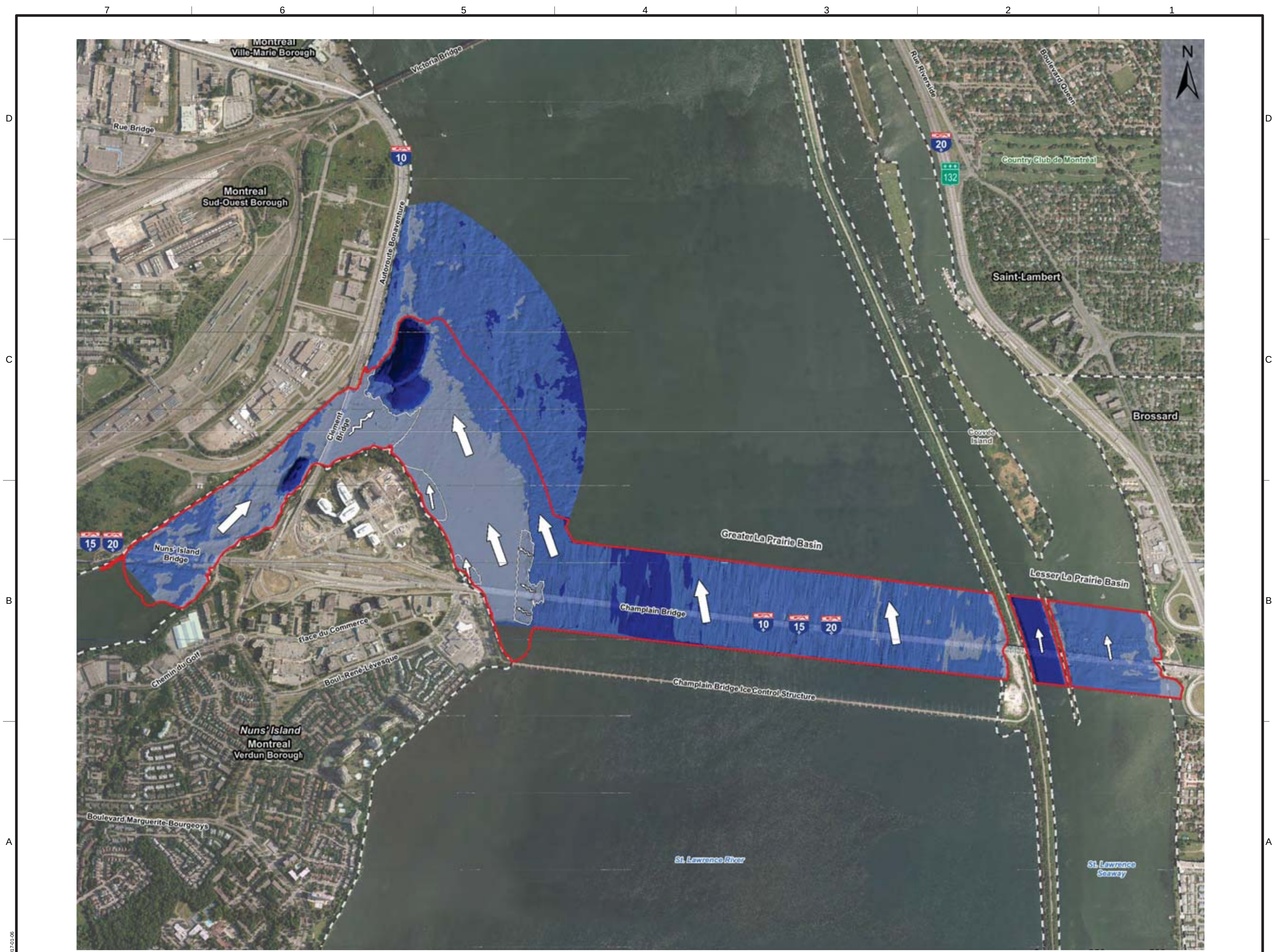
No Dessin / Drawing No	125859-0103	Rév. / Rev.	0

2016-12-09



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Flow Regimes

- Lotic – Whitewater
- Laminar lotic
- Lentic
- Flow Regime Limit

Depth (m)

- 0 -2
- 2- 5
- 5 - 15
- Over 15

- Bathymetric study area and surface substrate
- Municipal limit
- Borough limit

Drawing modified after DESSAU/CIMA+,2013-03-19

SOURCES :
- Bathymetry :
St. Lawrence Seaway, 2010
The Jacques Cartier and Champlain Bridges inc., 2007, 2010 et 2011
Environnement Illimité inc., 2012
- Flow facies : Environnement Illimité inc., 2012
- Orthophotographs : © Montreal Metropolitan Community, 2005-2011

0m 100 200 300 400 500 600

1 : 15000

Sceaux / Seals

Préparé par / Prepared by

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY-DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE
ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

BATHYMETRY AND FLOW REGIMES

Échelle / Scale	1:15 000	Date	2017-01-06
Dessiné / Drawn	[redacted]	Vérifié / Checked	B
Conçu / Designed		Approuvé / Approved	F. [redacted]
No Contrat / Contract No.	62453		
No Dessin / Drawing No	125859-0104	Rév. / Rev.	0

STUDY AREA
PROJECT STUDY AREA

TERRESTRIAL ENVIRONMENT
TREED SHRUBLAND
HERBACEOUS FIELD

SPECIAL STATUS PLANT SPECIES
-ST-LAWRENCE WATER-HOREHOUND (LYSL)

EXOTIC INVASIVE PLANT SPECIES
-BLACK BUCKTHORN (FRAL)
-WILD PARSNIP (PASA)
-EUROPEAN REED (PHAU)
-PURPLE LOOSESTRIFE (LYSA)

NOTES :

- THE INFORMATION ON THIS MAP IS REFERENCED FROM AECOM 2016: INVENTAIRE DE LA BIODIVERSITÉ SUR LE TERRITOIRE DE LA SOCIÉTÉ-FLORE, REPORT SUBMITTED TO THE JACQUES CARTIER AND CHAMPLAIN BRIDGES INC. PRELIMINARY REPORT.
- THE LOCATIONS ARE APPROXIMATE.

SCALE: 1:15 000
0 250 500 750 1 000m

PLAN BACKGROUND :
GOOGLE EARTH, 2016
(SATELLITE IMAGE : 2013)

REFERENCE DRAWINGS:
068-P-0000810-110-GO-D-0044-00
CARTE B-1

Sceaux / Seals

Préparé par / Prepared by:
Parsons
Tetra Tech
Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY - DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

TERRESTRIAL VEGETATION AND WETLANDS WESTERN PORTION OF THE STUDY AREA

Échelle / Scale: 1:15 000	Date: 2017-02-08
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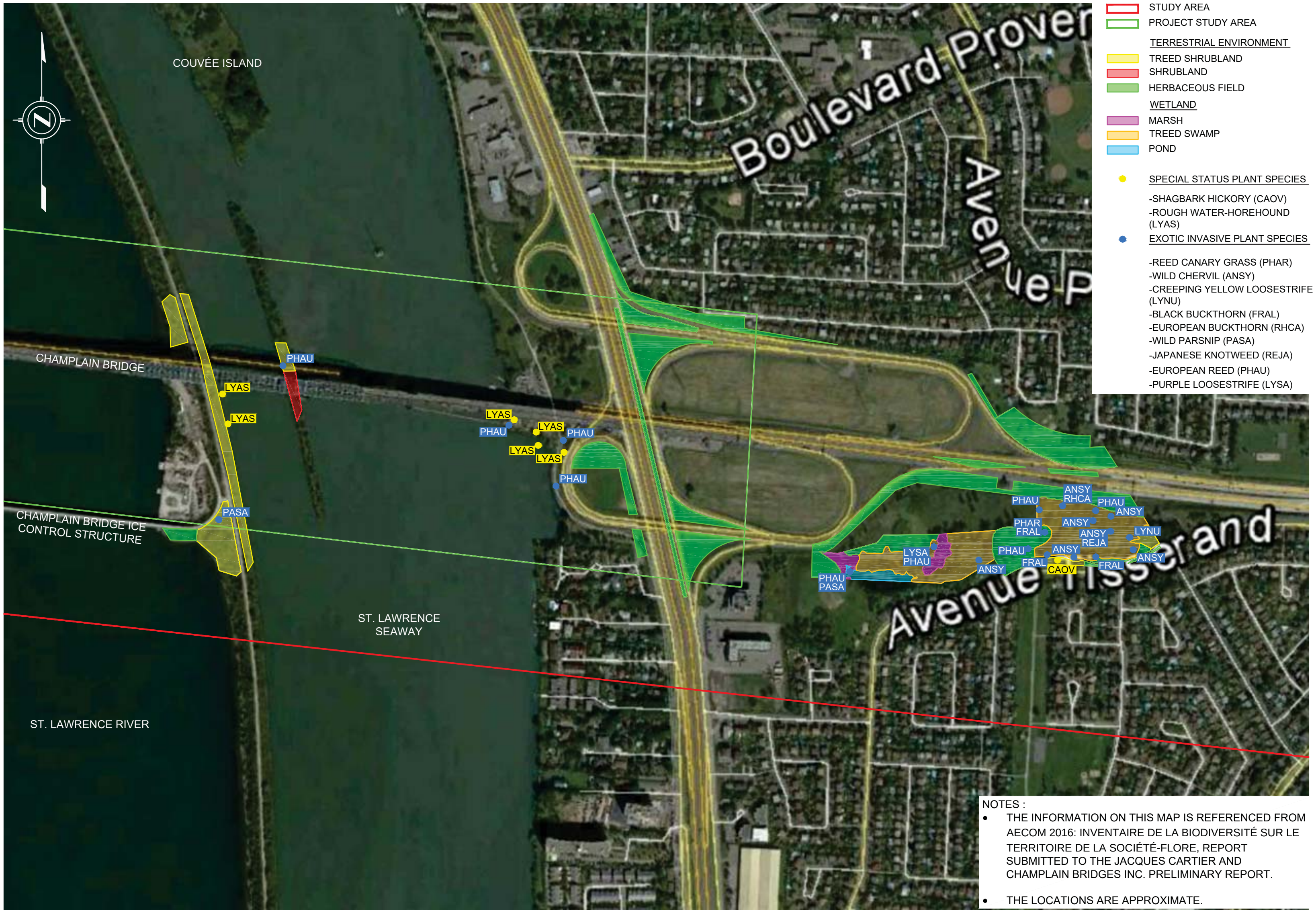
No Dessin / Drawing No: 125859-0105	Rév. / Rev.: 0

2016-12-09



NOTES :

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- THE LOCATIONS ARE APPROXIMATE.

SCALE: 1:7 500

0 250 500m

PLAN BACKGROUND :
GOOGLE EARTH, 2016
(SATELLITE IMAGE : 2013)

REFERENCE DRAWINGS:
068-P-0000810-110-GO-D-0044-00
CARTE B-1

Sceaux / Seals

Préparé par / Prepared by

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY - DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

TERRESTRIAL VEGETATION AND WETLANDS EASTERN PORTION OF THE STUDY AREA

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Conçu / Design	[redacted]	Approuvé / Approved	[redacted]
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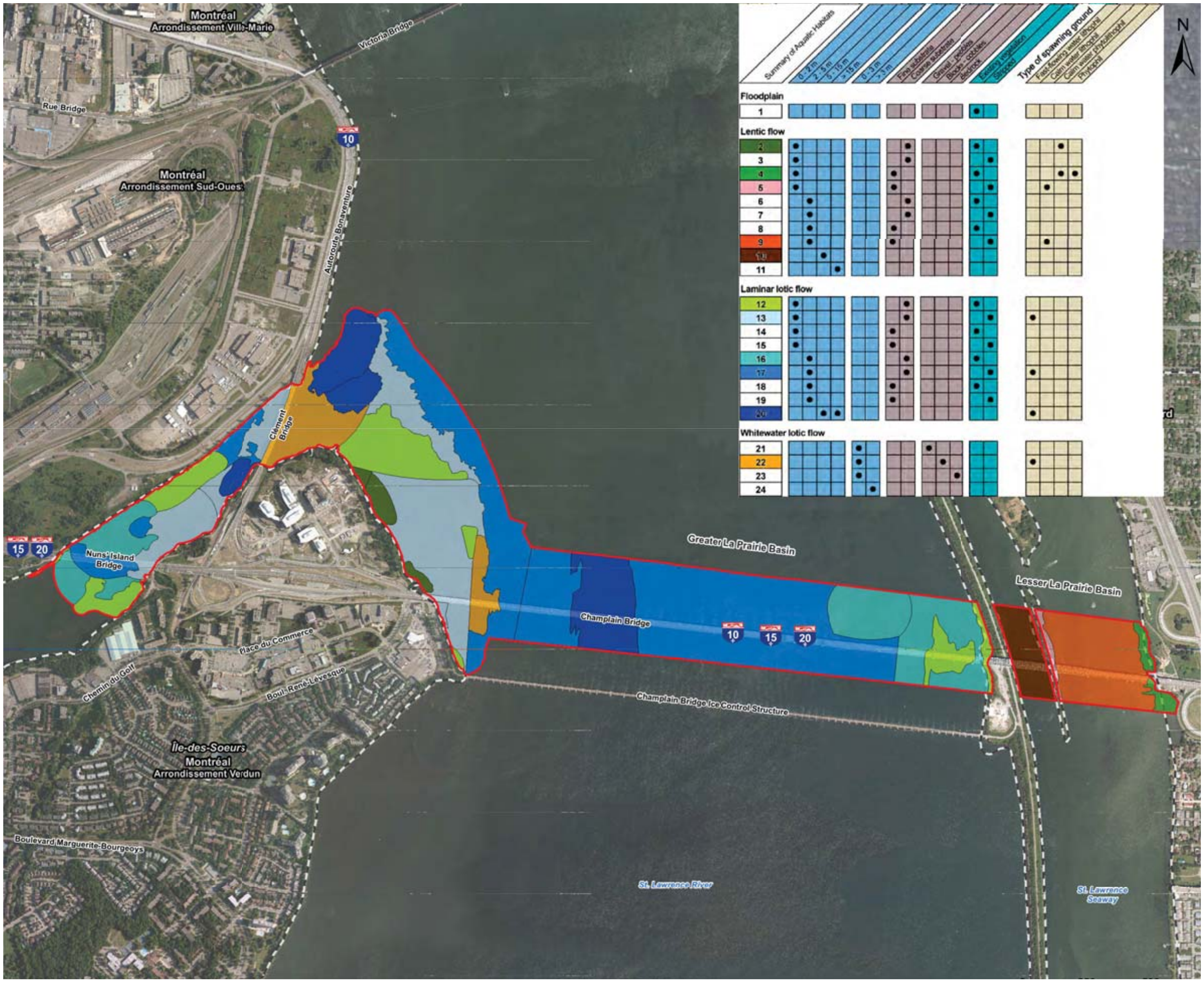
2016-12-09



Bathymetric study area and surface substrate
Municipal limit
Borough limit

Drawing modified after DESSAU/CIMA+,2013-03-19

SOURCES :
- Aquatic habitats : Environnement Illimité inc., 2012
- Orthophotographs: © Montreal Metropolitan Community, 2005-2011

0m 100 200 300 400 500 600

1 : 15000

Sceaux / Seals

Préparé par
Prepared by

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY-DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE
ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

SUMMARY OF AQUATIC HABITATS

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No Dessin / Drawing No	125859-0107	Rév. / Rev.	0

2017-01-06

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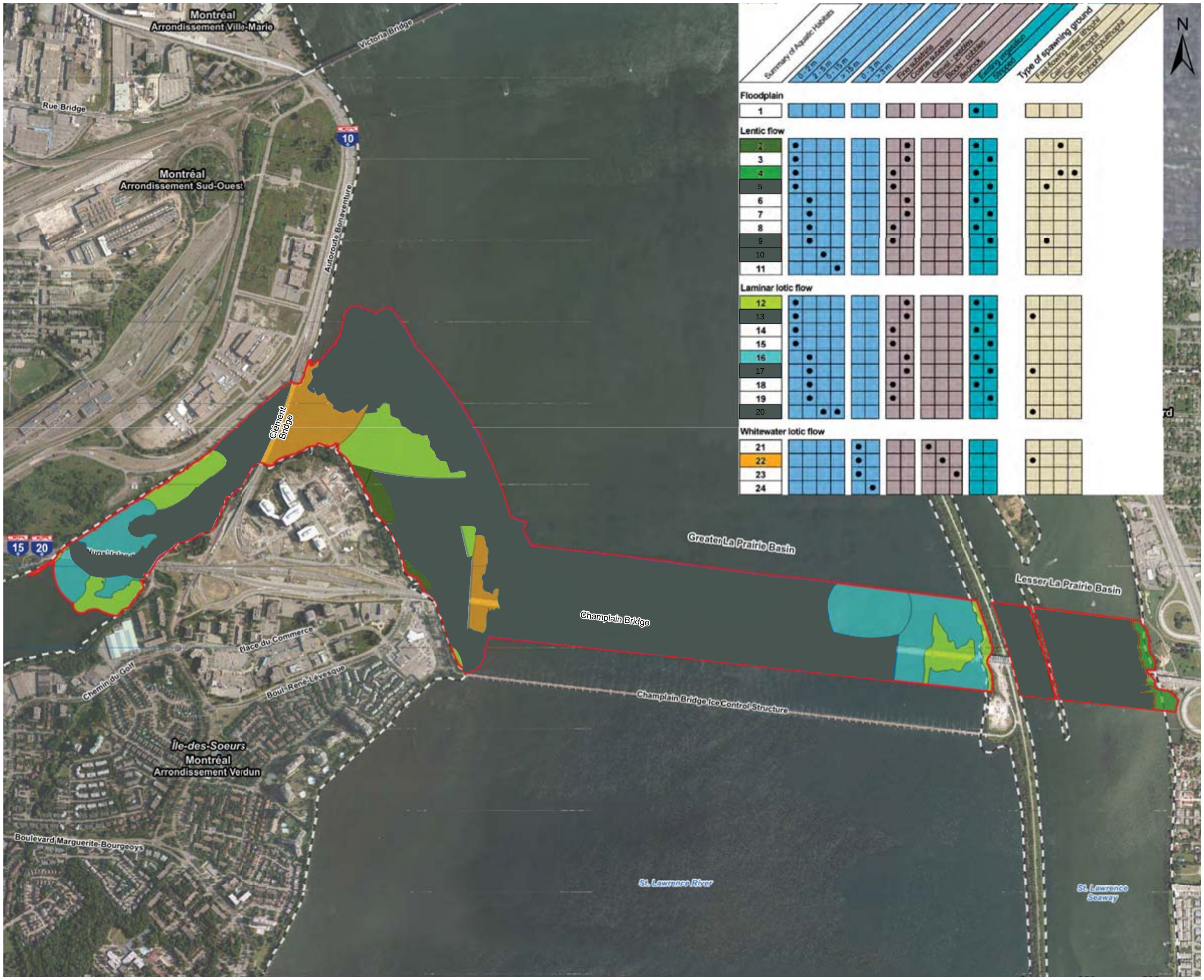

Bathymetric study area and surface substrate
Municipal limit
Borough limit

Drawing modified after DESSAU/CIMA+,2013-03-19

SOURCES :
- Aquatic habitats : Environnement Illimité inc., 2012
- Orthophotographs: © Montreal Metropolitan Community, 2005-2011

0m 100 200 300 400 500 600

1 : 15000

Échelle / Scale

Préparé par / Prepared by:

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY-DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE
ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

CRITICAL HABITATS

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2017-01-06

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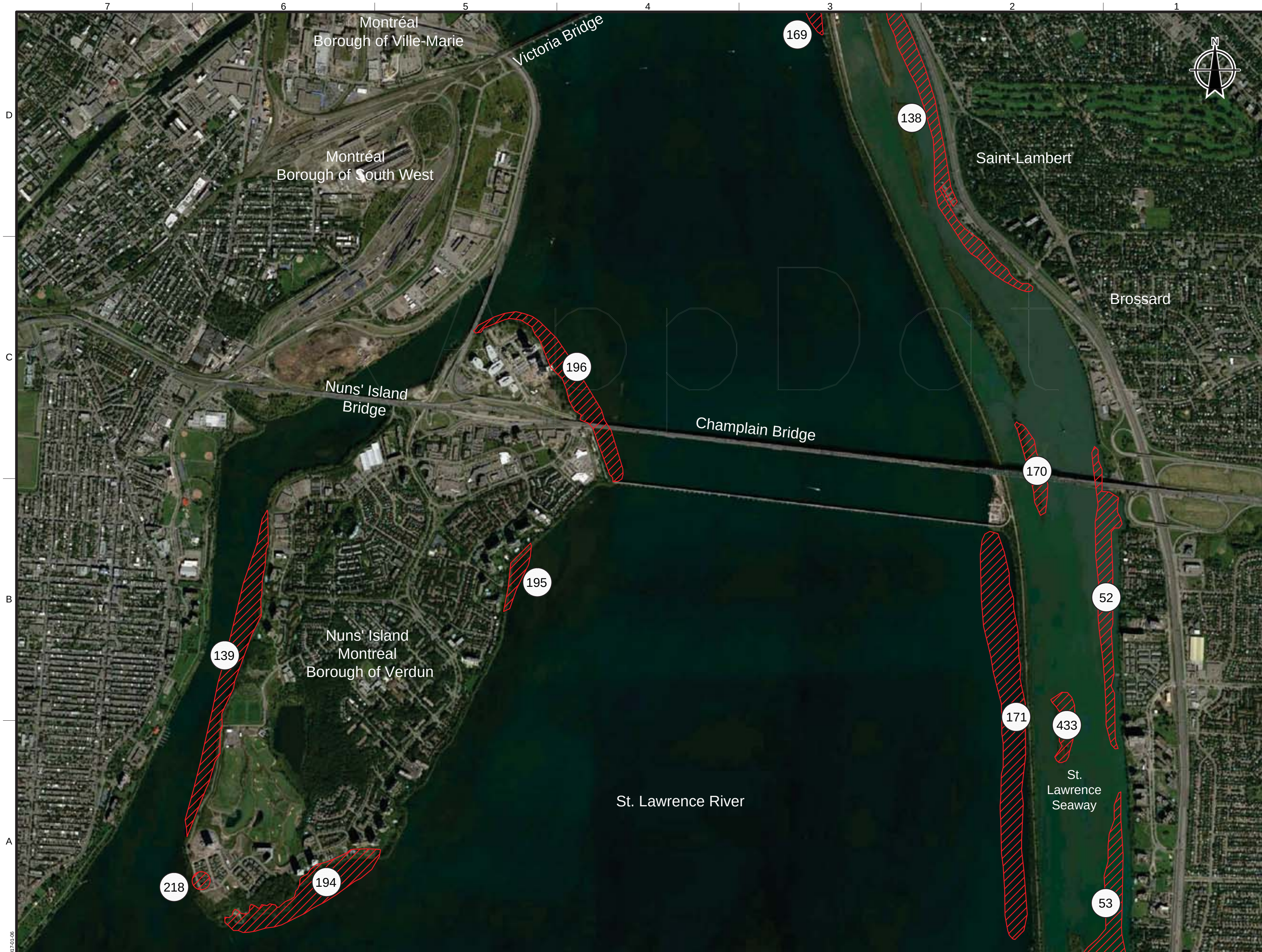

LEGEND:

-SPAWNING AREA WITH ZONE ID

BASEMAP SOURCE:
GOOGLE EARTH, 2016 (2013 SATELLITE IMAGE)

0m 200 400 600 800

1 : 20000

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts JACQUES CARTIER + CHAMPLAIN Bridges
Canada

FEASIBILITY STUDY-DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

CDPNQ IDENTIFIED SPAWNING GROUNDS

Échelle / *Scale* 1:20 000	Date 2017-01-06
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No Dessin / *Drawing No* 125859-0109	Rév. / *Rev.* 0

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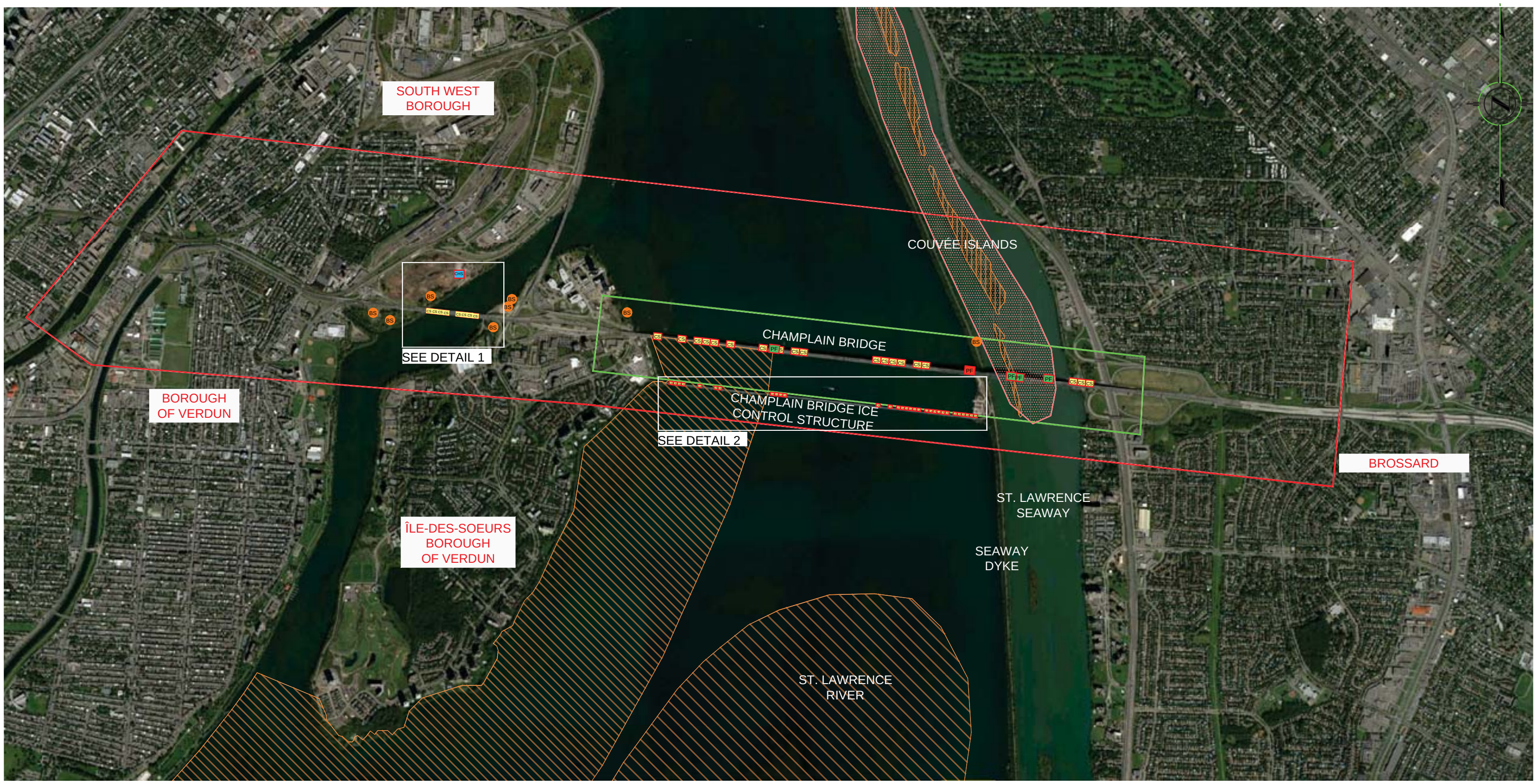


DETAIL 1, NOT TO SCALE

DETAIL 2, NOT TO SCALE

- LOCAL STUDY AREA
- PROJECT STUDY AREA
- WATERFOWL CONCENTRATION AREAS
- IMPORTANT BIRD AREAS
- BS BROWN SNAKE OBSERVATION
- PF PEREGRINE FALCON NEST (ACTIVE)
- PF PEREGRINE FALCON NEST (INACTIVE)
- CHS CHIMNEY SWIFT NEST
- CS CLIFF SWALLOW NEST

BASEPLAN:
GOOGLE EARTH, 2016
(SATELLITE IMAGE : 2013)

REFERENCE DRAWINGS:
068-P-0000810-110-GO-D-0039-00
068-P-0000810-110-GO-D-0040-00
068-P-0000810-110-GO-D-0041-00
068-P-0000810-110-GO-D-0044-00
068-P-0000810-110-GO-D-0045-00
068-P-0000810-110-GO-D-0046-00
068-P-0000810-110-GO-D-0047-00
068-P-0000810-110-GO-D-0048-00
068-P-0000810-110-GO-D-0084-00

Parsons
Tetra Tech
Amec Foster Wheeler

Ponts Jacques Cartier + Champlain Bridges
Canada

FEASIBILITY STUDY-DECONSTRUCTION OF THE EXISTING CHAMPLAIN BRIDGE ENVIRONMENTAL EFFECT EVALUATION AND PARTIAL BASELINE STUDY

IMPORTANT TERRESTRIAL FAUNA LOCATIONS

Scale	1:30 000	Date	2017-01-09
Drawn	[redacted]	Checked	[redacted]
Designed		Approved	
Contract No.	62453		
Drawing No	125859-0110	Rev	0

NOTE :
- THE INFORMATION ON THIS MAP IS TAKEN FROM SAINT LAWRENCE NEW BRIDGE ENVIRONMENTAL EVALUATION (© HER MAJESTY THE QUEEN IN RIGHT OF CANADA, CONDUCTED BY DESSAU-CIMA+, 2013)
- LOCATIONS ARE APPROXIMATE.

SCALE: 1:30 000
0 500 1 000 1 500 2 000m

Appendix 2

List of participants

List of participants

Parsons	Sylvain Montminy, P.Eng.	Project Manager
	Bertrand Voutaz, P.Eng.	Assistant Project Manager
	[redacted] P.Eng.	Tunnel and bridge specialist
	[redacted], P.Eng.	Tunnel and bridge specialist
	[redacted], P.Eng.	Structural engineering
Tetra Tech	Alain Robitaille, P.Eng.	Transportation of materials
	[redacted]	Sustainable development and reclamation of materials
	[redacted] P.Eng.	Sustainable development and stakeholders
Amec Foster Wheeler	[redacted]	EEE Team Lead
	[redacted]Geologist	Geology and soils
	[redacted] Geologist	Geology and soils
	[redacted], P.Eng.	Hydrogeology
	[redacted]	Senior reviewer, biological environment
	[redacted]	Aquatic fauna and habitats
	[redacted], Biologist	Aquatic fauna and habitats
	[redacted]CET	Terrestrial flora and fauna, species at risk
	[redacted], Biologist	Terrestrial vegetation and wetlands
	[redacted] Biologist	Terrestrial vegetation and wetlands
	[redacted] iologist	Terrestrial fauna and species at risk
	[redacted]	Air quality
	[redacted]	Meteorology and air quality
	[redacted]	Meteorology
	[redacted], Jr Eng.	Air quality
	[redacted]	Draftsperson
	[redacted]	Draftsperson
	[redacted]	Draftsperson
	[redacted]	Text formatting
	[redacted]	Translation and text correction
Provencher Roy	[redacted], Urban Planner	Asset reclamation
Soft dB	[redacted] Jr. Eng.	Acoustic environment
	[redacted] P.Eng.	Acoustic environment
Traduction Serge Bélair inc.	[redacted]	Translation
Independent Contractors	[redacted]	Translation
	[redacted]	Translation

Appendix 3

Proposed asset enhancement projects

Option 1: Network of cyclist rest areas and windows on the St. Lawrence linked with a network of enhanced natural environments

Primary intent	To improve the bike path network, and strengthen and enhance natural environments to support plant and animal species in the area while providing visitors with the opportunity to connect with these environments
Proposed actions	• Restoration, conservation and enhancement of existing natural environments; • Renaturalization and reshaping of laydown areas; • Existing and restored wildlife habitat enhancement and conservation plan; • Construction of natural environment interpretive trails; • Construction of lookout points/windows on the St. Lawrence River; • Construction of waterfowl staging areas on preserved and modified piers on the IDS side of the bridge; • Construction of boat ramps on the IDS and Brossard sides of the bridge; • Relocation of parts of the bike path (IDS and Brossard) to improve its relationship to the River; • Construction of cyclist rest areas; • Integration of signature furniture to the various facilities; • Implementation of a bike and pedestrian river shuttle service between the Seaway dike and Brossard.

OPTION 1

NETWORK OF CYCLE STOPS AND WINDOWS ON THE RIVER IN RELATION TO A DEVELOPMENT NETWORK OF NATURAL AREAS

Option 2: Historical and arts itinerary (+ option 1)

Primary intent

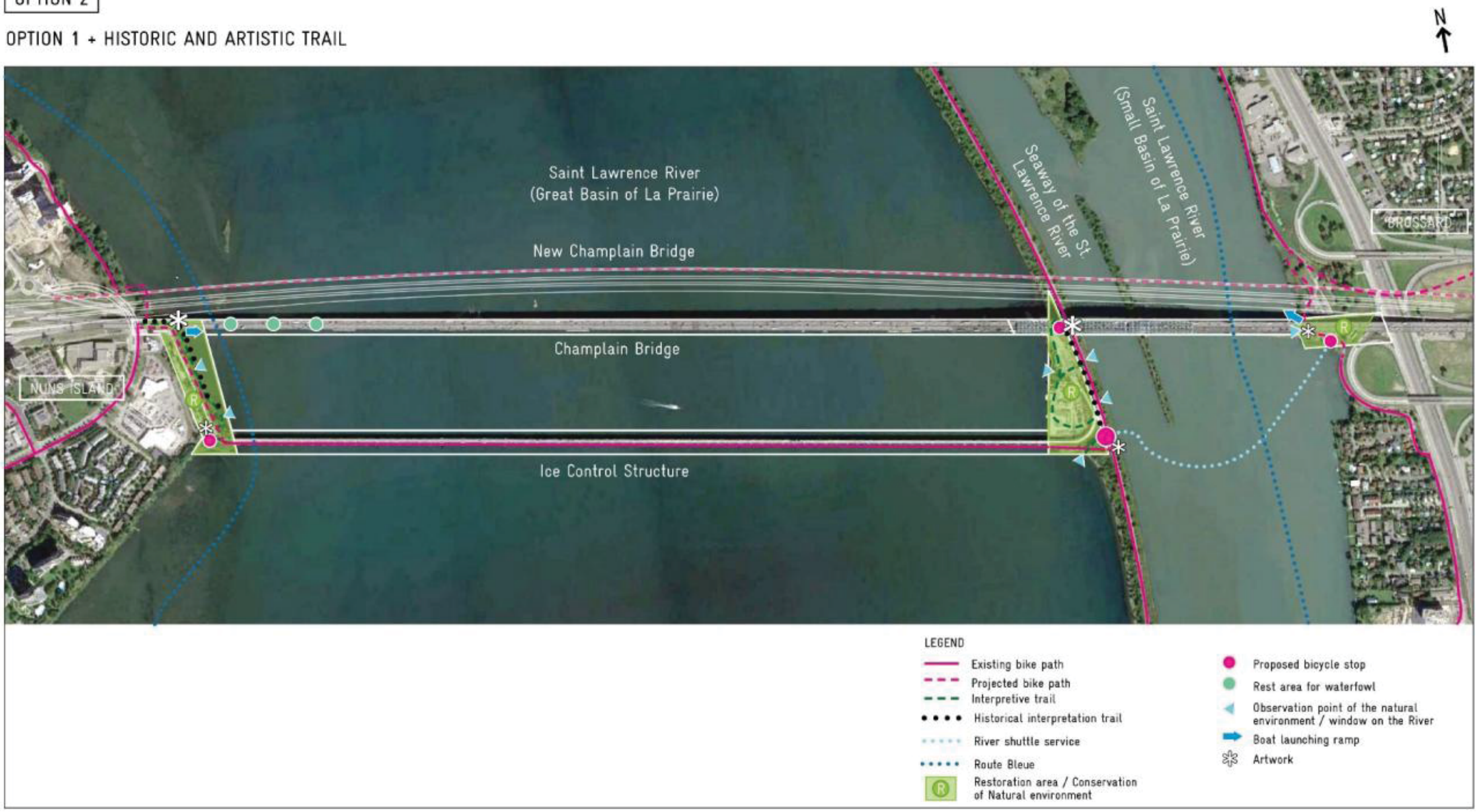
To commemorate the history of the site through the creation of historical and arts itineraries related with the bike path and foot trail network.

Proposed actions

- Incorporation of artwork made from materials reclaimed from the bridge;
- Integration of periodically updated interpretation panels on the history of the bridge and the Seaway.

OPTION 2

OPTION 1 + HISTORIC AND ARTISTIC TRAIL



Option 3: Multi-use wharves and infrastructure for aquatic activities (+ Options 1 and 2)

Primary intent To provide residents new access to the St. Lawrence River through the creation of points of interest along its banks, including wharves and surfing waves.

Proposed actions
- Construction of multi-use wharves with boat ramp supported in part on converted existing bridge piers;
- Construction of manmade surfing waves in the Greater La Praire Basin for surfers and whitewater kayakers.

Option 4: Construction of a nature beach (+ Options 1 to 3)

Intent	To increase the attraction potential of the Seaway dike and strengthen the relationship with the St. Lawrence River by providing a natural-type beach along the banks of the Greater La Prairie Basin.
Proposed actions	Construction of a pebble beach with a service building along the Seaway dike.

OPTION 4

OPTIONS 1 + OPTION 2 + OPTION 3 + NATURAL BEACH DEVELOPMENT

Option 5: Construction of an aerial extreme sports facility (+ Options 1 to 4)

Intent

To leverage existing large vertical elements along the Seaway dike to include aerial extreme sports activities.

Proposed actions

- Development of climbing routes on the preserved Seaway dike pier combined with a climbing block;
- Construction of a series of extreme sports decks (bungee, zip line, aerial courses) on the preserved Seaway dike pier, along the Ice Control Structure, and in the renaturalized portion of the dike.

OPTION 5

OPTIONS 1 + OPTION 2 + OPTION 3 + OPTION 4 + DEVELOPMENT OF AN EXTREME SPORTS SITE ON HIGH LEVEL

Option 6: Construction of a multi-use belvedere (+ Options 1 to 5)

Intent	To maximize the preservation and enhancement of existing Champlain Bridge infrastructure by building a one-of-a-kind belvedere.
Proposed actions	Construction of a multi-use belvedere on top of the preserved Seaway dike pier while reusing part of the steel structure of the bridge.

OPTION 6

OPTIONS 1 + OPTION 2 + OPTION 3 + OPTION 4 + OPTION 5 + DEVELOPMENT OF A MULTIFUNCTIONAL LOOKOUT

Appendix 4

Hydrogeology (HIS)

Inventory of developed wells in the local study area

#	X COORDINATE (m)	Y COORDINATE (m)	MTM ZONE	WELL ID	INITIAL OWNER	DIAMETER (cm)	DEPTH (m)	CASING LENGTH (m)	WATER LEVEL AT END OF WORK (m)	FLOW RATE (litres/minute)
1	303899	5037910	8	1978-300-10051504	Unknown	10,2	8,8	Unknown	Unknown	Unknown
2	304085	5037150	8	1978-300-10053500	Unknown	15,2	9,1	Unknown	Unknown	Unknown
3	304745	5037640	8	1985-300-10001015	Unknown	5,1	7	Unknown	-1,22	Unknown
4	305184	5037030	8	1981-100-46406218	BOURBEAU MR,	15,2	10,4	8,2	-3,66	54,6
5	305311	5036890	8	1984-100-26802750	A BURKE	15,2	131,1	12,8	-3,66	31,8
6	305555	5036560	8	1985-100-26801763	ANTOINE THEBERGE	15,2	76,2	12,5	-3,35	39,5

Source: MDDELCC Hydrogeological information system, updated January 15, 2015

Appendix 5

CDNPQ Database (2016)

Ministère
du Développement durable,
de l'Environnement
et de la Lutte contre les
changements climatiques
Québec

Direction régionale de l'analyse et de l'expertise
de Montréal, de Laval, de Lanaudière et des Laurentides

Montréal, le 3 mai 2016

[redacted]
AECOM
4700, boulevard Wilfrid-Hamel
Québec (Québec) G1P 2J9

Objet : Réponse à votre demande d'information sur les espèces floristiques menacées ou vulnérables : Secteur des ponts Champlain, Honoré-Mercier, Jacques-Cartier, région de Montréal

Madame,

En réponse à votre demande d'information reçue le 28 avril dernier, concernant les espèces floristiques menacées ou vulnérables dans le secteur mentionné en objet, veuillez prendre connaissance de ce qui suit :

Le Centre de données sur le patrimoine naturel du Québec (CDPNQ) est un outil servant à colliger, analyser et diffuser l'information sur les espèces menacées. Les données provenant de différentes sources (spécimens d'herbiers et de musées, littérature scientifique, inventaires récents, etc.) sont intégrées graduellement et ce, depuis 1988. Une partie des données existantes n'est toujours pas incorporée au Centre si bien que l'information fournie peut s'avérer incomplète. Une revue des données à être incorporées au Centre et des recherches sur le terrain s'avèrent essentielles pour obtenir un portrait général des espèces menacées du territoire à l'étude. De plus, la banque de données ne fait pas de distinction entre les portions de territoires reconnues comme étant dépourvues de telles espèces et celles non inventoriées. **Pour ces raisons, l'avis du CDPNQ concernant la présence, l'absence ou l'état des espèces menacées d'un territoire particulier n'est jamais définitif et ne doit pas être considéré comme un substitut aux inventaires de terrain requis dans le cadre des évaluations environnementales.**

Vous trouverez ci-joints les fichiers qui indiquent les habitats pour les espèces retrouvées dans la région et l'information détaillée pour les occurrences situées dans la zone à l'étude.

...2

Bureau de Montréal
5199, rue Sherbrooke Est, bureau 3860
Montréal (Québec) H1T 3X9
Téléphone : (514 873-3636
Télécopieur : (514) 864-0856
Internet: http://www.mddelcc.gouv.qc.ca

Veuillez noter les renseignements suivants pour les champs "PRÉCISION" et "LATITUDE" et "LONGITUDE" :

PRÉCISION : la précision de cette occurrence [4 possibilités : "S" i.e. dans un rayon de 100 m; "M" i.e. dans un rayon de 1,5 km; "G" i.e. dans un rayon de 8 km et "U" i.e. trop imprécis pour être cartographié].

LATITUDE et LONGITUDE : les coordonnées latitude et longitude de l'occurrence telle que cartographiée au Centre de données sur le patrimoine naturel du Québec (degré minute seconde, NAD 83). **Ces coordonnées doivent nécessairement être interprétées conjointement avec le degré de précision de l'occurrence**.

Ces informations vous sont transmises à titre confidentiel. Nous vous demandons d'utiliser ces données uniquement pour des fins de conservation et de gestion du territoire et de ne pas les divulguer. Cette requête vous est formulée de manière à mieux protéger ces espèces, notamment de la récolte.

Afin de faire du CDPNQ l'outil le plus complet possible, il nous serait utile de recevoir vos données relatives aux espèces menacées issues d'inventaires reliés à ce projet. Veuillez noter que les données pour les nouvelles occurrences nous intéressent particulièrement mais que les mises à jour d'occurrences déjà connues sont toutes aussi importantes.

En vous remerciant de l'intérêt que vous portez au Centre de données sur le patrimoine naturel du Québec, je demeure disponible pour répondre à vos questions au 514 873-3636, poste 221.

[redacted]
Préposé aux renseignements

p. j.

Bureau de Montréal
5199, rue Sherbrooke Est, bureau 3860
Montréal (Québec) H1T 3X9
Téléphone : (514 873-3636
Télécopieur : (514) 864-0856
Internet: http://www.mddelcc.gouv.qc.ca

Espèces à risque

1 – Nombre total d'occurrences pour cette requête : 3

Nom latin - (no d'occurrence)

Nom français

Localisation / Caractérisation

Latitude / Longitude	Qualité - Précision	Indice de biodiversité	Dernière observation

FLORE

Carex normalis - (22842)

carex normal

Ile St.Paul. / Wet-mesic hardwoods.

45,463 / -73,546	H (Historique) - G (Général, > 8000 m)	B0.00	ND

Meilleure source :

Justicia americana - (19760)

carmantine d'Amérique

MRC de Montréal, ville de Montréal, Secteur île des S□urs, versant nord. / Dans l'eau.

45,472 / -73,545	X (Extirpée) - M (Minute, 1500 m)	B0.00	1964-07-08

Meilleure source : HERBIERS 2001 -. Banque de données sur les spécimens d'herbier, active depuis 2001; continuellement mise à jour. Centre de données sur le patrimoine naturel du Québec (CDPNQ). Gouvernement du Québec, ministère du Développement durable, de l'Environnement et des Parcs, Direction du patrimoine écologique et des parcs. Québec, Québec.

Salix amygdaloides - (23305)

saule à feuilles de pêcher

Île Saint-Paul, près de Verdun. / Rivages du Saint-Laurent. 1943 : Aucune précision sur le nombre d'individus.

45,462 / -73,546	H (Historique) - G (Général, > 8000 m)	B0.00	1943

Meilleure source :

2 – Nombre total d'espèces pour cette requête : 3

Nom latin Nom commun Statut canadien Cosepac / Lep	Rangs de priorité G	N	S	Statut	Total Requête	Nombre d'occurrences dans votre sélection A	B	C	D	X	H	F	E	I	Autres*	Nombre au Québec**
FLORE																
Carex normalis carex normal X (Aucun) / X (Aucun)	G5	NNR	S2	Susceptible	1	0	0	0	0	0	1	0	0	0	0	7
Justicia americana carmantine d'Amérique M (Menacée) / M (Menacée)	G5	N2	S2	Menacée	1	0	0	0	0	1	0	0	0	0	0	5
Salix amygdaloides saule à feuilles de pêcher X (Aucun) / X (Aucun)	G5	NNR	S2	Susceptible	1	0	0	0	0	0	1	0	0	0	0	4
				Totaux:	3	0	0	0	0	1	2	0	0	0	0	

* Cette colonne compile les occurrences introduites, réintroduites et/ou restaurées pour chaque espèce suivie au CDPNQ.

** Les occurrences de qualités F, H, X ou compilées dans la colonne «Autres» ne sont pas comptabilisées dans ce nombre.

Signification des termes et symboles utilisés

Rang de priorité : Rang décroissant de priorité pour la conservation (de 1 à 5), déterminé selon trois échelles : G (GRANKe; l'aire de répartition totale) N (NRANKe; le pays) et S (SRANKe; la province ou l'État) en tenant compte principalement de la fréquence et de l'abondance de l'élément. Seuls les rangs 1 à 3 traduisent un certain degré de précarité. Dans certains cas, les rangs numériques sont remplacés ou nuancés par les cotes suivantes : B : population animale reproductrice (breeding); H : historique, non observé au cours des 20 dernières années (sud du Québec) ou des 40 dernières années (nord du Québec); M : population animale migratrice; N : population animale non reproductrice; NA : présence accidentelle / exotique / hybride / présence potentielle / présence rapportée mais non caractérisée / présence rapportée mais douteuse / présence signalée par erreur / synonymie de la nomenclature / existant, sans occurrence répertoriée; NR : rang non attribué; Q : statut taxinomique douteux; T : taxon infra-spécifique ou population isolée; U : rang impossible à déterminer; X : éteint ou extirpé; ? : indique une incertitude

Qualité des occurrences : A : excellente; B : bonne; C : passable; D : faible; E : à caractériser; F : non retrouvée; H : historique; X : disparue; I : introduite

Précision des occurrences : S : 150 m de rayon; M : 1,5 km de rayon; G : 8 km de rayon; U : > 8 km de rayon

Indice de biodiversité : 1: Exceptionnel; 2: Très élevé; 3: Élevé; 4: Modéré; 5: Marginal; 6: Indéterminé (pour plus de détails, voir à la page suivante)

Acronymes des herbiers : BL : MARCEL BLONDEAU; BM : Natural history museum; CAN : Musées nationaux; CCO : Université de Carleton; DAO : Agriculture Canada; DS : California academy of sciences; F : Field museum of natural history; GH : Gray; GR : Christian Grenier; ILL : University of Illinois; JEPS : Jepson herbarium; K : kew; LG : Université de Liège; MI : Université du Michigan; MO : Missouri; MT : MLCP (fusionné à MT); MT : Marie-Victorin; MTMG : Université McGill; NB : University of New Brunswick; NY : New York; OSC : Oregon state university; PM : Pierre Morisset; QFA : Louis-Marie; QFB-E : Forêts Canada; QFS : Université Laval; QK : Fowler; QSF : SCF; QUE : Québec; SFS : Rolland-Germain; TRTE : Toronto; UC : University of California; UQTA : Université du Québec; US : Smithsonian; V : Royal British Columbia museum; WAT : Waterloo university; WS : Washington state

CRITÈRES POUR L'ATTRIBUTION D'UN INDICE DE BIODIVERSITÉ À UNE OCCURRENCE

(adapté de The Nature Conservancy 1994 et 1996)

Indice	Sous-indice	Critères
B1	.01	Unique occurrence au monde d'un élément G1
	.02	Unique occurrence au Québec d'un élément G1
	.03	Unique occurrence au Québec d'un élément G2
	.04	Unique occurrence au Québec d'un élément G3
	.05	Occurrence d'excellente qualité d'un élément G1
	.07	Unique occurrence viable au Québec d'un élément S1
B2	.01	Occurrence autre que d'excellente qualité d'un élément G1
	.02	Occurrence d'excellente à bonne qualité d'un élément G2
	.03	Occurrence d'excellente qualité d'un élément G3
	.04	Occurrence d'excellente qualité d'un élément S1
B3	.01	Occurrence de qualité passable d'un élément G2
	.02	Occurrence de bonne qualité d'un élément G3
	.03	Occurrence de bonne qualité d'un élément S1
	.05	Occurrence d'excellente qualité d'une espèce S2 ou d'excellente qualité de toute communauté naturelle
	.11	Occurrence de bonne qualité d'un élément S2
B4	.01	Occurrence de qualité passable d'un élément G3
	.02	Occurrence de qualité passable d'un élément S1
	.03	Occurrence d'excellente qualité d'un élément S3
	.05	Occurrence de bonne qualité de toute communauté naturelle S3, S4 ou S5
	.07	Occurrence de bonne qualité d'un élément S3
B5	.01	Occurrence de qualité passable d'un élément S2
	.03	Occurrence de qualité passable d'un élément S3
	.04	Occurrence parmi les cas suivants : qualité faible, historique, présence contrôlée (existant)

Indice de biodiversité

L'indice de biodiversité est évalué pour les éléments les plus importants de la diversité biologique selon les critères indiqués dans le tableau. Pour fins de calcul, les rangs de priorité des sous-espèces et variétés (rangs T associés au rangs G) ainsi que ceux des populations (rangs T associés au rangs S) sont assimilés aux rangs de base (G ou S). L'indice met l'emphase sur le ou les éléments les plus rares. De même, une plus grande importance est accordée aux rangs de priorité à l'échelle globale. Seules les occurrences relativement précises (niveau de précision supérieur à 1,5 km) sont considérées.
Les occurrences de valeur indéterminée (E) ou historique (F et H) ont un poids très faible sur le plan de la conservation du territoire visé. Cependant, elles sont prioritaires sur le plan de l'acquisition de connaissances.

Intérêt pour la conservation

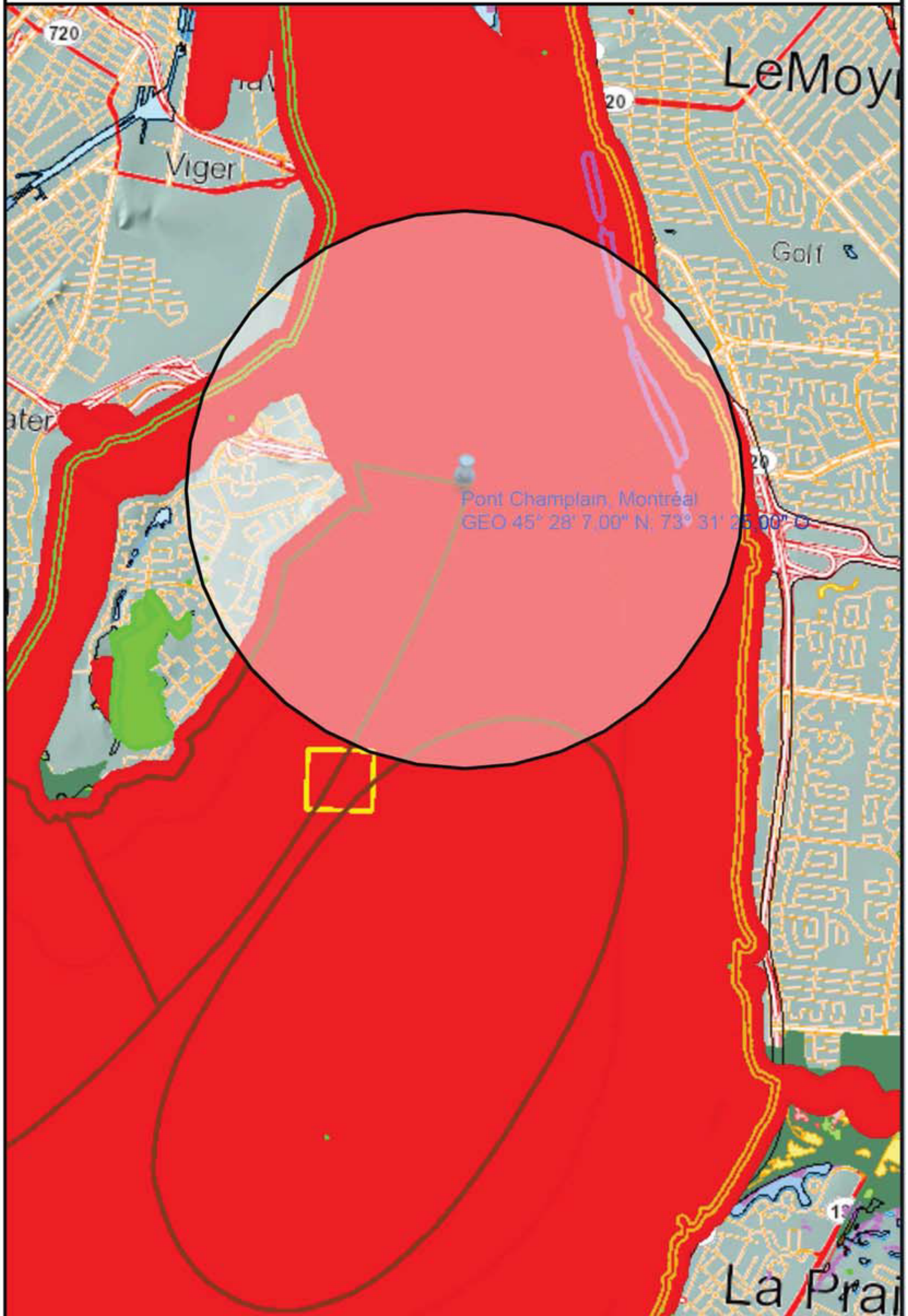
Les occurrences avec un indice de biodiversité de B1 à B3 sont considérées comme d'intérêt le plus significatif pour la conservation.

Références

The Nature Conservancy. 1994. The Nature Conservancy, Conservation Science Division, in association with the Network of Natural Heritage Programs and Conservation Data Centers. 1992. Biological and Conservation Data System (Supplement 2+, released March, 1994). Arlington, Virginia.

The Nature Conservancy. 1996. The Nature Conservancy Conservation Systems Department. Element Rank Rounding and Sequencing. Arlington, Virginia.

Carte-2, rayon de 2 kilomètres



- Sélection - Espèces végétales désignées et susceptibles
- Habitats espèces floristiques men. ou vuln. - MDDELCC
- Parcs marins - MDDELCC
- Réserves aquatiques - MDDELCC
  - Réserve aquatique
  - Réserve aquatique projetée
- Réserves naturelles reconnues - MDDELCC
- Réserves de biodiversité - MDDELCC
  - Réserve de biodiversité
  - Réserve de biodiversité projetée
- Réserves écologiques - MDDELCC
  - Réserve écologique
  - Réserve écologique projetée
- Réserve de territoire pour aire protégée - MDDELCC
- Aires protégées du MFFP Faune
  - Habitat espèce faunique men. ou vuln.
  - Refuge faunique
  - Aire de concentr. d'oiseaux aquatiques
  - Aire de confinement du cerf de Virginie
  - Colonie d'oiseaux de falaise
  - Colonie d'oiseaux d'île ou presqu'île
  - Habitat du rat musqué
  - Héronnière
  - Vasière
- Aires protégées du MFFP Parcs
  - Parc national du Québec

Échelle : 1 / 46 282 — 1km / 1mi

N

Source(s) des données :

Développement durable, Environnement et Lutte contre les changements climatiques
Québec

Préparé par:
[redacted]
Accueil et Loi d'accès
2016-05-03

Appendix 6

Terrestrial Fauna Tables

Table 1 List of Mammals of Quebec

Common Name	Scientific Name	Present in Eastern Great Lakes Lowlands Region?
Shrews and Moles	(Order Insectivora)	
Arctic Shrew	*Sorex arcticus*	
Masked Shrew	*Sorex cinereus*	x
Longtail Shrew	*Sorex dispar*	
Smoky Shrew	*Sorex fumeus*	x
Gaspe Shrew	*Sorex gaspensis*	
Northern Water Shrew	*Sorex palustris*	x
Pygmy Shrew	*Microsorex hoyi*	x
Short-tailed Shrew	*Blarina brevicauda*	x
Hairytail Mole	*Parascalops breweri*	x
Starnose Mole	*Condylura cristata*	x
Bats	(Order Chiroptera)	
Small Footed Myotis	*Myotis leibii*	x
Little Brown Myotis	*Myotis lucifugus*	x
Northern Myotis	*Myotis septentrionalis*	x
Silver-Haired Bat	*Lasionycteris noctivigans*	x
Eastern Pipistrelle (Tri-coloured Bat)	*Pipistrellus subflavus*	x
Big Brown Bat	*Eptisicus fuscus*	x
Red Bat	*Lasiurus borealis*	x
Hoary Bat	*Lasiurus cinereus*	
Rabbits and Hares	(Order Lagomorpha)	
Snowshoe Hare	*Lepus americanus*	x
Arctic Hare	*Lepus arcticus*	
Eastern Cottontail	*Sylvilagus floridanus*	x
New England Cottontail	*Sylvilagus transitionalis*	
Rodents	(Order Rodentia)	
Woodchuck	*Marmota monax*	x
Eastern Chipmunk	*Tamias striatus*	x
Least Chipmunk	*Eutamias minimus*	
Eastern Gray Squirrel	*Sciurus carolinensis*	x
Red Squirrel	*Tamiasciuris hudsonicus*	x
Northern Flying Squirrel	*Glaucomys sabrinicus*	x
Southern Flying Squirrel	*Glaucomys volans*	x
Beaver	*Castor canadensis*	x
White-Footed Mouse	*Peromyscus leucopus*	x
Deer Mouse	*Peromyscus maniculatus*	x
Hudson Bay Collared Lemming	*Dicrostonyx hudsonicus*	
Northern Bog Lemming	*Synaptomys borealis*	
Southern Bog Lemming	*Synaptomys cooperi*	x
Boreal Redback Vole	*Clethrionomys gapperi*	x
Mountain Phenacomys	*Phenacomys intermedius*	
Yellownose Vole (Rock Vole)	*Microtus chrotorrhinus*	x

Common Name	Scientific Name	Present in Eastern Great Lakes Lowlands Region?
Meadow Vole	*Micotus pennsylvanicus*	x
Woodland Vole	*Micotus pinetorum*	
Muskrat	*Ondatra zibethicus*	x
Norway Rat	*Rattus norvegicus*	x
House Mouse	*Mus musculus*	x
Meadow Jumping Mouse	*Zapus hudsonicus*	x
Woodland Jumping Mouse	*Napeozapus insignis*	x
Porcupine	*Erethizon dorsatum*	x
Whales and Porpoises	(Order Cetecea)	
Northern Bottlenose Whale	*Hyperoodon ampullatus*	
Beluga Whale	*Delphinapterus leucus*	
Narwhal	*Monodon monocerus*	
Atlantic White-Sided Dolphin	*Lagenorhyncus acutus*	
White-Beaked Dolphin	*Lagenorhyncus albirostris*	
Killer Whale	*Orcinus orca*	
Long-Finned Pilot Whale	*Globicephala melaena*	
Harbour porpoise	*Phocoena phocoena*	
Minke Whale	*Balaenoptera acutorostrata*	
Fin Whale	*Balaenoptera physalus*	
Blue Whale	*Balaenoptera musculus*	
Humpback Whale	*Megoptera novaeangliae*	
Biscayan Right Whale	*Eubalaena glacialis*	
Bowhead Whale	*Balaena mysticetus*	
Carnivores	(Order Carnivora)	
Coyote	*Canis latrans*	x
Gray Wolf	*Canis lupus*	
Arctic Fox	*Alopex lagopus*	
Red Fox	*Vulpes vulpes*	x
Gray Fox	*Urocyon cinereoargenteus*	
Black Bear	*Ursus americanus*	x
Polar Bear	*Ursus maritimus*	
Raccoon	*Procyon lotor*	x
Marten	*Martes americana*	
Fisher	*Martes pennanti*	x
Shorttail Weasel	*Mustela erminea*	x
Longtail Weasel	*Mustela frenata*	x
Least Weasel	*Mustela nivalis*	x
Mink	*Mustela vison*	x
Wolverine	*Gulo gulo*	
Striped Skunk	*Mephitis mephitis*	x
River Otter	*Lutra canadensis*	x
Mountain Lion	*Felis concolor cougar*	
Lynx	*Lynx canadensis*	x
Bobcat	*Lynx rufus*	x

Common Name	Scientific Name	Present in Eastern Great Lakes Lowlands Region?
Seals and Walruses	(Order Pinnipedia)	
Walrus	*Odobenus rosmarus*	
Ringed Seal	*Phoca hispida*	
Harbour Seal	*Phoca vitulina*	
Bearded Seal	*Erignathus barbatus*	
Grey Seal	*Halichoerus grypsus*	
Harp Seal	*Pagophilus groenlandicus*	
Ungulates	(Order Artiodactyla)	
Whitetail Deer	*Odocoileus virginianus*	x
Moose	*Alces alces*	x
Woodland Caribou	*Rangifer tarandus caribou*	

Sources: Smithsonian National Museum of Natural History 2016; Quebec Biodiversity Website 2016

Table 2 QBBA Species List for Atlas Square 18XR13

Common Name	Scientific Name	Breeding Evidence Code	Breeding Status
Canada Goose	*Branta canadensis*	NO	Confirmed
Wood Duck	*Aix sponsa*	H	Possible
Gadwall	*Anas strepera*	JE	Confirmed
American Wigeon	*Anas americana*	JE	Confirmed
American Black Duck	*Anas rubripes*	H	Possible
Mallard	*Anas platyrhynchos*	JE	Confirmed
Hooded Merganser	*Lophodytes cucullatus*	H	Possible
Common Merganser	*Mergus merganser*	JE	Confirmed
Red-breasted Merganser	*Mergus serrator*	JE	Confirmed
Wild Turkey	*Meleagris gallopavo*	JE	Confirmed
Pied-billed Grebe	*Podilymbus podiceps*	JE	Confirmed
Double-crested Cormorant	*Phalacrocorax auritus*	NJ	Confirmed
Least Bittern	*Ixobrychus exilis*	A	Probable
Great Blue Heron	*Ardea herodias*	NJ	Confirmed
Great Egret	*Ardea alba*	NJ	Confirmed
Green Heron	*Butorides virescens*	T	Probable
Black-crowned Night-Heron	*Nycticorax nycticorax*	NO	Confirmed
Turkey Vulture	*Cathartes aura*	JE	Confirmed
Osprey	*Pandion haliaetus*	H	Possible
Bald Eagle	*Haliaeetus leucocephalus*	NO	Confirmed
Cooper's Hawk	*Accipiter cooperii*	NJ	Confirmed
Red-shouldered Hawk	*Buteo lineatus*	NO	Confirmed
Red-tailed Hawk	*Buteo jamaicensis*	H	Possible
American Kestrel	*Falco sparverius*	JE	Confirmed
Merlin	*Falco columbarius*	NJ	Confirmed
Peregrine Falcon	*Falco peregrinus*	NJ	Confirmed
Virginia Rail	*Rallus limicola*	S	Possible
Killdeer	*Charadrius vociferus*	S	Possible
Spotted Sandpiper	*Actitis macularius*	NF	Confirmed
Ring-billed Gull	*Larus delawarensis*	NF	Confirmed
Herring Gull	*Larus argentatus*	P	Probable
Great Black-backed Gull	*Larus marinus*	NJ	Confirmed
Common Tern	*Sterna hirundo*	NJ	Confirmed
Rock Pigeon	*Columba livia*	NO	Confirmed
Mourning Dove	*Zenaida macroura*	T	Probable
Eastern Screech-Owl	*Megascops asio*	NO	Confirmed

Common Name	Scientific Name	Breeding Evidence Code	Breeding Status
Barred Owl	*Strix varia*	H	Possible
Common Nighthawk	*Chordeiles minor*	JE	Confirmed
Chimney Swift	*Chaetura pelagica*	NO	Confirmed
Belted Kingfisher	*Megaceryle alcyon*	H	Possible
Downy Woodpecker	*Picoides pubescens*	NO	Confirmed
Hairy Woodpecker	*Picoides villosus*	NO	Confirmed
Northern Flicker	*Colaptes auratus*	NO	Confirmed
Pileated Woodpecker	*Dryocopus pileatus*	T	Probable
Eastern Wood-Pewee	*Contopus virens*	S	Possible
Alder Flycatcher	*Empidonax alnorum*	T	Probable
Willow Flycatcher	*Empidonax traillii*	T	Probable
Least Flycatcher	*Empidonax minimus*	S	Possible
Eastern Phoebe	*Sayornis phoebe*	AT	Confirmed
Great Crested Flycatcher	*Myiarchus crinitus*	AT	Confirmed
Eastern Kingbird	*Tyrannus tyrannus*	JE	Confirmed
Yellow-throated Vireo	*Vireo flavifrons*	S	Possible
Warbling Vireo	*Vireo gilvus*	AT	Confirmed
Red-eyed Vireo	*Vireo olivaceus*	A	Probable
Blue Jay	*Cyanocitta cristata*	S	Possible
American Crow	*Corvus brachyrhynchos*	NJ	Confirmed
Common Raven	*Corvus corax*	S	Possible
Purple Martin	*Progne subis*	NJ	Confirmed
Tree Swallow	*Tachycineta bicolor*	NO	Confirmed
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	V	Probable
Cliff Swallow	*Petrochelidon pyrrhonota*	NJ	Confirmed
Barn Swallow	*Hirundo rustica*	JE	Confirmed
Black-capped Chickadee	*Poecile atricapillus*	AT	Confirmed
Tufted Titmouse	*Baeolophus bicolor*	T	Probable
White-breasted Nuthatch	*Sitta carolinensis*	S	Possible
Brown Creeper	*Certhia americana*	CN	Confirmed
Carolina Wren	*Thryothorus ludovicianus*	T	Probable
Winter Wren	*Troglodytes hiemalis*	JE	Confirmed
Marsh Wren	*Cistothorus palustris*	S	Possible
Hermit Thrush	*Catharus guttatus*	P	Probable
American Robin	*Turdus migratorius*	NJ	Confirmed
Gray Catbird	*Dumetella carolinensis*	AT	Confirmed
Northern Mockingbird	*Mimus polyglottos*	NJ	Confirmed

Common Name	Scientific Name	Breeding Evidence Code	Breeding Status
European Starling	*Sturnus vulgaris*	NJ	Confirmed
Cedar Waxwing	*Bombycilla cedrorum*	T	Probable
Yellow Warbler	*Setophaga petechia*	AT	Confirmed
Black-throated Green Warbler	*Setophaga virens*	S	Possible
American Redstart	*Setophaga ruticilla*	CN	Confirmed
Common Yellowthroat	*Geothlypis trichas*	AT	Confirmed
Chipping Sparrow	*Spizella passerina*	T	Probable
Savannah Sparrow	*Passerculus sandwichensis*	T	Probable
Song Sparrow	*Melospiza melodia*	AT	Confirmed
Swamp Sparrow	*Melospiza georgiana*	T	Probable
Northern Cardinal	*Cardinalis cardinalis*	JE	Confirmed
Indigo Bunting	*Passerina cyanea*	AT	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	AT	Confirmed
Common Grackle	*Quiscalus quiscula*	AT	Confirmed
Brown-headed Cowbird	*Molothrus ater*	JE	Confirmed
Baltimore Oriole	*Icterus galbula*	JE	Confirmed
House Finch	*Haemorhous mexicanus*	JE	Confirmed
American Goldfinch	*Spinus tristis*	NJ	Confirmed
House Sparrow	*Passer domesticus*	NJ	Confirmed

Breeding Evidence Codes:

POSSIBLE BREEDING

H: Species observed in suitable nesting habitat during its breeding season.

S: Individual singing or producing other sounds associated with breeding (e.g., calls or drumming) in suitable nesting habitat during the species' breeding season.

PROBABLE BREEDING

P: Pair observed in suitable nesting habitat during the species' breeding season.

T: Presumed territory based on the presence of an adult bird, whether producing sounds associated with breeding (e.g., song, other calls or drumming) or not, at the same place, in suitable nesting habitat, on at least two visits, one week or more apart, during the species' breeding season.

V: Bird visiting a probable nest site in suitable nesting habitat during the species' breeding season.

A: Agitated behaviour or alarm call of an adult in suitable nesting habitat during the species' breeding season.

CONFIRMED BREEDING

CN: Nest building, including the carrying of nesting material, by all species except wrens and woodpeckers.

JE: Recently fledged (nidicolous species) or downy (nidifugous species) young incapable of sustained flight.

NO: Adult occupying, leaving or entering a probable nest site (visible or not) and whose behaviour suggests the presence of an occupied nest.

AT: Adult carrying food for young.

NF: Nest containing one or more eggs.

NJ: Nest with one or more young (seen or heard).

Table 3 Bird Species Observed by Sector in 2012 Surveys (adapted from Dessau-Cima+ 2013)

Common Name	Scientific Name	Sector					
		Brossard Shore	Couvee Islands	Seaway Dyke	Île-des-Soeurs (east)	Île-des-Soeurs (west)	Montreal Island
Canada Goose	*Branta canadensis*				x		
Gadwall	*Anas strepera*	x				x	
Mallard	*Anas platyrhynchos*	x			x	x	
Double-crested Cormorant	*Phalacrocorax auritus*				x		
Great Blue Heron	*Ardea herodias*		x	x	x	x	x
Great Egret	*Ardea alba*					x	
Black-crowned Night-Heron	*Nycticorax nycticorax*	x		x		x	
Peregrine Falcon	*Falco peregrinus anatum*		x				
Killdeer	*Charadrius vociferus*	x					
Spotted Sandpiper	*Actitis macularius*					x	
Ring-billed gull	*Larus delawarensis*	x	x	x	x	x	
Herring Gull	*Larus argentatus*	x	x				
Great Black-backed Gull	*Larus marinus*			x	x		
Common Tern	*Sterna hirundo*		x		x		
Rock Pigeon	*Columba livia*	x		x			
Mourning Dove	*Zenaida macroura*				x		x
Chimney Swift	*Chaetura pelagica*						x
Downy Woodpecker	*Picoides pubescens*				x		x
Eastern Kingbird	*Tyrannus tyrannus*	x	x	x		x	x
Warbling Vireo	*Vireo gilvus*	x	x	x	x	x	x
Red-eyed Vireo	*Vireo olivaceus*	x		x			
American Crow	*Corvus brachyrhynchos*	x	x	x	x	x	
Tree Swallow	*Tachycineta bicolor*		x	x	x	x	x
Cliff Swallow	*Petrochelidon pyrrhonota*	x	x	x	x	x	x

Common Name	Scientific Name	Sector					
		Brossard Shore	Couvee Islands	Seaway Dyke	Île-des-Soeurs (east)	Île-des-Soeurs (west)	Montreal Island
American Robin	*Turdus migratorius*	x		x	x	x	x
Gray Catbird	*Dumetella carolinensis*		x	x			
European Starling	*Sturnus vulgaris*		x	x	x	x	
Cedar Waxwing	*Bombycilla cedrorum*	x	x	x		x	x
Yellow Warbler	*Dendroica petechia*	x	x	x	x	x	x
Black-throated Blue Warbler	*Dendroica caerulescens*	x				x	
American Redstart	*Setophaga ruticilla*						x
Common Yellowthroat	*Geothlypis trichas*	x					
Song Sparrow	*Melospiza melodia*	x	x	x	x	x	x
Swamp Sparrow	*Melospiza georgiana*	x					
Northern Cardinal	*Cardinalis cardinalis*	x					
Red-winged Blackbird	*Agelaius phoeniceus*	x	x	x	x	x	x
Common Grackle	*Quiscalus quiscula*					x	x
Brown-headed Cowbird	*Molothrus ater*					x	x
Baltimore Oriole	*Icterus galbula*		x	x	x		x
House Finch	*Carpodacus mexicanus*						x
American Goldfinch	*Spinus tristis*	x	x		x	x	x

Table 4 Species Reported in the Montreal Christmas Bird Count, 1931 to 2015 (Source: National Audubon Society 2016)

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
Snow Goose	*Chen caerulescens*	7	5.46	0	251
Brant	*Branta bernicla*	1	0.01	0	1
Cackling Goose	*Branta hutchinsii*	1	0.04	0	3
Canada Goose	*Branta canadensis*	26	175.42	0	4184
Mute Swan	*Cygnus olor*	1	0.01	0	1
Wood Duck	*Aix sponsa*	8	0.15	0	2
Gadwall	*Anas strepera*	30	7.55	0	115
American Wigeon	*Anas americana*	41	11.20	0	150
American Black Duck	*Anas rubripes*	68	308.30	0	1575
Mallard	*Anas platyrhynchos*	66	468.64	0	3835
Mallard (Domestic type)	*Anas platyrhynchos*	1	0.04	0	3
American Black Duck x Mallard (hybrid)	*Anas rubripes x platyrhynchos*	3	0.09	0	5
Blue-winged Teal	*Anas discors*	1	0.01	0	1
Northern Shoveler	*Anas clypeata*	1	0.01	0	1
Northern Pintail	*Anas acuta*	54	31.16	0	217
Green-winged Teal	*Anas carolinensis*	4	0.08	0	2
Canvasback	*Aythya valisineria*	11	0.46	0	12
Redhead	*Aythya americana*	11	0.28	0	5
Ring-necked Duck	*Aythya collaris*	13	0.99	0	50
Greater Scaup	*Aythya marila*	49	69.03	0	1425
Lesser Scaup	*Aythya affinis*	32	30.95	0	1502
Greater/Lesser Scaup	*Aythya sp.*	10	0.79	0	17
Harlequin Duck	*Histrionicus histrionicus*	10	0.14	0	2
Surf Scoter	*Melanitta perspicillata*	3	0.06	0	2
White-winged Scoter	*Melanitta fusca*	13	0.76	0	37
Black Scoter	*Melanitta americana*	7	0.09	0	1
Long-tailed Duck	*Clangula hyemalis*	10	0.27	0	5

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
Bufflehead	*Bucephala albeola*	19	0.47	0	5
Common Goldeneye	*Bucephala clangula*	80	571.71	2	2423
Barrow's Goldeneye	*Bucephala islandica*	16	0.35	0	5
Hooded Merganser	*Lophodytes cucullatus*	36	6.63	0	106
Common Merganser	*Mergus merganser*	77	161.41	0	1316
Red-breasted Merganser	*Mergus serrator*	30	4.53	0	120
merganser sp.	*Mergellus/Lophodytes/Mergus sp.*	1	0.03	0	2
Ruddy Duck	*Oxyura jamaicensis*	cw	0.00	0	0
duck sp.	*Anatinae sp.*	6	16.20	0	501
Northern Bobwhite	*Colinus virginianus*	cw	0.00	0	0
Ring-necked Pheasant	*Phasianus colchicus*	38	21.09	0	143
Gray Partridge	*Perdix perdix*	43	42.70	0	400
Ruffed Grouse	*Bonasa umbellus*	53	2.73	0	15
Wild Turkey	*Meleagris gallopavo*	1	0.19	0	15
Red-throated Loon	*Gavia stellata*	4	0.05	0	1
Common Loon	*Gavia immer*	24	0.78	0	7
Pied-billed Grebe	*Podilymbus podiceps*	7	0.11	0	2
Horned Grebe	*Podiceps auritus*	3	0.05	0	2
Red-necked Grebe	*Podiceps grisegena*	4	0.05	0	1
Northern Gannet	*Morus bassanus*	cw	0.00	0	0
Double-crested Cormorant	*Phalacrocorax auritus*	27	2.01	0	75
Great Blue Heron	*Ardea herodias*	14	0.38	0	6
Black-crowned Night-Heron	*Nycticorax nycticorax*	2	0.03	0	1
Northern Harrier	*Circus cyaneus*	12	0.27	0	7
Sharp-shinned Hawk	*Accipiter striatus*	26	0.70	0	6
Cooper's Hawk	*Accipiter cooperii*	23	1.17	0	14
Northern Goshawk	*Accipiter gentilis*	28	0.58	0	5
Accipiter sp.	*Accipiter sp.*	4	0.08	0	2
Bald Eagle	*Haliaeetus leucocephalus*	7	0.10	0	2
Red-shouldered Hawk	*Buteo lineatus*	3	0.04	0	1

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
Red-tailed Hawk	*Buteo jamaicensis*	33	3.11	0	28
Rough-legged Hawk	*Buteo lagopus*	55	2.64	0	32
Common Gallinule	*Gallinula galeata*	cw	0.00	0	0
American Coot	*Fulica americana*	3	0.04	0	1
Purple Sandpiper	*Calidris maritima*	1	0.01	0	1
Thick-billed Murre	*Uria lomvia*	2	0.26	0	15
Atlantic Puffin	*Fratercula arctica*	cw	0.00	0	0
Black-legged Kittiwake	*Rissa tridactyla*	1	0.01	0	1
Ivory Gull	*Pagophila eburnea*	cw	0.00	0	0
Bonaparte's Gull	*Chroicocephalus philadelphia*	1	0.05	0	4
Black-headed Gull	*Chroicocephalus ridibundus*	1	0.01	0	1
Little Gull	*Hydrocoloeus minutus*	1	0.01	0	1
Laughing Gull	*Leucophaeus atricilla*	2	0.03	0	1
Mew Gull	*Larus canus*	3	0.04	0	1
Ring-billed Gull	*Larus delawarensis*	56	362.04	0	8260
Herring Gull	*Larus argentatus*	74	1302.83	0	9731
Thayer's Gull	*Larus thayeri*	5	0.08	0	2
Iceland Gull	*Larus glaucoides*	49	3.18	0	64
Lesser Black-backed Gull	*Larus fuscus*	7	0.11	0	3
Glaucous Gull	*Larus hyperboreus*	41	3.13	0	69
Great Black-backed Gull	*Larus marinus*	69	333.13	0	1839
gull sp.	*Larinae sp.*	12	4.25	0	101
Rock Pigeon	*Columba livia*	42	888.99	0	4816
Mourning Dove	*Zenaida macroura*	42	43.04	0	253
Eastern Screech-Owl	*Megascops asio*	33	1.75	0	15
screech-owl sp.	*Megascops sp.*	25	0.67	0	7
Great Horned Owl	*Bubo virginianus*	55	1.88	0	11
Snowy Owl	*Bubo scandiacus*	46	1.75	0	10
Northern Hawk Owl	*Surnia ulula*	7	0.09	0	1
Barred Owl	*Strix varia*	24	0.38	0	4

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
Great Gray Owl	*Strix nebulosa*	2	0.05	0	3
Long-eared Owl	*Asio otus*	13	0.18	0	2
Short-eared Owl	*Asio flammeus*	24	0.64	0	8
Boreal Owl	*Aegolius funereus*	1	0.01	0	1
Northern Saw-whet Owl	*Aegolius acadicus*	9	0.15	0	3
Belted Kingfisher	*Megaceryle alcyon*	11	0.20	0	3
Red-bellied Woodpecker	*Melanerpes carolinus*	11	0.20	0	3
Yellow-bellied Sapsucker	*Sphyrapicus varius*	cw	0.00	0	0
Downy Woodpecker	*Picoides pubescens*	79	37.47	cw	143
Hairy Woodpecker	*Picoides villosus*	77	18.18	0	70
American Three-toed Woodpecker	*Picoides dorsalis*	10	0.22	0	4
Black-backed Woodpecker	*Picoides arcticus*	10	0.18	0	3
Northern Flicker	*Colaptes auratus*	51	2.30	0	14
Pileated Woodpecker	*Dryocopus pileatus*	33	1.80	0	18
American Kestrel	*Falco sparverius*	63	4.44	0	23
Merlin	*Falco columbarius*	19	0.68	0	10
Gyrfalcon	*Falco rusticolus*	1	0.01	0	1
Peregrine Falcon	*Falco peregrinus*	20	0.72	0	6
falcon sp.	*Falco sp.*	3	0.04	0	1
Eastern Phoebe	*Sayornis phoebe*	1	0.01	0	1
Northern Shrike	*Lanius excubitor*	52	1.83	0	10
Gray Jay	*Perisoreus canadensis*	4	0.05	0	1
Blue Jay	*Cyanocitta cristata*	59	17.41	0	64
American Crow	*Corvus brachyrhynchos*	77	917.89	0	9149
Common Raven	*Corvus corax*	19	3.04	0	150
Horned Lark	*Eremophila alpestris*	22	6.97	0	119
Black-capped Chickadee	*Poecile atricapillus*	79	231.89	0	876
chickadee sp.	*Poecile sp.*	1	0.41	0	33
Tufted Titmouse	*Baeolophus bicolor*	12	0.55	0	8
Red-breasted Nuthatch	*Sitta canadensis*	24	0.90	0	12

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
White-breasted Nuthatch	*Sitta carolinensis*	76	31.19	0	146
Brown Creeper	*Certhia americana*	75	12.66	0	39
House Wren	*Troglodytes aedon*	cw	0.00	0	0
Winter Wren	*Troglodytes hiemalis*	25	0.48	0	5
Carolina Wren	*Thryothorus ludovicianus*	18	0.54	0	5
Golden-crowned Kinglet	*Regulus satrapa*	31	2.08	0	36
Ruby-crowned Kinglet	*Regulus calendula*	10	0.16	0	3
Eastern Bluebird	*Sialia sialis*	3	0.19	0	7
Townsend's Solitaire	*Myadestes townsendi*	1	0.01	0	1
Hermit Thrush	*Catharus guttatus*	13	0.20	0	2
American Robin	*Turdus migratorius*	68	64.43	0	1064
thrush sp.	*Turdidae sp.*	1	0.01	0	1
Gray Catbird	*Dumetella carolinensis*	3	0.04	0	1
Brown Thrasher	*Toxostoma rufum*	4	0.05	0	1
Northern Mockingbird	*Mimus polyglottos*	29	0.62	0	5
European Starling	*Sturnus vulgaris*	80	1844.71	27	14000
Bohemian Waxwing	*Bombycilla garrulus*	20	32.66	0	1417
Cedar Waxwing	*Bombycilla cedrorum*	39	15.52	0	210
Bohemian/Cedar Waxwing	*Bombycilla garrulus/cedrorum*	1	0.03	0	2
Lapland Longspur	*Calcarius lapponicus*	4	0.14	0	4
Snow Bunting	*Plectrophenax nivalis*	65	97.21	0	740
Ovenbird	*Seiurus aurocapilla*	cw	0.00	0	0
Orange-crowned Warbler	*Oreothlypis celata*	3	0.04	0	1
Nashville Warbler	*Oreothlypis ruficapilla*	2	0.03	0	1
Common Yellowthroat	*Geothlypis trichas*	4	0.05	0	1
Yellow Warbler	*Setophaga petechia*	cw	0.00	0	0
Black-throated Blue Warbler	*Setophaga caerulescens*	1	0.01	0	1
Pine Warbler	*Setophaga pinus*	4	0.05	0	1
Yellow-rumped Warbler	*Setophaga coronata*	10	0.20	0	3
Black-throated Gray Warbler	*Setophaga nigrescens*	1	0.01	0	1

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
Wilson's Warbler	*Cardellina pusilla*	1	0.01	0	1
warbler sp.	*Parulidae sp.*	2	0.03	0	1
American Tree Sparrow	*Spizelloides arborea*	62	47.51	0	170
Chipping Sparrow	*Spizella passerina*	1	0.01	0	1
Field Sparrow	*Spizella pusilla*	1	0.03	0	2
Dark-eyed Junco	*Junco hyemalis*	46	23.52	0	175
White-crowned Sparrow	*Zonotrichia leucophrys*	4	0.05	0	1
Harris's Sparrow	*Zonotrichia querula*	1	0.01	0	1
White-throated Sparrow	*Zonotrichia albicollis*	38	2.45	0	29
Song Sparrow	*Melospiza melodia*	59	5.87	0	31
Lincoln's Sparrow	*Melospiza lincolnii*	cw	0.00	0	0
Swamp Sparrow	*Melospiza georgiana*	9	0.14	0	2
Eastern Towhee	*Pipilo erythrophthalmus*	3	0.04	0	1
Northern Cardinal	*Cardinalis cardinalis*	45	31.66	0	204
Red-winged Blackbird	*Agelaius phoeniceus*	42	3.96	0	122
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	1	0.01	0	1
Rusty Blackbird	*Euphagus carolinus*	4	0.05	0	1
Common Grackle	*Quiscalus quiscula*	22	0.77	0	16
Brown-headed Cowbird	*Molothrus ater*	22	33.14	0	1600
Baltimore Oriole	*Icterus galbula*	2	0.03	0	1
blackbird sp.	*Icteridae sp.*	3	0.71	0	41
Pine Grosbeak	*Pinicola enucleator*	43	14.12	0	206
House Finch	*Haemorhous mexicanus*	32	52.19	0	421
Purple Finch	*Haemorhous purpureus*	28	1.78	0	45
Red Crossbill	*Loxia curvirostra*	3	0.83	0	63
White-winged Crossbill	*Loxia leucoptera*	8	0.70	0	35
crossbill sp.	*Loxia sp.*	1	0.25	0	20
Common Redpoll	*Acanthis flammea*	52	63.35	0	537
Hoary Redpoll	*Acanthis hornemanni*	7	0.16	0	4
Pine Siskin	*Spinus pinus*	20	3.37	0	55

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed		
			Average	Min	Max
American Goldfinch	*Spinus tristis*	55	67.81	0	439
European Goldfinch	*Carduelis carduelis*	1	0.01	0	1
Evening Grosbeak	*Coccothraustes vespertinus*	27	11.36	0	214
finch sp.	*Fringillidae sp.*	1	0.13	0	10
House Sparrow	*Passer domesticus*	74	1047.76	0	2794

Note: 1. Out of a total of 80 CBCs conducted between 1931 and 2015. "cw" denotes that a species was observed during the week of the count, but not on the count day itself. Number of individuals is not recorded for Count Week species.

Appendix 7

Technical report – Acoustic environment

Revue du climat sonore ambiant pour le Pont Champlain

Société des Ponts Jacques-Cartier Champlain inc.

Rapport réalisé pour :

Tetra Tech

Préparé par :

Pierre-Claude Ostiguy, ing. jr., Ph. D.

Anthony Gérard, ing., Ph. D.

Soft dB

Janvier 2017

Dossier : 16-09-08-AG

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1 Contexte

Soft dB inc. a été mandaté par Tetra Tech pour faire une revue des informations disponibles publiquement sur le climat sonore aux abords du pont Champlain, en vue de sa déconstruction. Deux secteurs potentiellement sensibles sont à l'étude, soit L'Île-des-Sœurs et Brossard (voir Figure 1).

Figure 1: Abords du pont Champlain (secteurs d'intérêts encadrés en orange)

2 Objectif

L'objectif de l'étude est de faire une revue des informations disponibles sur le climat sonore ambiant près du pont Champlain, et de déterminer si les informations trouvées permettraient d'établir les cibles acoustiques à respecter en phase destruction du pont Champlain.

3 Documents de référence

L'évaluation est basée sur les documents publics suivants :

- Transports Canada (mars 2013). *Un nouveau pont pour le Saint-Laurent : évaluation environnementale, première partie, sections 1 à 4*, 574 p.
- Signature sur le Saint-Laurent (3 février 2016). *Gestion du bruit : rencontre du comité de bon voisinage des arrondissements Verdun / Sud-Ouest, projet de corridor du nouveau pont Champlain*, 36 p.
- Signature sur le Saint-Laurent (8 juin 2015). *Rencontre d'information publique – centre communautaire Elgar, Île-des-Sœurs, Verdun*. 37 p.
- Signature sur le Saint-Laurent (14 octobre 2015). *Rencontre d'information publique – projet du corridor du pont Champlain – centre socioculturel de Brossard,* 43 p.
- Transport Québec (2008-10-30). *Mesures d'atténuation environnementales temporaires*, tome 2, chapitre 9, 40 p.

4 Réglementation et lexique

4.1 Lexique

- $LA_{eq,T}$: Niveau de pression acoustique continue équivalent pour une période de mesure *T*, considérant une pondération fréquentielle de type A. La pondération A permet de tenir compte de la sensibilité de l'oreille humaine;
- $L_{10\%}$: Niveau acoustique dépassé 10% du temps durant la période de mesures;
- L_{max} : Niveau sonore maximum mesuré durant une période.

4.2 Réglementations pour les bruits de chantier

4.2.1 Réglementation provinciale sur les bruits de chantier selon le Ministère du Développement Durable, de l'Environnement et de la Lutte contre les Changements Climatiques, MDDELCC[1]

Pour la période de jour, comprise entre 7 h et 19 h, le MDDELCC a pour politique que toutes les mesures raisonnables et faisables doivent être prises par le maître d'œuvre pour que le niveau acoustique d'évaluation $LA_{eq,12h}$ provenant du chantier de construction soit égal ou inférieur au plus élevé des niveaux sonores suivant, soit 55 dBA ou le niveau de bruit initial s'il est supérieur à 55 dBA. Cette limite s'applique en tout point de réception dont l'occupation est résidentielle ou l'équivalent.

Pour les périodes de soirée (19h à 22h) et de nuit (22h à 7h), tout niveau acoustique d'évaluation sur une heure, $LA_{eq,1h}$, provenant d'un chantier de construction doit être égal ou inférieur au plus élevé des niveaux sonores suivants, soit 45 dBA ou le niveau de bruit initial s'il est supérieur à 45 dBA.

La nuit (22h à 7h), afin de protéger le sommeil, aucune dérogation à ces limites ne peut être jugée acceptable (sauf en cas d'urgence ou de nécessité absolue). Toutefois, pour les trois heures en soirée (19h à 22h), lorsque la situation le justifie, le niveau acoustique d'évaluation $LA_{eq,3h}$ peut atteindre 55 dBA peu importe le niveau initial à la condition de justifier ces dépassements conformément aux exigences du MDDELCC.

[1] Source : Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction industriel, voir extrait à l'annexe B

4.2.2 Niveaux recommandés par le Ministère des Transports, de la Mobilité durable et de l'Électrification des transports (MTMDET) pour les bruits de chantier

En règle générale, les chantiers de construction routiers sont soumis à la politique du MTMDET. Le tableau 3 présente les seuils à respecter recommandés en phase construction par le MTMDET, selon les types de zones à proximité des travaux.

Tableau 1: Seuils recommandés par le MTMDET à respecter en phase construction

		Niveaux sonores à ne pas dépasser (dBA) (bruit ambiant et chantier combiné)					
		Jour (de 7h à 19h)		Soir (de 19h à 23h)		Nuit (de 23h à 7h)	
Zone	**Zone et utilisation du sol**	L_{10}	L_{max}	L_{10}	L_{max}	L_{10}	L_{max}
1	Zones sensibles au bruit : habitations, établissements hospitaliers et scolaires, parcs, hôtels, etc.	75 ou bruit ambiant +5*	85 ou 90 pour un bruit d'impact**	Bruit ambiant +5	85	Bruit ambiant +5 (si bruit ambiant <70) Bruit ambiant+3 (si bruit ambiant >70)	80
2	Zones commerciales : immeubles de bureaux, commerces, etc.	80 ou bruit ambiant +5*	Aucun	Bruit ambiant +5***	Aucun	Aucun	Aucun
3	Zones industrielles : usines, ateliers, etc.	85 ou bruit ambiant +5	Aucun	Aucun	Aucun	Aucun	Aucun

** Le plus élevé des deux devient le niveau sonore à ne pas dépasser*
*** Le bruit d'impact est un bruit intermittent dont l'intensité s'élève rapidement*
**** Si applicable, pendant les heures d'ouverture des commerces*

Également, selon la documentation du MTMDET :

Le bruit ambiant doit être établi avant le début des travaux à partir d'au moins deux relevés sonores de 24 heures, effectués pendant la semaine de façon non consécutive, à des localisations représentatives le long de la zone des travaux.

Le bruit ambiant doit être évalué pour la période de jour (de 7h à 19h), de soir (de 19h à 23h) et de nuit (de 23h à 7h). Il est à noter que la mesure du bruit ambiant ne doit pas se faire à l'intérieur de l'emprise requise pour les travaux.

Les niveaux sonores maximaux recommandés sont mesurés à 5 m du bâtiment à protéger (habitation, école, hôpital, etc.) ou à la limite de propriété, si le bâtiment est situé à moins de 5 m de la route où sont effectués les travaux.

Les seuils à respecter s'appliquent au rez-de-chaussée ainsi qu'aux étages des bâtiments à protéger.

En résumé, les mesures fournies dans les documents évalués doivent répondre aux critères suivants :

1. La mesure du climat sonore ambiant doit être faite pour deux périodes complètes et non consécutives de 24 heures;
2. Les mesures doivent être prises durant la semaine;
3. Le niveau LAeq obtenu pour les deux périodes de nuit (23h à 7h) doit être utilisé comme référence de nuit, auquel est ajouté 3 ou 5 dB de cible selon le niveau de bruit ambiant mesuré;
4. Le niveau LAeq obtenu pour les deux périodes de soir (19h à 23h) doit être utilisé comme référence de soir, auquel est ajouté 5 dB.
5. Le niveau LAeq obtenu pour les deux périodes de jour (7h-19h) doit être utilisé comme référence de jour, auquel est ajouté 5 dB. Le niveau obtenu après addition doit être considéré comme la limite seulement si celui-ci dépasse 75 dBA, sans quoi la limite de jour est de 75 dBA.

5 Revue de la littérature publique sur les niveaux sonores aux abords du pont Champlain

Pour les travaux routiers, les limites de bruit recommandées par le MTMDET sont généralement considérées comme cibles à respecter. En ce sens, une revue exhaustive des rapports publics trouvés présentant des informations sur le climat sonore aux abords du pont Champlain a été effectuée. Pour le moment, seulement deux projets potentiellement pertinents, décrivant les niveaux sonores aux abords du pont Champlain, ont été trouvés :

- Transports Canada - un nouveau pont pour le Saint-Laurent : évaluation environnementale, première partie, sections 1 à 4;
- Documents publics de Signature sur le Saint-Laurent sur le climat sonore avant la construction du nouveau pont Champlain.

5.1 Description des études

L'étude de Transports Canada est une étude environnementale qui évalue l'impact sonore du bruit de circulation après la construction du nouveau pont Champlain. Basée sur des mesures du climat sonore et du comptage routier, une projection du bruit après construction du nouveau pont est effectuée et permet d'évaluer la nécessité d'installer des mesures d'atténuation fixes le long des nouveaux axes routiers.

L'étude de Signature sur le Saint-Laurent (SSL) consiste à évaluer l'impact du bruit associé à la construction du nouveau pont Champlain sur les secteurs potentiellement sensibles entourant la zone des travaux. Cette étude se concentre sur des secteurs à Brossard, à L'Île-des-Sœurs et à Montréal. Néanmoins, seules des présentations publiques ont été trouvées et peu de détails sur la procédure précise de mesures sont disponibles.

5.2 Position des points de mesures

La Figure 2 et la Figure 3 montrent la position des zones où des mesures du climat sonore ont été faites. Les points en jaune sont les points de mesures provenant des documents de SSL (la position exacte du point de mesures est inconnue), et les points de mesures en vert proviennent de l'étude de Transports Canada (position exacte des points de mesures).

Figure 2: Secteurs où des mesures ont été effectuées (Île-des-Sœurs)

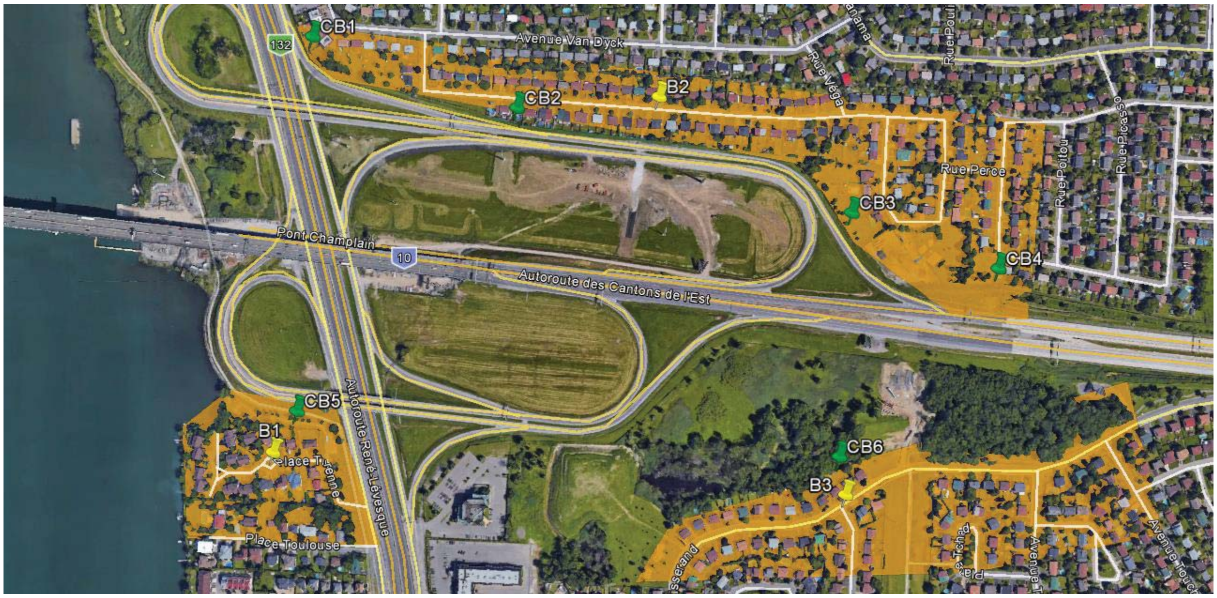

Figure 3: Secteurs où des mesures ont été effectuées (Brossard)

5.3 Niveaux mesurés

Le Tableau 2 présente les critères de bruit extraits des documents publics de SSL, tandis que le Tableau 3 présente les niveaux sonores mesurés extraits du document de Transports Canada.

Tableau 2: Niveaux sonores provenant des documents publics de SSL

	Critère de bruit $LA_{10\%}$		
Identification	**Jour**	**Soir**	**Nuit**
B2	75	67	63
B3	75		
B1	75		
I1	75	58*	59*
I2	75	64*	62*/56***
I3	75	57*	57**/62***

** Rencontre du comité de bon voisinage du 3 février 2016*
*** Registre des suivis sonores – 2015*
**** Critères présentés lors de la rencontre publique du 8 juin 2015 (possiblement des niveaux mesurés sur des périodes de 12 heures et non sur les périodes recommandées du MTMDET)*

Tableau 3: Niveaux sonores provenant du rapport de Transports Canada (dBA)

Identification	Adresse	Durée de la mesure	Niveau mesurés $LA_{eq,T}$
CI1	210-230 Chemin du Golf	3h	55,9
CB1	477 Avenue Van Dick	1h	71,5
CB2	485 Avenue Voltaire	24h	63,2
CB3	6560 Rue Villon	3h	64,3
CB4	6850 Rue Pinard	1h	62,1
CB5	7010 Place Turenne	24h	62
CB6	6165 Avenue Tisserand	1h	54,4

6 Interprétation des résultats et recommandations

6.1 Étude de Transports Canada

Pour les mesures acoustiques de l'étude de Transports Canada, l'objectif était d'évaluer le climat sonore et prédire l'impact du nouveau pont Champlain sur les niveaux sonores à Brossard, à L'Île-des-Sœurs et à Montréal.

Pour se faire, des relevés 24h ont été pris pour estimer les niveaux sonores actuels et des mesures ponctuelles de courte durée, de jour, ont été prises à différentes positions dans les secteurs résidentiels potentiellement impactés.

Les niveaux sonores mesurés et les mesures de comptage ont été utilisés pour prédire le bruit de la circulation routière en 2026. Par contre, les mesures effectuées ne permettent pas d'établir les cibles à respecter pour les raisons suivantes :

- Les niveaux sonores ne sont pas présentés selon les périodes nécessaires pour l'évaluation du bruit de chantier de construction (jour/soir/nuit);
- Les mesures n'ont pas été faites pour deux périodes de 24 heures non consécutives.

Ces données ne peuvent donc pas être utilisées pour établir les critères de bruit de soir et de nuit pour le chantier de démolition du pont Champlain.

6.2 Étude de Signature sur le Saint-Laurent (SSL)

L'étude de bruit de SSL avait pour objectif d'établir les cibles à respecter durant la construction du nouveau pont Champlain. Ces mesures ont été prises dans des secteurs près du pont Champlain à L'Île-des-Sœurs et à Brossard.

Les informations publiques récupérées proviennent de présentations qui ont été faites par SSL. Bien que ces présentations contiennent des éléments intéressants sur le climat sonore avant travaux, il est recommandé que des informations supplémentaires soient obtenues sur ces mesures avant que celles-ci ne puissent être considérées comme utilisables dans le cadre du projet:

- La position exacte des points de mesures n'est pas connue, seulement les niveaux dans les secteurs donnés;
- La méthodologie utilisée pour prendre les mesures ne semble pas présentée publiquement (2* 24 heures, dates de mesures, adresses, distances par rapport aux murs, position par rapport aux futurs travaux de destruction du pont Champlain);
- Certaines données sont manquantes pour établir l'ensemble des critères sonores à respecter (Brossard);
- La classe et le type d'équipements de mesures ne sont pas présentés.

7 Conclusion

À la demande de PJCCI et de Tetra Tech, Soft dB a effectué une revue de la littérature publique disponible sur le climat sonore près du pont Champlain.

Selon les informations recueillies et analysées, les données du rapport de Transports Canada ne peuvent être utilisées pour établir les critères à respecter pour le chantier de construction. L'objectif de cette étude était de prédire la variation des niveaux sonores associés au nouveau pont Champlain et au trafic, et non d'établir des cibles sonores pour des travaux de construction.

En conclusion, pour les données provenant de SSL, trop d'informations sont manquantes sur la méthodologie suivie, la position des points de mesures et les équipements de mesures utilisés pour pouvoir confirmer que ces valeurs pourraient être utilisées (voir section 6). Également, quelques données clés sont manquantes pour les périodes de soir et de nuit à Brossard. L'obtention des informations supplémentaires permettrait de déterminer si ces mesures pourraient être utilisées pour le présent projet.

Nous recommandons qu'une campagne de mesures soit effectuée conformément aux recommandations du MTMDET, afin de s'assurer que l'ensemble des critères soit respecté et que les niveaux sonores mesurés soient les plus représentatifs possible du climat sonore aux abords du pont Champlain dans les secteurs sensibles.

ANNEXE A – Extraits des règlements sur les niveaux sonores pour les chantiers (MTMDET et MDDELCC)

Développement durable, Environnement et Lutte contre les changements climatiques
Québec

Lignes directrices relativement aux niveaux sonores provenant d'un chantier de construction industriel

1. Pour le jour

Pour la période du jour comprise entre 7 h et 19 h, le MDDELCC a pour politique que toutes les mesures raisonnables et faisables doivent être prises par le maître d'œuvre pour que le niveau acoustique d'évaluation ($L_{Ar,\,12h}$)[1] provenant du chantier de construction soit égal ou inférieur au plus élevée des niveaux sonores suivants, soit 55 dB ou le niveau de bruit initial s'il est supérieur à 55 dB. Cette limite s'applique en tout point de réception dont l'occupation est résidentielle ou l'équivalent (hôpital, institution, école).

On convient cependant qu'il existe des situations où les contraintes sont telles que le maître d'œuvre ne peut exécuter les travaux tout en respectant ces limites. Le cas échéant, le maître d'œuvre est requis de:

a) prévoir le plus en avance possible ces situations, les identifier et les circonscrire;

b) préciser la nature des travaux et les sources de bruit mises en cause;

c) justifier les méthodes de construction utilisées par rapport aux alternatives possibles;

d) démontrer que toutes les mesures raisonnables et faisables sont prises pour réduire au minimum l'ampleur et la durée des dépassements;

e) estimer l'ampleur et la durée des dépassements prévus;

f) planifier des mesures de suivi afin d'évaluer l'impact réel de ces situations et de prendre les mesures correctrices nécessaires.

2. Pour la soirée et la nuit

Pour les périodes de soirée (19 h à 22 h) et de nuit (22 h à 7 h), tout niveau acoustique d'évaluation sur une heure ($L_{Ar,1\,h}$) provenant d'un chantier de construction doit être égal ou inférieur au plus élevé des niveaux sonores suivants, soit 45 dB ou le niveau de bruit initial s'il est supérieur à 45 dB. Cette limite s'applique en tout point de réception dont l'occupation est résidentielle ou l'équivalent (hôpital, institution, école).

La nuit (22 h à 7 h), afin de protéger le sommeil, aucune dérogation à ces limites ne peut être jugée acceptable (sauf en cas d'urgence ou de nécessité absolue). Pour les trois heures en soirée toutefois (19 h à 22 h), lorsque la situation[2] le justifie, le niveau acoustique d'évaluation $L_{Ar,3\,h}$ peut atteindre 55 dB peu importe le niveau initial à la condition de justifier ces dépassements conformément aux exigences « a » à « f » telles qu'elles sont décrites à la section 1.

---

[1] Le niveau acoustique d'évaluation $L_{Ar,T}$ (où T est la durée de l'intervalle de référence) est un indice de l'exposition au bruit qui contient niveau de pression acoustique continu équivalent $L_{Aeq,T}$, auquel on ajoute le cas échéant un ou plusieurs termes correctifs pour des appréciations subjectives du type de bruit. Pour plus de détail concernant l'application des termes correctifs, consulter la Note d'instructions 98-01 sur le bruit.

[2] C'est-à-dire lorsque les contraintes sont telles que le maître d'œuvre ne peut exécuter les travaux tout en respectant les limites mentionnées au paragraphe précédent pour la soirée et la nuit.

Version du 27 mars 2015

Tableau 9.9–1
Niveaux sonores maximaux recommandés en bordure des zones à protéger

Zone et utilisation du sol	Niveaux sonores à ne pas dépasser (dBA) (bruit ambiant et chantier combinés)					
	Jour (de 7 h à 19 h)		Soir (de 19 h à 23 h)		Nuit (de 23 h à 7 h)	
	L_{10}	L_{max}	L_{10}	L_{max}	L_{10}	L_{max}
Zones sensibles au bruit : habitations, établissements hospitaliers et scolaires, parcs, hôtels, etc.	75 ou bruit ambiant + 5[1]	85 ou 90 pour un bruit d'impact [2]	Bruit ambiant + 5	85	Bruit ambiant + 5 (si bruit ambiant < 70) Bruit ambiant + 3 (si bruit ambiant ≥ 70)	80
Zones commerciales : immeubles de bureaux, commerces, etc.	80 ou bruit ambiant + 5[1]	aucun	Bruit ambiant + 5[3]	aucun	aucun	aucun
Zones industrielles : usines, ateliers, etc.	85 ou bruit ambiant + 5[1]	aucun	aucun	aucun	aucun	aucun

1. Le plus élevé des deux devient le niveau sonore à ne pas dépasser.
2. Le bruit d'impact est un bruit intermittent dont l'intensité s'élève rapidement.
3. Si applicable, pendant les heures d'ouverture des commerces.

Le bruit ambiant doit être établi avant le début des travaux à partir d'au moins deux relevés sonores de 24 heures, effectués pendant la semaine de façon non consécutive, à des localisations représentatives le long de la zone des travaux. Le bruit ambiant doit être évalué pour la période de jour (de 7 h à 19 h), le soir (de 19 h à 23 h) et la nuit (de 23 h à 7 h). Il est à noter que la mesure du bruit ambiant ne doit pas se faire à l'intérieur de l'emprise requise pour les travaux.

Notes :

Le L_{10} mesuré est moyenné sur une période de 30 minutes. Le L_{max} mesuré représente la valeur maximale d'une émission sonore en dBA. Le temps de mesure est en général d'une seconde.

L'appareil de mesure utilisé est un sonomètre intégrateur de classe 1, conforme à la norme ANSI 5.1.4 – 1983 (R 1990) « Specification for sound level meters ». Les méthodes et conditions de mesure devront être conformes à celles spécifiées au document *Measurement of Highway-Related Noise*, mai 1996, de la FHWA (FHWA-PD-96-046).

Les niveaux sonores maximaux recommandés sont mesurés à 5 m du bâtiment à protéger (habitation, école, hôpital, etc.) ou à la limite de propriété, si le bâtiment est situé à moins de 5 m de la route où sont effectués les travaux. Les seuils à respecter s'appliquent au rez-de-chaussée ainsi qu'aux étages des bâtiments à protéger. La limite imposée la nuit ne s'applique pas près d'un établissement scolaire.

Le tableau 9.9–2 présente les niveaux sonores maximaux recommandés pour un certain type d'équipement utilisé sur un chantier. Il s'agit des niveaux sonores maximaux qui s'appliquent à des classes particulières d'équipements dans le but de limiter les émissions sonores à la source.

ANNEXE B – Informations extraites des rapports évalués

Figure 4: Position des points de mesures (selon les documents publics de SSL)

Figure 5: Position des points de mesures (selon les documents publics de SSL)

Tableau 4: Documents publics - étude du bon voisinage du 14 octobre 2015

Activité	Période de travail (J / S / N)	Zone sensible la plus exposée	Bruit ambiant en dba (J / S / N)	Critère en dba (J / S / N)	Bruit estimé en dba	Mesures d'atténuation particulière
Construction de la jetée est et installations de chantier de l'approche est	J / S / N	B2	62 / 62 / 58	75 / 67 / 63	67	Non*
Déviation de la conduite d'aqueduc	J	B2	62	75	73	Non
Construction d'un mur temporaire - culée est	J	B2	62	75	82	Oui
Terrassement de l'approche est	J	B3	58	75	68	Non
Concassage	J	B1	60	75	68	Non

Tableau 5: Rencontre d'informations publiques - 14 septembre 2015

signature SUR LE SAINT-LAURENT

Niveaux de bruit ambiant / estimés

Jour

Zone sensible	Bruit ambiant jour	Critères à respecter	Niveau de bruit estimé
Evolo 2	54	75	64
Cours des Fougères	60	75	65

Nuit

Zone sensible	Bruit ambiant nuit	Critères à respecter	Niveau de bruit estimé
Evolo 2	51	56	64
Cours des Fougères	57	62	64

Tableau 6: Rencontre du comité de bon voisinage des arrondissements Verdun / Sud-Ouest

SIGNATURE SUR LE SAINT-LAURENT

Les critères de bruit

CRITÈRES DE BRUIT
- Jour (7 h à 19 h) : 75 décibels ou 5 décibels au-dessus du niveau de bruit ambiant
- Soir et nuit (19 h à 7 h) : 5 décibels au-dessus du niveau de bruit ambiant

Zone sensible	Critère de bruit le jour (de 7h à 19h) L_{A10} en dBA	Critère de bruit le soir (de 19h à 22h) L_{A10} en dBA	Critère de bruit la nuit (de 22h à 7h) L_{A10} en dBA
M1 - Sud-Ouest / Argenson	75	69	67
M2 - Sud-Ouest / Butler et Charlevoix	75	66	64
M3 - Verdun	75	65	64
I1 - Sax	75	58	59
I2 - Pointe-Nord	75	64	62
I3 - Cours des Fougères	75	57	57

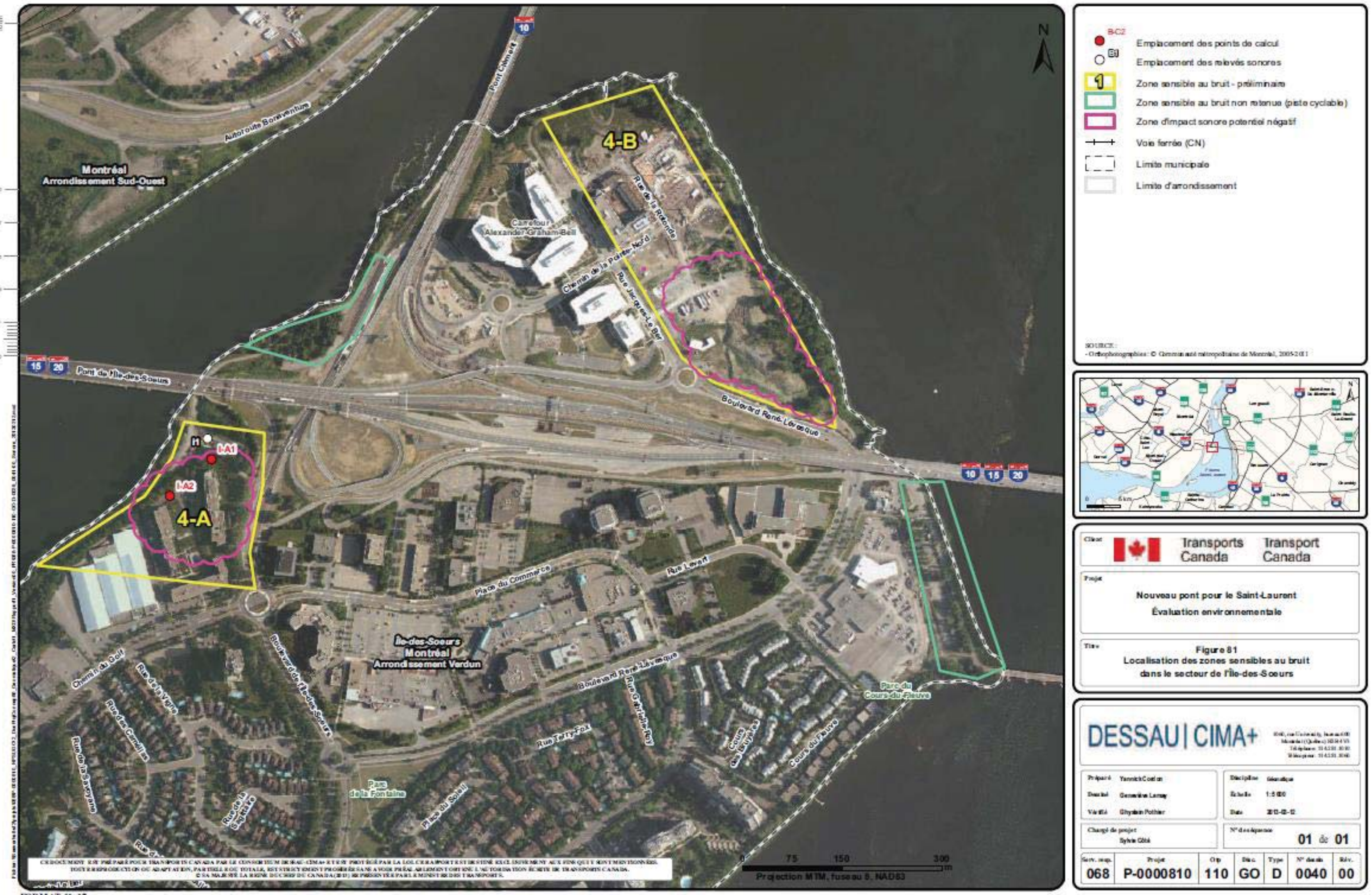

Figure 6: Position des points de mesures dans l'étude de Transports Canada (Île des Sœurs)

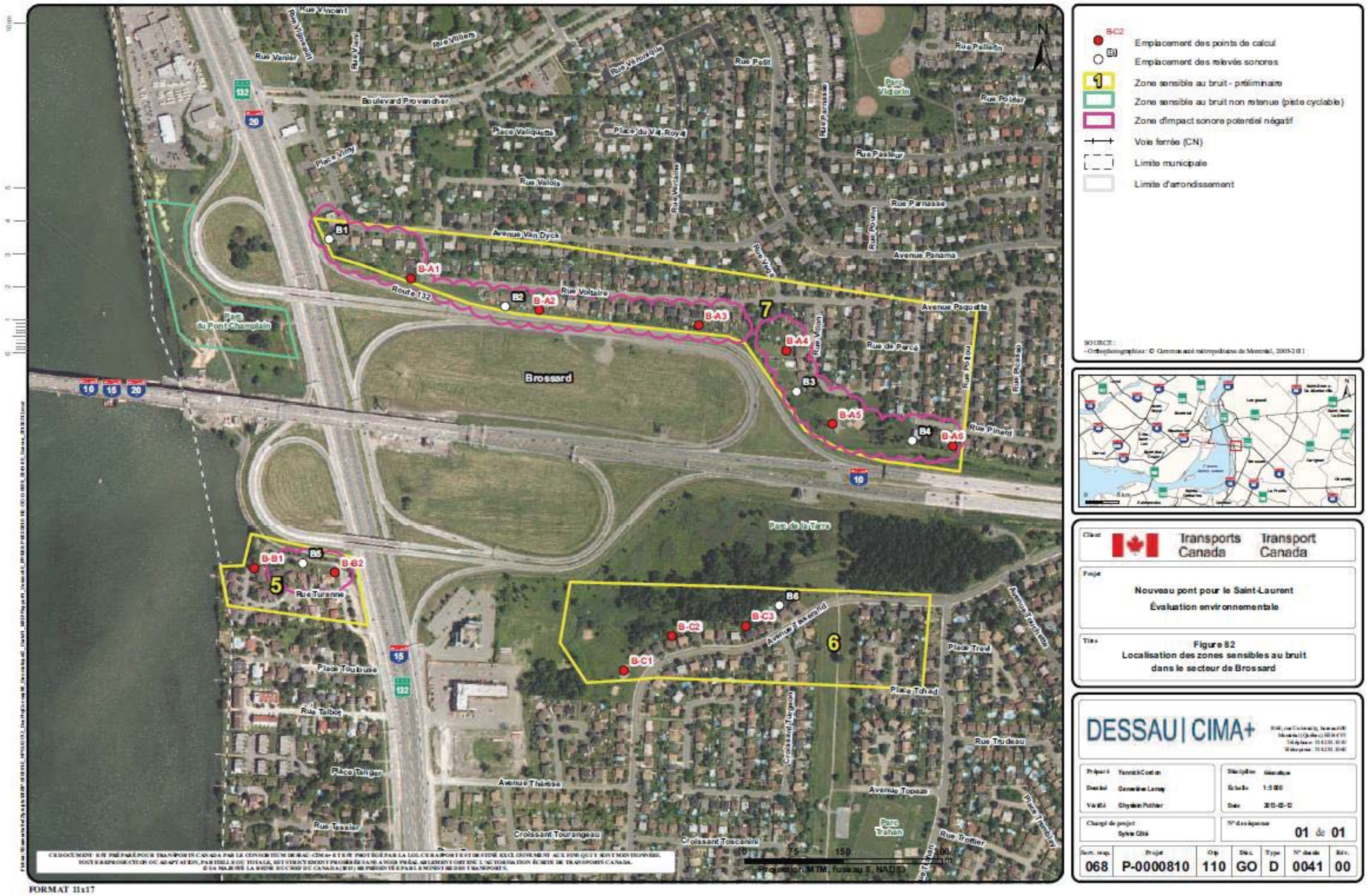

Figure 7: Position des points de mesures dans l'étude de Transports Canada (Brossard)